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Parallel Sessions

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STRATEGIC ALLIANCES PERFORMANCE ENHANCING BY KNOWLEDGE INNOVATION

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ABSTRACT

This paper investigates the relationships among merge & acquisition and strategic alliances, and organizational performance constructs. This paper compares the influences of merge & acquisition and strategic alliances from 1993 to 2008 on both price and trading volumes of underlying stock around the announcement date on Taiwanese stock market. The empirical results demonstrate that the merge & acquisition announcement has statistically strong positive SCAR and SCAV in whole listed companies and non-electronics industries.

The result finds M&A can help save costs and achieve economies of scale among the same industry, and the acquiring firm requires fewer resources to integrate the difference with organization, creasing a corporate M&A effect and increasing investor investment willingness. Strategic alliances are characterized by elasticity, lower risk and smaller capital requirements, particularly in the case of high-technology companies which frequently use strategic alliances to enter new markets, invest in new talent and improve their manufacturing ability.

Keywords: Merge & Acquisition; Strategic Alliance; Trading Volumes; Stock Price; Knowledge Innovation

INTRODUCTION

In knowledge innovation-based environments, those businesses that can master knowledge and technology will be able to gain a competitive edge. An organization must respond quickly to all changes in its external environment, be able to handle large amounts of complex information, use new technology, and have proactive thinking and innovation for the most effective management of knowledge (Yeh, Lai, and Ho, 2006; Lin and Tseng, 2005; Wadhwa et al., 2005; Wei, Choy, and Yeow, 2006; Gottschalk, 2006). To enhance competitiveness, enterprises strive to create innovative knowledge approaches (Huang and Lin, 2006; Darroch, 2002; Porter and Scott, 2001; Wong, 2005) in order to enhance

performance (Beheshti, 2004). Therefore, knowledge management capabilities and knowledge innovation have become important topics for improving business performances (Yang and Yu, 2002; Wadhwa, Bhoon, and Chan, 2006; Lin and Kou, 2007; Ho, 2008; Omerzel and Antonc˘ic, 2008).

Individual companies cannot provide all the knowledge resources necessary to operate. Companies are forced to choose a cooperative co-existence business model to replace the traditional mutual competitiveness. Therefore, enterprises must have a sound business strategy to cope with foreign competition and challenges, and the ability to recognize and adopt new opportunities in order to continue in a leading position (Lin, Wang, and Chen, 2009). In order to adapt to changes in the environment, high-tech industries have, through horizontal and vertical integration, gained cross-sector combinations, or other forms of strategic alliances; such expanded scale of production maintains business competitiveness. As enterprises grow, they tend to generate economies of scale through external growth methods, such as merger & acquisition or strategic alliance (Porter, 1985). Lewis (1990) proposed that, when faced with resources, risks, and control demands, merger & acquisition and strategic alliance are important rapid growth strategies to achieve maximized shareholder equity.

Innovation in information technology promotes the development of a knowledge economy, making knowledge a major factor in the manufacturing processes of an enterprise. High-tech industries are knowledge-intensive industries, with competitiveness growing from the accumulation, creation, and application of knowledge. To avoid a rigidity of core technological capabilities of an enterprise, moderation of external resources that activate knowledge basics and the ability to pursue innovation are necessary conditions for continuity in high-tech enterprises. In addition, R&D investments cost large amounts of capital, and the life cycle of high-tech products tends to be relatively short; therefore, high-tech products generated from internal R&D often result in an inability to take advantage of the expected benefits due to a high attrition rate. Hence, through merge & acquisition, enterprises often directly access R&D resources, technologies, knowledge, and achievements of a target companies to strengthen and build innovation capabilities and core competencies, as well as establishing durable competitive advantages (Anand and Khanna, 2000; Helfat and Peteraf, 2003).

Merge & acquisition is an important strategic operation acquired through the external growth of an enterprise (Glueck, 1979; PwC/ EIU, 2005, 2007). It enables the enterprise to expand business and technological scopes, change original paths of learning (path breaking), overcome rigid core crisis, integrate internal resources and external learning opportunities, and it is the best way to create dynamic capabilities for an enterprise (Eisenhardt and Martin, 2000; Karim and Mitchell, 2000; Luo, 2002; Seth, Song, and Pettit, 2002). In addition to comprehensive benefits through complementary combinations of merge & acquisition (Hoskisson and Hitt, 1990; Krishnan, Joshi, and Krishnan, 2004; Chung, Singh, and Lee, 2000), the processes of merger & acquisition will enable the enterprise to integrate learning resources, reconfigure resources, and regroup internal and external resources (Teece, Pisano, and Shuen, 1997). It contributes to increased constructs of competitiveness for the enterprise and improves business operational efficiency (Capron, 1999; Hoskisson, Hitt, Hoskisson, and Ireland, 2001).

After merge & acquisition, an enterprise can construct and promote a combined learning and knowledge database from the two parties (Helfat and Peteraf, 2003; King et al, 2004). Through resource transfers, the acquirer and the target company combine resources, which enable both parties to increase external technical support on the basis of the existing capabilities (Szulanski, 2000; Seth et al, 2002; Chung et al, 2000). At the same time, some enterprises conduct cross-organizational cooperation through strategic alliance to obtain external resources and knowledge. Strategic alliance is a key strategic choice of an official and long-term alliance, which links activities of the companies strategies (Porter and Fuller, 1986) to ensure, maintain, or enhance competitive advantages (Harrigan, 1988). For mutual needs, risk pooling, and cooperation of common goals (Lewis, 1990), it is a commitment maintained through mutually beneficial processes and interdependence (James, 2001). Through strategic alliance, enterprises exchange knowledge with partners, and then, integrate it into its own organization, which is also an effective way to strengthen the competitive advantage of an enterprise. Hence, numerous high-tech companies take advantage of mergers & acquisitions and strategic alliances to obtain external R&D capabilities and achievements for external growth (Bertrand and Zuniga, 2006; Puranam, Singh, and Zollo, 2006; Smith, 1991).

Although merge & acquisition and strategic alliance can integrate R&D strengths and achievements of enterprises in order to obtain external resources and external growth strategies, they may have positive or negative impact on business performance. No consensus has been reached in the verification of past literature (Cassiman et al., 2005). Although, merge & acquisition and strategic alliance may create positive economic impact on the enterprises, it may also create negative rivalry, transfer of benefits, or have indirect and adverse affects on investors or creditors. Some scholars advocate that merge & acquisition integrates the R&D strengths of the acquirer and the target company, which enhances R&D innovation investments and achievements after integration (Ahuja and Katila, 2001; Bertrand and Zuniga, 2006; Prabhu, Chandy, and Ellis, 2005). However, other scholars argue that, to improve market force after a merger & acquisition, redundant resources will be abolished for reduced investment by the enterprise in R&D innovative activities (Ernst and Vitt, 2000; Hitt et al., 1996), and thus, merge & acquisition does not create value for an enterprises, and may even result in damage to the corporate value (DeLong, 2001; Houston, James and Ryngaert, 2001).

In the past, enterprises used merger & acquisition to achieve business growth, however, current investment-laws and regulations governing merge & acquisition are relatively more complex compared with strategic alliance. The reactions of employees and management issues in cases of strategic alliance are less severe than merger & acquisition. However, as the involvement of strategic alliance is not as high as merge & acquisition, in addition to low frequency of interactions, it may lead to difficulties in internalization of external knowledge (Karim and Mitchell, 2000; Makadok, 2001).

Discussions in literature and empirical studies on knowledge innovation have failed to define the impact relationships of merge & acquisition and strategic alliances on business performances. Therefore, this study plans to discuss and compare Taiwan's high-tech industry as subjects, as well as the impacts of merge & acquisition and strategic alliance on business performance, on the basis of knowledge innovation.

Whether merger & acquisition and strategic alliance can create values for shareholders has been a topic of considerable concern in global capital markets. Many past scholars have pointed that, both merge & acquisition and strategic alliance can create unique and hard-to-imitate comprehensive effects, which generate relatively long standing competitive advantages, as well as positive abnormal returns for the enterprises (Harrison et al, 2001; Luo, 2002; Jensen and Ruback, 1983; Jarrell and Poulsen, 1989; Schwert, 1996; Cotter, Shivdasani, and Zenner, 1997; Akhigbe, Borde, and Whyte, 2000; Billett, King, and Mauer, 2004; Fee and Thomas, 2004; Spyros and Georgia, 2007; Travlos, 1987). In addition, stock prices and share trading performances of an enterprise are subject to investors' expectations of business performance after merge & acquisition or strategic alliance. Therefore, analysis of the stock price and share trading volume will allow better understanding of the real benefits of the two strategies of business operations. Therefore, this paper infers that, both merge & acquisition and strategic alliance can generate abnormal returns, as well as considerable enhancements to stock trading volume and stock prices.

This paper is organized as follows. Section 2 presents a study model of financial returns. Section 3 describes the empirical results and analysis. Finally, Section 4 discusses the results and presents conclusions.

SAMPLE SELECTION AND RESEARCH DESIGN

The purpose of this study is to discuss the differences on impact statements of merger & acquisition and strategic alliance on stock prices and stock trading volumes between 1993 to March 2008. The data are taken from company trading information and major information published in the "Market Observation Post System" of the Taiwan Stock Exchange, and data matrix subject to the declaration date of merger & acquisition or strategic alliance.

Regarding the data of listed company merger & acquisition samples, there are a total of 110 initial screening samples. 22 samples are deleted due to insufficient estimation periods or event periods. There are to-be-listed, listed companies, and companies disappeared after merger & acquisition; 17 such samples are removed, as the data are not applicable, with 81 merger & acquisition sample companies remaining; upon removal of non-electronic companies, 53 electronic companies remain as samples of this study.

Regarding strategic alliance data, there are 100 initial screening samples, with 24 samples deleted due to insufficient estimation periods or event periods, and 16 samples are removed due to improper data, leaving 60 companies of strategic alliance remaining; upon removal of non-electronic samples, 54 non-electronic companies of strategic alliance are chosen as samples of this study.

This study executes tests to determine whether there is any related information effects on the M&A and strategic alliance occurring near the announcement date, a described event study is performed. The event date is defined as the announcement date of M&A and strategic alliance, and the announcement date of information disclosure, namely Day 0, with the estimation period from Days -105 to -16. The event window of interest begins from Day -15 and ends on Day +15, and the total observational period covers 121 trading days.

This study executes the tests whether there is related information effect on the M&A and strategic alliance around the announcement date, an event study described is performed. The event date is defined as the announcement date of M&A and strategic alliance. The event date is defined as the announcement date of information disclosure, namely Day 0, and the estimation period is from Days -105 to -16. The event window of interest begins from Day -15 and ends on Day +15, and total observational period covers 121 trading days.

The research of system process and framework is as follows Figure 1 and Figure 2:

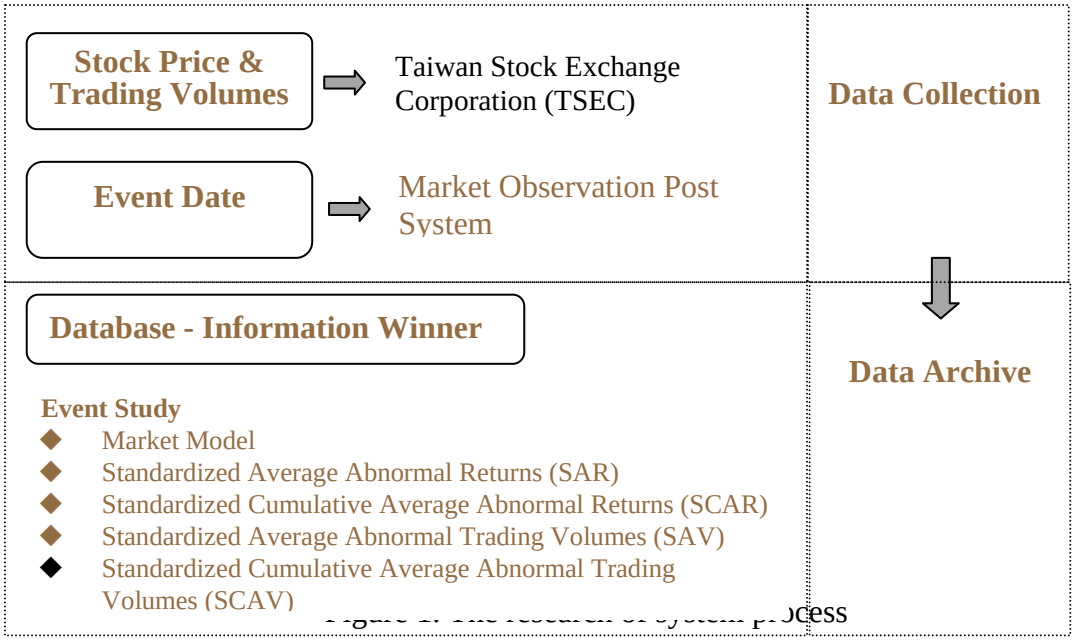

Figure 1. The research of system process

Figure 2. The research of framework

This investigation adopted event study (Brown & Zhang, 1997) **t**o explore stock price whether it will receive the influence of the specific event. The method had already been applied extensively in the finance and the accounting research domain, on the research approach of the real example so far, still plays a very important role.

Probing into the stock price will declare to enterprises M&A and strategic alliance change the response of information, the expected return was derived using the market model where the model parameters α and β were obtained from the estimation period, namely $R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$,where R_{it} indicates the expected return on stock *i* on trading day *t* and R_{mt} denotes the return on the market portfolio on day *t*. α_i is the intercept, β_i is the systematic risk of individual stock and ε_{it} residuals is the component of returns which is abnormal or unexpected.

Abnormal returns on stock *i* on day *t* (AR_{it}) are calculated for a reference period surrounding the event date. These are obtained as the difference between the observed returns and those predicted by the market model

$$AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt} \quad \ldots\ldots\ldots (1)$$

Next, we compute the average abnormal returns for day *t* as $\overline{AR_t} = \frac{1}{N}\sum_{i=1}^{N} AR_{it}$ where *t = -15, -14, …, 0, …, 14, 15.*

The cumulative average abnormal returns (CAR_t) through τ days ($\tau = \tau_2 - \tau_1$) for a portfolio of *N* stocks can be calculated as:

$$CAR_i(\tau) = \frac{1}{N}\sum_{t=\tau_1}^{\tau_2}\sum_{i=1}^{N} AR_{it} \quad \ldots\ldots\ldots (2)$$

The standardized cumulative average abnormal returns (SCAR) will start from special date τ_1 accumulate to the τ_2 day in event period, it may obtain the SCAR, the event period of the SCAR from the τ_1 to the τ_2 total *t* day, namely

$$SCAR\ (\tau) = \frac{1}{N}\sum_{t=\tau_1}^{\tau_2}\sum_{i=1}^{N}\frac{AR_{it}}{S_{it}} \quad \ldots\ldots\ldots (3)$$

where τ indicates event date from the τ_1 to τ_2 as a examination period.
The standardized residual cross-sectional method ignores estimation period estimates of variance, thus, this paper uses the standardized residual cross-sectional for its *t-test* (Boehmer et al., 1991). The resulting of *t-test* statistic for AR_{it} is

$$t_{SROCSM}^{AR} = \frac{\frac{1}{N}\sum_{i=1}^{N} SAR_{iE}}{\sqrt{\frac{1}{N(N-1)}\sum_{i=1}^{N}\left(SAR_{iE} - \sum_{i=1}^{N}\frac{SAR_{iE}}{N}\right)^2}} \quad \ldots\ldots\ldots (4)$$

The *t-test* statistic for the CAR_t for standardized residual cross-sectional is calculated as

$$t_{SROCSM}^{SCAR} = \frac{SCAR(\tau_1,\tau_2)}{\sqrt{\frac{1}{N(N-1)}\sum_{i=1}^{N}\left(SCAR_i(\tau_1,\tau_2) - \sum_{i=1}^{N}\frac{SCAR_i(\tau_1,\tau_2)}{N}\right)^2}} \quad \ldots\ldots\ldots (5)$$

where $SCAR_i(\tau_1,\tau_2) = \sum_{E=\tau_1}^{\tau_2} SAR_{iE}$

Certain empirical results have an association between abnormal returns and abnormal trading volumes, including Campbell et al. (1993), Chan & Wei (2001) and Chen & Wu (2001). Hence, stock trading volumes around announcement date was inspected. Trading turnover

rate is substituted for trading volumes (*Vol*it) in studies such as those of Michaely et al. (1995) and Chan & Wei (2001). Daily trading turnover rate for stock *i* on day *t* is defined as

$$Vol_{it} = \frac{Number\ of\ \ shares\ traded_{it}}{Number\ of\ \ shares\ outs\tan ding_{it}} \quad \ldots\ldots\ldots\ldots\ (6)$$

where *t = -106, -105, …, -16.*

Normal trading volumes *(NVol*i) for stock *i* are defined as the average trading turnover rate of the stock as estimated for the 90 days prior to the event window, namely,

$$NVol_i = \frac{1}{90}\sum_{t=-106}^{-16} Vol_{it} \quad \ldots\ldots\ldots\ldots\ldots\ (7)$$

By average trading turnover rate (AV_t) before the event window, AV_t can be compared across different stocks of various sizes. Therefore, the AV_t for a portfolio of *N* stocks on day *t* is calculated as

$$AV_t = \frac{1}{N}\sum_{i=1}^{N} \frac{Vol_{it}}{NVol_i} \quad \ldots\ldots\ldots\ldots\ (8)$$

where *t = -15, -14,…, 15.*

The abnormal trading volumes ($AVol_t$) in percentage terms on day *t* for a portfolio of *N* stocks and its standard deviation (*SD*) can be calculated as $AVOL_t = AV_t - 1$

where
$$SD = \sqrt{\frac{1}{31}\sum_{t=-15}^{15}\left(AV_t - \overline{AV}\right)^2} \quad \ldots\ldots\ldots\ldots\ (10)$$
$$\overline{AV} = \frac{1}{31}\sum_{t=-15}^{15} AV_t$$

EMPIRICAL RESULTS

This section debates the empirical results for stock price and trading volumes for electronics industries, non-electronics industries and whole listed companies.

Table 1 uses the *t-test* statistics to examine the standardized average abnormal returns (SAR) and standardized average abnormal trading volumes (SAV) that appear in the event window from Days -15 to +15. For enterprises announcing M&A, the results demonstrate positive SAR and SAV, 0.1661 and 0.3822, for days -12 and 0, with the results being statistically significant at the 0.05 and 0.01 levels using the *t-test*. For strategic alliances, the results indicate positive SAR, 0.3503 and 0.2482 for days -1 and 13 and negative SAR, -0.2395, for day -10, with the results being statistically significant at 0.05 level by *t-test*. However, a significant and positive response is found for SAV, for days -11, -2 to 1, 3, 6 to 8, 13 and 15. Hence, the results indicate that if an electronics industry announces a strategic alliance, industry trading volumes will increase. Summing up the above results, the information effect of strategic alliances is significantly greater than that for M&A, especially for trading volume.

Table 2 shows the information effect of disclosure M&A and strategic alliance plans in the event window for electronics industries. This investigation adopts standardized cumulative average abnormal returns (SCAR) and standardized cumulative average abnormal trading volumes (SCAV) to determine the reaction strength of M&A and strategic alliances around the event period. The empirical results by this study reveal statistically significant and positive SCAR in the event window for days -4 to 1. Thus it can be inferred that M&A news leakage exerts a sustained influence on the stock market. For strategic alliance events, the empirical evidence indicates positive SCAR for days -12, -11, -2 to 3, 6 to 9, and 11 to 15, which is statistically significant at the 0.05 level based on *t-test*. Furthermore, there is positive SCAV for days -2, -1 and 0 to 15, which is statistically significant at the 0.05 and 0.01 levels using the *t-test*. The empirical results indicate a strong relationship between SCAR and SCAV.

For non-electronics industries, the results of the SAR and SAV lists in Table 3 demonstrate statistically significant and positive SAV around the M&A event divulgence date for days -8 to 9 using the t-test. Corporate law stipulates that convener convened board of directors of the director and supervisor and states the matter clearly seven days prior. Owing to inside information being disclosed ahead of time, industry declares that M&A events result from reaction to trading volumes. Furthermore, SAR is positive and statistically significant, with a value of 0.1694, on day 4. The empirical results listed in Table 3 show that message disclosure of strategic alliances have statistically significant and negative SAR, of -0.2504 and -0.2364, for days -7 and 4, and have statistically significant and positive SAR, of 0.2318, for day -4. The results reveal positive and abnormal trading volumes around the strategic alliance announcement date, 0.4292, for day 11. Therefore, SAV around announcement date of strategic alliance for non-electronics industry is insignificant. Overall, the SAV results for M&A are very positive.

According to the results of Table 4 show, for M&A events, positive SCAR is observed for days 0, 1, 4 to 10. The SCAV for the event window from -8 to 15 shows statistically significant at the 0.05 and 0.01 levels. Thus, before disclosure of M&A information for non-electronics industries, trading volumes can increase, indicating that investors maintain an optimistic attitude and results from market trading volumes increase continuously. For strategic alliance events occurring in non-electronics industry, standardized cumulative average abnormal returns and standardized cumulative average abnormal trading volumes were shown not to be affected; namely, no strong relationship was identified between two SCAR and SCAV. Thus investor behavior appears not to be influenced by strategic alliance announce during the event window.

Table 5 lists the results for SAR, SAV and the related t-test statistics for whole listed companies of stock and trading volumes in the event window around the M&A and strategic alliance announcement date. For M&A events of whole listed industry, the empirical evidence indicates positive SAR, 0.0921, for day 6, which is statistically significant at the 0.05 level using the *t-test.* Moreover, SAV is positive and statistically significantly on days -8 to 10 and day 12. For strategic alliance announcement events, the empirical result found that the positive SAR 0.1504, 0.2088, 0.1978, for days -4, 6, 11 is statistically significant at the 0.05 level by t-test. Statistically markedly shows the positive SAV for days -8, -3 to 1, 6 to 8, 11, 13 and 15. Table 6 lists SCAR, SCAV and their *t-test* statistics for whole listed

companies of stock price and trading volumes in the event window around the M&A and strategic alliance announcement date. For M&A events, the research results of event window reveal positive SCAR for days -10 to 15 by *t-test.* Statistically significantly shows the positive SCAV for days -8 to 15. Substantially, when M&A information had leaked to the market, stock price and trading volumes are clearly influenced. The empirical results presented in this study demonstrate the positive SCAR around the strategic alliance event disclosure date, 0.8661, 1.0276, 0.9537 and 0.9947 for days -1 to 1 and 7 using the *t-test*. For strategic alliance announcement events, the result presented in this study demonstrate positive SCAV for days -2, 1, days 0 to 15, which is statistically significant at the 0.05 and 0.01 levels by *t-test* respectively.

Table 1 SAR and SAV around announcement date of M&A and Strategic alliance for electronics companies

Event window	M&A		Strategic alliance		Event window	M&A		Strategic alliance	
	SAR	SAV	SAR	SAV		SAR	SAV	SAR	SAV
-15	-0.0203	-0.0684	0.1880	0.0778	0	-0.0308	**0.3822(**)**	0.1502	**0.8071(**)**
-14	-0.0519	0.0742	0.0365	0.1087	1	-0.0273	0.1982	-0.1075	**0.4792(**)**
-13	0.0893	0.0471	0.1152	0.1301	2	-0.0352	0.1431	-0.0491	0.2698
-12	**0.1661(*)**	0.0533	0.2172	0.2861	3	-0.0186	-0.0747	-0.1488	**0.4043(*)**
-11	0.0299	0.0175	0.1186	**0.5035(*)**	4	-0.0610	-0.1212	0.0529	0.4541
-10	0.0912	0.0148	**-0.2395(*)**	0.1968	5	-0.0148	0.0147	0.0561	0.4605
-9	0.0173	0.1432	-0.0457	0.1350	6	0.0781	0.2274	0.1641	**0.5710(*)**
-8	0.0671	0.1442	0.1408	0.3804	7	-0.0341	0.0344	0.0916	**0.5205(**)**
-7	-0.0375	0.1991	-0.0292	0.0146	8	0.0401	0.3002	0.0918	**0.6472(**)**
-6	0.0265	0.1460	-0.0763	-0.0231	9	-0.0081	0.0984	-0.0914	0.2365
-5	0.0923	0.1033	0.1920	-0.0620	10	0.0082	0.2049	-0.0970	0.2689
-4	0.0396	0.0595	0.0813	0.0540	11	0.0194	0.0685	0.1720	0.1143
-3	0.0904	0.2391	0.2184	0.4271	12	-0.0076	0.0374	-0.0189	0.1625
-2	0.0922	0.2664	0.1970	**0.6410(*)**	13	-0.0309	-0.0268	**0.2482(*)**	**0.4478(*)**
-1	-0.0102	0.2309	**0.3503(**)**	**0.6817(**)**	14	-0.0856	0.1188	-0.0166	0.6317
					15	-0.0024	0.1226	0.0520	**0.4436(*)**

Note：1. The * (**) denotes statistical significance at the 0.05 (0.01) level.
2. The *t-value* uses Standardize Residual Cross-Sectional Method to test.

Table 2 SCAR and SCAV around announcement date of M&A and Strategic alliance for electronics companies

Event window	M&A		Strategic alliance		Event window	M&A		Strategic alliance	
	SCAR	SCAV	SCAR	SCAV		SCAR	SCAV	SCAR	SCAV
-15	-0.0203	-0.0684	0.1880	0.0778	0	**0.6511(*)**	2.0525	**1.6148(**)**	**4.3586(**)**
-14	-0.0722	0.0058	0.2244	0.1865	1	**0.6238(*)**	2.2507	**1.5073(*)**	**4.8379(**)**
-13	0.0171	0.0530	0.3396	0.3166	2	0.5886	2.3938	**1.4582(*)**	**5.1076(**)**
-12	0.1832	0.1063	**0.5568(*)**	0.6026	3	0.5700	2.3191	**1.3094(*)**	**5.5120(**)**
-11	0.2131	0.1238	**0.6754(*)**	1.1061	4	0.5089	2.1979	1.3623	**5.9660(**)**
-10	0.3043	0.1386	0.4360	1.3029	5	0.4942	2.2126	1.4183	**6.4265(**)**
-9	0.3216	0.2818	0.3903	1.4379	6	0.5723	2.4401	**1.5824(*)**	**6.9975(**)**
-8	0.3887	0.4260	0.5311	1.8183	7	0.5382	2.4745	**1.6740(*)**	**7.5180(**)**
-7	0.3512	0.6251	0.5019	1.8329	8	0.5783	2.7747	**1.7658(*)**	**8.1651(**)**
-6	0.3777	0.7711	0.4255	1.8098	9	0.5703	2.8731	**1.6744(*)**	**8.4016(**)**
-5	0.4699	0.8744	0.6175	1.7478	10	0.5784	3.0779	1.5774	**8.6705(**)**
-4	**0.5095(*)**	0.9339	0.6988	1.8018	11	0.5978	3.1465	**1.7494(*)**	**8.7848(**)**
-3	**0.5999(*)**	1.1730	0.9172	2.2289	12	0.5901	3.1839	**1.7304(*)**	**8.9473(**)**
-2	**0.6921(**)**	1.4394	**1.1142(*)**	**2.8699(*)**	13	0.5593	3.1572	**1.9787(*)**	**9.3951(**)**
-1	**0.6819(*)**	1.6703	**1.4645(*)**	**3.5515(*)**	14	0.4736	3.2760	**1.9620(*)**	**10.0267(**)**
					15	0.4712	3.3986	**2.0141(*)**	**10.4703(**)**

Note：1. The * (**) denotes statistical significance at the 0.05 (0.01) level.
2. The *t-value* uses Standardize Residual Cross-Sectional Method to test.

Table 3 SAR and SAV around announcement date of M&A and Strategic alliance for non-electronics companies

Event window	M&A		Strategic alliance		Event window	M&A		Strategic alliance	
	SAR	SAV	SAR	SAV		SAR	SAV	SAR	SAV
-15	0.0673	0.0094	-0.0329	0.0720	0	0.1655	**0.7275(**)**	0.1747	0.6617
-14	0.0633	0.1959	0.1117	0.1824	1	0.0863	**0.6724(**)**	-0.0345	0.1638
-13	-0.0438	0.1200	-0.1422	0.1276	2	-0.1340	**0.5150(**)**	-0.2206	0.0864
-12	0.0136	0.0618	0.0203	0.0538	3	-0.0660	**0.5327(**)**	0.0300	-0.0457
-11	0.0583	0.1840	-0.1092	-0.1133	4	**0.1694(*)**	**0.4340(**)**	**-0.2364(*)**	-0.1585
-10	0.0507	0.1773	0.1372	0.0516	5	0.1110	**0.4665(**)**	-0.0584	-0.0972
-9	0.0664	0.1672	-0.0501	0.0061	6	0.1060	**0.4838(**)**	0.2616	0.4319
-8	0.0221	**0.3096(*)**	-0.0408	0.2329	7	0.0733	**0.3999(**)**	0.1168	0.2721
-7	0.1077	**0.3342(*)**	**-0.2504(*)**	-0.0221	8	-0.0582	**0.3173(**)**	-0.1984	0.1877
-6	-0.0122	**0.3093(*)**	0.1060	0.0726	9	-0.0401	**0.3081(*)**	-0.1730	0.3220
-5	0.0109	**0.2566(*)**	-0.1621	-0.0635	10	-0.0555	0.3401	-0.0568	0.3056
-4	0.0313	**0.4143(**)**	**0.2318(*)**	0.1282	11	-0.0574	0.3523	0.2283	**0.4292(*)**
-3	0.0216	**0.4757(**)**	0.0840	0.2685	12	0.0093	**0.4177(**)**	-0.2171	0.2830
-2	0.0607	**0.4131(**)**	0.0446	0.1674	13	0.0136	**0.2660(*)**	-0.0072	0.1279
-1	0.0148	**0.5180(**)**	0.2132	0.2419	14	0.0268	0.1197	-0.1094	0.1479
					15	-0.0116	0.2535	0.2200	0.3616

Note：1. The * (**) denotes statistical significance at the 0.05 (0.01) level.
2. The *t-value* uses Standardize Residual Cross-Sectional Method to test.

Table 4 SCAR and SCAV around announcement date of M&A and Strategic alliance for non-electronics companies

Event window	M&A		Strategic alliance		Event window	M&A		Strategic alliance	
	SCAR	SCAV	SCAR	SCAV		SCAR	SCAV	SCAR	SCAV
-15	0.0673	0.0094	-0.0329	0.0720	0	**0.6980(*)**	**4.6740(**)**	0.3359	2.0679
-14	0.1306	0.2052	0.0787	0.2545	1	**0.7843(*)**	**5.3463(**)**	0.3014	2.2317
-13	0.0868	0.3252	-0.0635	0.3821	2	0.6503	**5.8613(**)**	0.0808	2.3181
-12	0.1003	0.3870	-0.0431	0.4359	3	0.5843	**6.3940(**)**	0.1108	2.2724
-11	0.1586	0.5710	-0.1523	0.3226	4	**0.7537(*)**	**6.8280(**)**	-0.1256	2.1138
-10	0.2093	0.7483	-0.0151	0.3742	5	**0.8647(*)**	**7.2946(**)**	-0.1840	2.0166
-9	0.2757	0.9156	-0.0651	0.3803	6	**0.9708(*)**	**7.7784(**)**	0.0776	2.4485
-8	0.2978	**1.2252(*)**	-0.1059	0.6132	7	**1.0441(**)**	**8.1783(**)**	0.1944	2.7205
-7	0.4055	**1.5594(*)**	-0.3563	0.5911	8	**0.9859(*)**	**8.4957(**)**	-0.0040	2.9082
-6	0.3932	**1.8687(*)**	-0.2503	0.6637	9	**0.9457(*)**	**8.8038(**)**	-0.1770	3.2302
-5	0.4042	**2.1253(*)**	-0.4124	0.6002	10	**0.8902(*)**	**9.1439(**)**	-0.2337	3.5359
-4	0.4354	**2.5396(*)**	-0.1806	0.7284	11	0.8328	**9.4962(**)**	-0.0055	3.9650
-3	0.4570	**3.0153(**)**	-0.0966	0.9968	12	0.8421	**9.9139(**)**	-0.2226	4.2480
-2	0.5177	**3.4284(**)**	-0.0520	1.1643	13	0.8557	**10.1799(**)**	-0.2298	4.3759
-1	0.5325	**3.9464(**)**	0.1612	1.4062	14	0.8825	**10.2996(**)**	-0.3392	4.5239
					15	0.8709	**10.5531(**)**	-0.1193	4.8854

Note：1. The * (**) denotes statistical significance at the 0.05 (0.01) level.
2. The *t-value* uses Standardize Residual Cross-Sectional Method to test.

Table 5 SAR and SAV around announcement date of M&A and Strategic alliance for whole listed companies

Event window	M&A		Strategic alliance		Event window	M&A		Strategic alliance	
	SAR	SAV	SAR	SAV		SAR	SAV	SAR	SAV
-15	0.0237	-0.0285	0.0865	0.0751	0	0.0677	**0.5596(**)**	0.1615	**0.7378(*)**
-14	0.0059	0.1367	0.0710	0.1438	1	0.0298	**0.4418(**)**	-0.0740	**0.3289(*)**
-13	0.0225	0.0846	-0.0030	0.1289	2	-0.0848	**0.3341(**)**	-0.1278	0.1824
-12	0.0895	0.0577	0.1268	0.1754	3	-0.0424	**0.2373(*)**	-0.0667	0.1899
-11	0.0441	0.1030	0.0140	0.2096	4	0.0547	**0.1640(*)**	-0.0799	0.1621
-10	0.0708	0.0983	-0.0665	0.1276	5	0.0484	**0.2468(**)**	0.0035	0.1947
-9	0.0419	0.1556	-0.0477	0.0736	6	**0.0921(*)**	**0.3592(*)**	**0.2088(*)**	**0.5047(**)**
-8	0.0445	**0.2292(**)**	0.0574	**0.3101(*)**	7	0.0198	**0.2222(*)**	0.1032	**0.4021(**)**
-7	0.0354	**0.2685(**)**	-0.1307	-0.0029	8	-0.0093	**0.3090(*)**	-0.0414	**0.4282(**)**
-6	0.0071	**0.2299(*)**	0.0074	0.0225	9	-0.0242	**0.2061(*)**	-0.1289	0.2773
-5	0.0514	**0.1821(*)**	0.0294	-0.0627	10	-0.0238	**0.2744(*)**	-0.0785	0.2864
-4	0.0354	**0.2418(**)**	**0.1504(*)**	0.0893	11	-0.0192	0.2143	**0.1978(*)**	**0.2643(*)**
-3	0.0559	**0.3606(**)**	0.1567	**0.3515(*)**	12	0.0008	**0.2328(*)**	-0.1099	0.2199
-2	0.0764	**0.3418(**)**	0.1270	**0.4153(*)**	13	-0.0085	0.1236	0.1310	**0.2954(*)**
-1	0.0024	**0.3784(**)**	**0.2874(**)**	**0.4721(*)**	14	-0.0292	0.1193	-0.0592	0.4011
					15	-0.0070	0.1898	0.1291	**0.4045(*)**

Note：1. The * (**) denotes statistical significance at the 0.05 (0.01) level.
2. The *t-value* uses Standardize Residual Cross-Sectional Method to test.

Table 6 SCAR and SCAV around announcement date of M&A and Strategic alliance for whole listed companies

Event window	M&A		Strategic alliance		Event window	M&A		Strategic alliance	
	SCAR	SCAV	SCAR	SCAV		SCAR	SCAV	SCAR	SCAV
-15	0.0237	-0.0285	0.0865	0.0751	0	**0.6746(**)**	**3.3992(**)**	**1.0276(*)**	**3.2669(**)**
-14	0.0296	0.1083	0.1575	0.2189	1	**0.7044(**)**	**3.8410(**)**	**0.9537(*)**	**3.5958(**)**
-13	0.0521	0.1928	0.1546	0.3478	2	**0.6196(**)**	**4.1751(**)**	0.8258	**3.7782(**)**
-12	0.1416	0.2505	0.2814	0.5232	3	**0.5772(*)**	**4.4125(**)**	0.7591	**3.9681(**)**
-11	0.1857	0.3535	0.2954	0.7327	4	**0.6318(*)**	**4.5765(**)**	0.6792	**4.1302(**)**
-10	**0.2566(*)**	0.4518	0.2289	0.8603	5	**0.6802(**)**	**4.8233(**)**	0.6827	**4.3249(**)**
-9	**0.2985(*)**	0.6074	0.1812	0.9339	6	**0.7724(**)**	**5.1825(**)**	0.8915	**4.8296(**)**
-8	**0.3430(*)**	**0.8366(*)**	0.2386	1.2440	7	**0.7922(**)**	**5.4046(**)**	**0.9947(*)**	**5.2317(**)**
-7	**0.3784(*)**	**1.1050(*)**	0.1079	1.2411	8	**0.7829(**)**	**5.7136(**)**	0.9533	**5.6599(**)**
-6	**0.3855(*)**	**1.3350(*)**	0.1152	1.2636	9	**0.7588(**)**	**5.9198(**)**	0.8244	**5.9371(**)**
-5	**0.4369(*)**	**1.5170(**)**	0.1446	1.2009	10	**0.7350(*)**	**6.1941(**)**	0.7459	**6.2235(**)**
-4	**0.4723(*)**	**1.7588(**)**	0.2950	1.2902	11	**0.7158(*)**	**6.4084(**)**	0.9437	**6.4879(**)**
-3	**0.5282(**)**	**2.1194(**)**	0.4518	1.6417	12	**0.7166(*)**	**6.6412(**)**	0.8338	**6.7078(**)**
-2	**0.6046(**)**	**2.4612(**)**	0.5788	**2.0571(*)**	13	**0.7081(*)**	**6.7648(**)**	0.9647	**7.0031(**)**
-1	**0.6069(**)**	**2.8396(**)**	**0.8661(*)**	**2.5291(*)**	14	**0.6789(*)**	**6.8841(**)**	0.9055	**7.4043(**)**
					15	**0.6719(*)**	**7.0740(**)**	1.0346	**7.8088(**)**

Note：1. The * (**) denotes statistical significance at the 0.05 (0.01) level.
2. The *t-value* uses Standardize Residual Cross-Sectional Method to test.

CONCLUSION

Today's fiercely competitive and fast-changing environment shortens product life cycles, prompting enterprises to recognize that effective management and operation of knowledge has become a very important topic, as knowledge innovation is strength in competition (Huang and Lin, 2006; Wadhwa, Bhoon, and Chan, 2006).

Based on the findings, it is known that when faced with the pressures of knowledge innovation, enterprises will choose merge & acquisition or strategic alliance to learn, build, and add innovation to knowledge. However, investors prefer merge & acquisition as the response strategy. The possible reason may be that, strategic alliance is established based on specific goals, which may cause cooperative processes to be lacking in flexibility (Das and Teng, 2000), and when the alliance goals are achieved, the partners will end the alliance; therefore, alliance is often relatively short-lived (Hatfield and Pearce, 1994). On the contrary, in merge & acquisition, the acquirer and target company can learn and duplicate technological capabilities of each other to enhance the knowledge basis of both parties (Seth et al., 2002). Therefore, as far as the enterprise is concerned, on the basis of knowledge innovation, merge & acquisition can be regarded as the best method of organizational learning and innovation (Eisenhardt and Martin, 2000; Karim and Mitchell, 2000; Seth et al., 2002).

In recent years, governments have developed enterprise merger & acquisition laws to promote large-scale enterprises to adopt this method in an attempt to expand the economies of scale of enterprises and enhance business performances, thus maintaining proper

competitive environments for improving business performances. It is recommended that enterprises should first understand the nature of merger & acquisition, and then adopt a proper merger & acquisition model in order to effectively integrate the enterprises, and generate comprehensive benefits from merger & acquisition.

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INTERACTIONS BETWEEN BURNOUT SYNDROME, LEARNING STYLES AND FEATURES OF PERSONALITY AMONG POLISH MANAGERS

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ABSTRACT

Managers, working under a constant stress and pressure of making decisions are a social group that is highly prone to burnout syndrome. A research taking into consideration variables such as learning styles, features of personality such as extraversion vs introversion, sensing vs intuition, thinking vs feeling and judging vs perceiving may provide data essential to protect managers from this unwanted psychological phenomenon. Burnout syndrome, invented as a concept in 1970, according to the Maslah Burnout Inventory (MBI) is consisted of three aspects: emotional exhaustion, depersonalization and reduced personal accomplishment. Burnout syndrome is indicated by lower scores on the personal accomplishment and higher scores on the emotional exhaustion and depersonalization. This psychological phenomenon leads to gaining less satisfaction from work that seems to be a significantly important problem in the contemporary job market, especially among managers. It is strongly connected with the intensity of stress at work. If stress is permanent and not handled appropriately impairments of cognitive abilities such as declined attention and perception may occur. Some features of personality can also be correlated with higher susceptibility to stress and the risk of burnout syndrome.

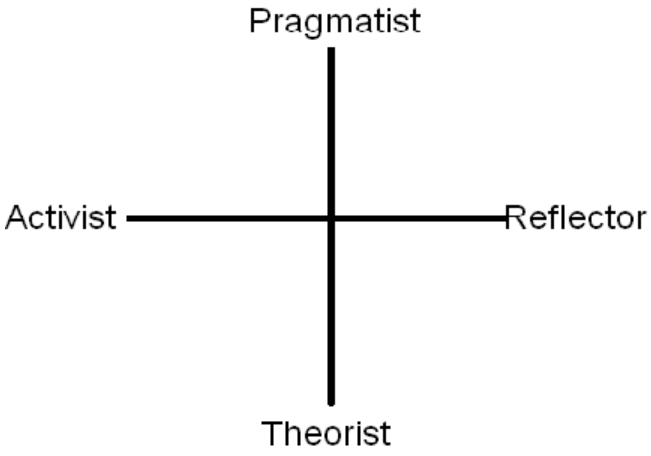
Keywords: burning out syndrome, learning styles, MBTI, managers

INTRODUCTION

This article attempts to demonstrate the interaction between personality types, learning styles and burnout. Without a shadow of a doubt, much attention was paid to the interaction between burnout and features of personality such as “Big Five” (NEO FFI) or MMPI (Munn – Giddings, Hart, Ramon , 2005) where the neuroticism was a predictor of depersonalization among the professional caregivers; however the MBTI questionnaire was not so frequently applied in the studies among managers. The correlation between MBTI types of personality and learning styles was also not so in deep examined apart from some studies, for example one examining upper-level civilian managers of US Army that proofed relationships existing between Kolb's LSI dimension of concrete vs abstract and the MBTI dimension of feeling vs thinking and between the LSI dimension of active vs reflective and the MBTI dimension of extrovert vs introvert (Konopka, George, 1999) MBTI concentrates on four basic aspects of human personality – interactions of humans and widely taken environment, the way people make decisions, preference of living in more structured or more spontaneous world and the type of information they receive from their surroundings. The view on the learning styles has been developed in the recent years (De Bello, 1990). Theoretical research concept is derived from Kolb’s learning cycle. The learning cycle covered all areas of the learning process: concrete experience (CE); reflective observation (RO); abstract coneptualization (AC); active

experimentation (AE). The learning cycle has the underlying assumption that the most effective learning will include all parts of this process. Research has consistently demonstrated that most people have strengths in some areas and weaknesses in others and this has led to the popularity of learning styles. The learning styles allow us to identify how an individual prefers to learn. There is debate in the application of learning styles however. Should learning styles predict who will be more successful when a learning experience matches styles? (Allinson & Hayes, 1988). As for the burnout, Christina Maslach et al. (2001) describes it as a *prolonged response to a chronic emotional and interpersonal stressors on the job and it is defined by the three dimensions: exhaustion, cynicism and inefficiency*. So the researches of this phenomena are of the opinion that burnout consists of three aspects: emotional exhaustion (reduced energy and ob enthusiasm), depersonalization (cynic approach to clients or co – workers) and reduced personal accomplishment (capacity to innovate and a sense of efficacy).

Figure I



Source: Honey and Mumford (1986)

Figure 1 shows that the activist and reflective learning styles are placed on opposing sides of the profile. To take a true measure of the preference for an activist style it is necessary to consider the reflective preferences at the same time (Wells et al, 1991). The following table shows a combined measure of the two scores.

METHOD

Participants

Descriptive analyses were used to summarize the demographic characterization of the participants. The studied group was consisted of 110 middle managers and executives, aged 25 – 58 years. All of them came both from the public and private sector. The average seniority in this group was 13,5 years and the managerial serenity amounted 6,43 years. In the survey were not included managers with the managerial experience less than 1 year, because this period of time is needed to get accustomed to the change, what could have blurred the results of the survey. The majority were men (58%); 87 per cent lived together with a partner; 85 per cent of them declared having many friends and acquaintances, only 15 per cent of the

group admitted having severe problems in the private life, while 26 per cent declared having severe problems in the occupational life. In the survey participants were also asked about job satisfaction; 6 per cent estimated their satisfaction as low, 71 per cent as an average and 23 per cent assessed it as high. The majority were non smoking (71%) and taking sport occasionally (66%). Thus it was dealt with a typical managerial sample consisted of predominantly middle aged and married men.

MEASURES

Burnout was measured using Maslach Burnout Inventory (MBI) having three subscales – depersonalization, emotional exhaustion and personal accomplishment. All items are scored on a 7 – point frequency rating scale from 0 (meaning "never") to 6 (meaning daily). According to the author burnout is indicated both by high scores on the emotional exhaustion and depersonalization subscale and low scores on personal accomplishment subscale. The learning styles were measured in this study using Learning Styles Questionnaire (LSQ) developed by Honey and Mumford and consisted of four stressed styles – activist, reflector, theorist and pragmatist. This questionnaire is consisted of 80 affirmations (e.g. "I like to try new and different things without too much preparation") and each style correspond with 20 items. The personality test used in this study was Myers – Briggs Type Indicator (MBTI) - short version, having four subscales – extraversion vs introversion; intuition vs sensing; thinking vs feeling and perceiving vs judging. Myers-Briggs Type Indicator (MBTI) personality inventory based on the C.G. Jung theory of personality was chosen, because it was rather designed for non clinical use.

RESULTS

Table II shows the mean and standard deviation of the study variables. The most common learning style among surveyed managers was pragmatist (mean = 11,97; SD = 3,61), while the most rare learning style seemed to be an activist (mean = 7,66; SD = 3,91). In comparison with results from British, Canadian and American surveys, showed in the Table I, the Polish sample scores relatively lower for all styles. As for theorist (mean = 10,48; SD = 3,63), the nominal score is almost three full points lower than for Canadian and British managers and almost four points lower than American managers. Correlations among the study variables are presented in the Table III. In terms of the outcome, extraversion was correlated with activist learning style (r = 0, 21, p < 0,05) and there was negative correlated with reflector learning style (r = - 0, 19, p < 0,05). Moreover, there was a significant correlation between intuition and activist learning style (r = 0, 5, p < 0,01), while activist correlates negatively with sensing (r = 0, 44, p < 0,01). Sensing also correlates with reflector (r = 0, 22, p < 0,05) and theorist (r = 0, 23, p < 0,05). Furthermore, it occurred that negative correlation was between intuition and theorist learning style (r = - 0, 32, p < 0,01) as well as reflector learning style (r = - 0, 31, p < 0,05). Thinking correlates with reflector (r = 0, 36, p < 0,01), theorist (r = 0, 38, p < 0,01), and pragmatist (r = 0, 22 p < 0,05), but negatively with activist(r = - 0, 23, p < 0,05) . Feeling correlates with activist (r = 0, 26, p < 0,01), however negatively with both reflector (r = 0, 36, p < 0,01), and theorist (r = 0, 4, p < 0,01). As far as burnout is concerned, only sub scale of depersonalization seemed to be significant in the correlation with the learning styles. Depersonalization correlates with activist (r = 0, 3, p <

0,01), and pragmatist (r = 0, 23, p < 0,01). There were no significant correlations between two other sub scale of burnout as emotional exhaustion and personal accomplishment.

Table I
Learning styles distribution in Great Britain, Canada and the United States

Nationality	Activist	Reflector	Theorist	Pragmatist
British	8,7	12,9	13,5	14,5
Canadian	8,5	13,9	13,7	14,0
American	9,5	12,0	14,5	14,5

Source: Honey and Mumford, 1986, p 79.

TABLE II

Mean and standard deviations of four categories of personality styles (extraversion vs introversion; intuition vs sensing; thinking vs feeling; perceiving vs judging), three subscales of burnout (emotional exhaustion, depersonalization, personal accomplishment) and four learning styles (activist, reflector, theorist, pragmatist)

	Mean	**SD**
Extraversion	22, 96	5,61
Introversion	17,43	5,46
Intuition	18,65	5,91
Sensing	27,76	5,74
Thinking	24,56	4,95
Feeling	15,82	4,68
Perceiving	17,95	4,64
Judging	22,34	4,81
Emotional Exhaustion	17,02	9,97
Depersonalization	8,78	6,61
Personal Accomplishment	34,60	8,56
Activist	7,66	3,91
Reflector	10,97	3,99
Theorist	10,48	3,63
Pragmatist	11,61	3,61

TABLE I I I

Correlations between four learning styles (activist, reflector, theorist, pragmatist) and four categories of personality styles (extraversion vs introversion; intuition vs sensing; thinking vs feeling; perceiving vs judging), three subscales of burnout (emotional exhaustion, depersonalization, personal accomplishment)

	Activists	Reflector	Theorist	Pragmatist
Extraversion	,209*	-,190*	-,134	,041
Introversion	-,112	,099	,039	-,018
Intuition	,502**	-,305**	-,319**	-,044
Sensing	-,437**	,219*	,232*	,055
Thinking	-,227*	,335**	,376**	,217*
Feeling	,265**	-,358**	-,397**	-,157
Perceiving	,117	-,136	-,200*	-,119
Judging	-,017	,033	,061	,116
Emotional Exhaustion	,151	-,131	,050	,051
Depersonalization	,296**	-,089	,088	,229*
Personal Accomplishment	,022	,040	,000	-,007

Note: *p < 0,05; **p < 0,01

DISCUSSION

The results suggests that some of the learning styles correlates with both personality types from MBTI, as well as sub scales of burnout. Extravertic types of personalities seems to be more active learning types. As the days of activists are filled with activity, it must be strongly connected with facing with situations, in which other people are involved, such as meetings, panel discussions and conferences. In this type of social situations contact with other people is inevitable, what makes these managers more sensitive to horizontal and vertical interactions with other people. Some other studies shows the correlations between the LSQ and the big-five factors (NEO-PI-R) showed that the activist learning style was correlated with agreeableness, conscientiousness, and extroversion (Gentry, Mondore, Cox, 2007). In the shadow of this data, another correlations seems to be easier to explained. While activist tends to act first and then consider the consequences afterwards, the reflector at first collect date and observe people in the process of doing the activity, instead of actively taking part in it. This kind of attitude needs more philosophy of cautiousness. It is easier to be an observant being outside a social group than taking part in its work. The results shown also a negative

correlation between activist and the way of judging - thinking that is based on logical process aimed at the impersonal findings, which is the reverse to feeling. Feeling types are naturally friendly and sociable, finding it difficult to be businesslike (Brigs Myers; Myers, 1995), which closely corresponds with activist preferring sharing ideas with other people. Negative correlation between perceiving and theorist seems to be expected, since perceive type, who is active and empirical appears to be disconjoining with precise and detailed - focused theorist. Essential information from this survey is that only two learning styles are prone to depersonalization. Being an activist means tackling problems by brainstorming, while being pragmatist means trying out new ideas in practice; so both learning styles are strongly connected with being in touch with others who either accompany activist in the process of creative thinking or give pragmatist the feedback about applied solutions. The more interactions with co - workers or clients managers have, the more potential stressful situation may occur. If the satisfaction from work is low and stress become to be chronic, managers can treat people around as unfeeling objects, which leads to distancing from them and cynical attitude towards them. In the light of this results, the question if the reflector and theorist can protect from the burnout syndrome should be asked. As for the learning styles, the overall learning profile is lower for Polish managers and this may mean that they will be more selective or less interested in learning. The dominant style is clearly pragmatist and the sample scored very low on the activist style. This shows that Polish managers are passive, not very willing to take actions or to make changes. From the research it is difficult to evaluate the reasons for this. It may be the educational system, which did not use active methods or applications but focused on acquiring theoretical knowledge. The result of this study can be used in academic education among students of management, business, marketing etc, who after getting know their personality styles and learning styles can more consciously affect their educational attainment. As well as in the higher education, the results of this survey have practical implications in MBA programs and courses designed especially for managers, as Wells; Layne; Allen, 1991) suggested in the literature, because the better methods of teaching are matched , the greater chances for success can be observed. Further study is needed on the correlation between learning styles, burnout and cognitive functioning of Polish managers, to examine potential interaction between attention, memory, perceptiveness and learning styles.

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TARIFF GROUPS AS A BASIS OF FINANCING OF HIGHER EDUCATION INSTITUTIONS/PROGRAMS

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ABSTRACT

During the past 10 years European higher education (HE) has experienced radical changes with the aim to make the higher education area more responsive to society and to stimulate the transfer of knowledge in the triangle of research, education and innovation and in this way contribute to the economic development and increased competitiveness and enable the transition into knowledge-based society. Key obstacles are limited available public and scarce private financial resources. Thus, new and mixed financial resources are needed and, consequently, »distribution« and »control« instruments and mechanisms which will encourage economical and cost-effective use of limited resources and ensure more effective achievement of HE objectives. One of the most commonly used mechanisms for the allocation of public funds is a formula based on tariff groups which should reflect the cost of individual study programmes in different fields of study. The key question is how many tariff groups are needed and what their factors are. Keeping in mind that the formula is one of possible mechanisms for the implementation of national HE policy, it has to be structured in a transparent way with a combination of formula elements (including tariff groups) which stimulate higher education institutions (HEIs) to achieve national strategic objectives. If, for instance, tariff groups and factors fail to reflect the cost of study programmes from different fields of study, we have to either change (lower) their number and factors value or, what is much more difficult to implement, another mechanism should be used for the allocation of (public) funds for higher education.

Keywords: higher education, public funding, lump sum, tariff groups

INTRODUCTION

Higher education (HE) in all EU member states falls within national responsibility and focuses on governmental policy goals together with the EU policy. With the Bologna reform[1], HE is faced with numerous challenges, e.g. various choices of study possibilities, flexibility of study paths, student and teacher mobility, inclusion of increasingly diverse student population and its ageing, openness and innovativeness of HE area in its wider environment, transfer of knowledge in the economy and vice versa (the so called knowledge triangle), internationalisation and globalisation, and increased financial needs and requirements which have to be balanced with financial limitations. Currently, the main

[1] The Bologna reform includes and is open to countries that have signed or ratified the European Cultural Convention (Paris, 19 December 1954). The process currently includes 47 countries (all EU member states and others; the last to join was Kazakhstan in March 2010).

guidelines in the field of funding of HE in the EU is the Resolution of the Council of the European Union, dated November 23, 2007, on the modernisation of universities in order to increase competitiveness of Europe in a global knowledge-based economy.

The OECD (Tertiary Education for the Knowledge Society, 2008) forecasts that the main challenges in adopting policies in HE will include among other areas transfer of international strategies to the national context, achieving equity, enhancing the role of tertiary education in research and innovation, strengthening ties with the labour market, assuring and improving quality and matching funding strategies with national priorities.

Many HE experts and government officials agree that the development of HE is limited mainly due to the availability of public funds for financing HE. Therefore, special attention must be given to equitable redistribution of funds among HE institutions (HEIs) which should ensure effective[2] use of limited public funds. For this reason the integrated, lump-sum or block-grant funding is being so widely introduced not only in Europe and there is a belief that it can lead to rationalisation on the level of HEIs. By making HEIs more accountable for their actions and at the same time giving them more autonomy and flexibility for funds management and distribution, they should be able to do more with existing funds than the government or any other actor on the national level.

Most commonly used funding mechanism for delivering public funds to HEIs by governments is based on a funding formula which groups study programmes (or HEIs) in different tariff groups in relation to their complexity and costs (or the price) the government is prepared to pay. According to Eurydice, in the academic year 2006/07 all EU member states except for Cyprus, Luxemburg and Malta (for Germany and Spain this can vary by region) used the funding formula as the main mechanism for direct public funding (Higher Education Governance in Europe, Eurydice, 2008). According to the OECD, the funding formula is also used in Australia, Japan, New Zealand, Switzerland, Chile and Russia (Education at a glance, OECD, 2008).

The question we are exploring in this paper is how well tariff groups and their factors express the differences in costs of delivery of study programmes taking into consideration their field of study. Furthermore, we would like to find out what has to be taken into account when setting the "right" number of tariff groups in a national HE system (for example, Australia has 16 tariff groups while other countries like the Netherlands get by with only 4) and what should the scale of factors be so that they would properly reflect the costs of study programmes in a particular tariff group (for example, factors of tariff groups in Australian funding formula range from 1 to 10.2, while in Denmark they only range from 1.1 to 2.4). (Deen et. Al: Bekostigingstarieven in het hoger onderwijs, Een vergelijking tussen zeven landen, 2005)

A glance at the Slovenian HE area would reveal that discussion about the expenses and insufficient financing of HE from public finances has accompanied the HE reform according

[2] Effectiveness of HE is the relationship between HE activities and HE goals. What really matters is that money and resources are spent in such a way that one gets outputs that in a broader sense layer are related to the productivity and growth (Study on the Efficiency and Effectiveness of Public Spending on Tertiary Education, 2009).

to the guidelines of the Bologna process since 2004. In the same year Slovenia also introduced the lump-sum funding of HE teaching.

The Slovenian case of introduction of performance-based lump-sum public financing demonstrates that HEIs are able to adapt to system changes more quickly than expected and not always in a direction anticipated by the government. Being used to the old norms and standards set by the government, HEIs recalculated what behaviour (taking into account the elements of the formula) would bring them more money. At the same time most institutions have not significantly improved their internal management practices. The reason for this could be that the formula in use for the redistribution of public funding on the national level does not include qualitative elements that focus on the accountability and performance other than the number of students and graduates which are distributed in six tariff groups according to the field of study.

Because of mentioned goals, trends, reasons and facts we have decided to thoroughly analyse the role and the influence of tariff groups and their factors, which altogether have a strong effect on (effective) funding of HE.

BACKGROUND

HE trends in Europe

Lately, nowhere in the world HE has been faced with such radical changes as in Europe. During the past ten years, changes have been based on three key developmental efforts:

- Sorbonne Declaration (1998): harmonisation of the European HE system;
- The Bologna Process (since 1999): to create an open and competitive European HE area by setting up unique European higher education (EHEA) and research area (ERA).
- The Lisbon Strategy (2000): transformation of fragmented European economic systems into united, knowledge-based economy. The key document in the area of HE, the Council Resolution on modernising universities for Europe's competitiveness in a global knowledge economy (2007), stresses that education, research, innovation and modernisation of HE institutions represent key elements of the Lisbon Strategy.

HEIs as well as governments and other actors should be aware of their key role in the »knowledge-based society i.e. Europe« and should assume responsibilities in ensuring the expected economic, social and cultural welfare. For this reason countries have been particularly active in the integration policies regarding their economies, political and social systems and wider HE systems.

In general, European HE systems have been facing numerous changes and are increasingly becoming more and more internationalised, deregulated, liberalised, and market-oriented which has its advantages and disadvantages, supporters and opponents.

Economics of HE

Financing has a direct influence on the HE reform and therefore on the efficiency, equity and quality of HE. In Europe, government budgets represent the main source of HEIs funding, as demonstrated in Figure 1.

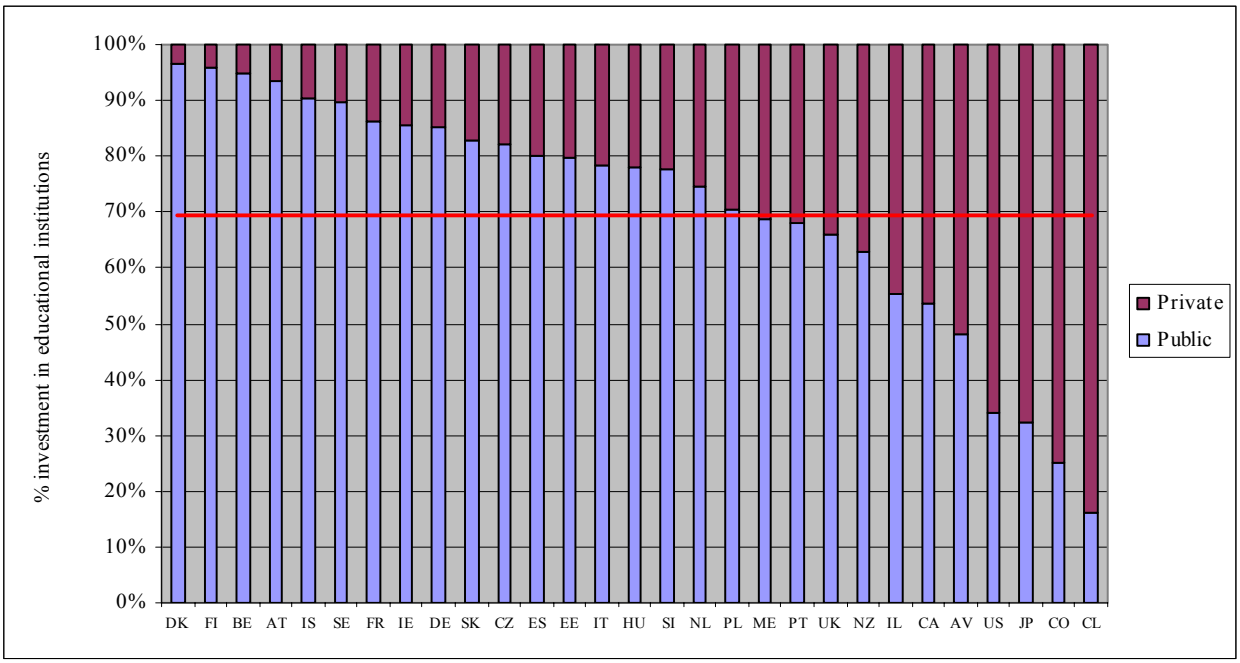

Figure 1: Public and private investments in tertiary education institutions in 2006 (Education at a Glance, 2009, OECD)

In most analysed countries, tertiary education institutions are mainly financed from public resources. In OECD member states in 2006, 69.4% of tertiary education institutions funding came from public resources. However, the share of public funding of tertiary education institutions in most analysed countries is decreasing. In OECD member states, the share of public resources in the period 1995-2006 decreased by 7.1%.

It is expected that public funds will have an important role in financing of HEIs in the EU also in the future, since the Communiqué of the Conference of European Ministers Responsible for Higher Education, Leuven and Louvain-la-Neuve, 28-29 April 2009, confirmed public funding as one of the main HE priorities until 2020 in order to guarantee equitable access and further sustainable development of autonomous HEIs. The Communiqué also stressed that greater attention should be paid to seeking new and diversified funding sources and methods.

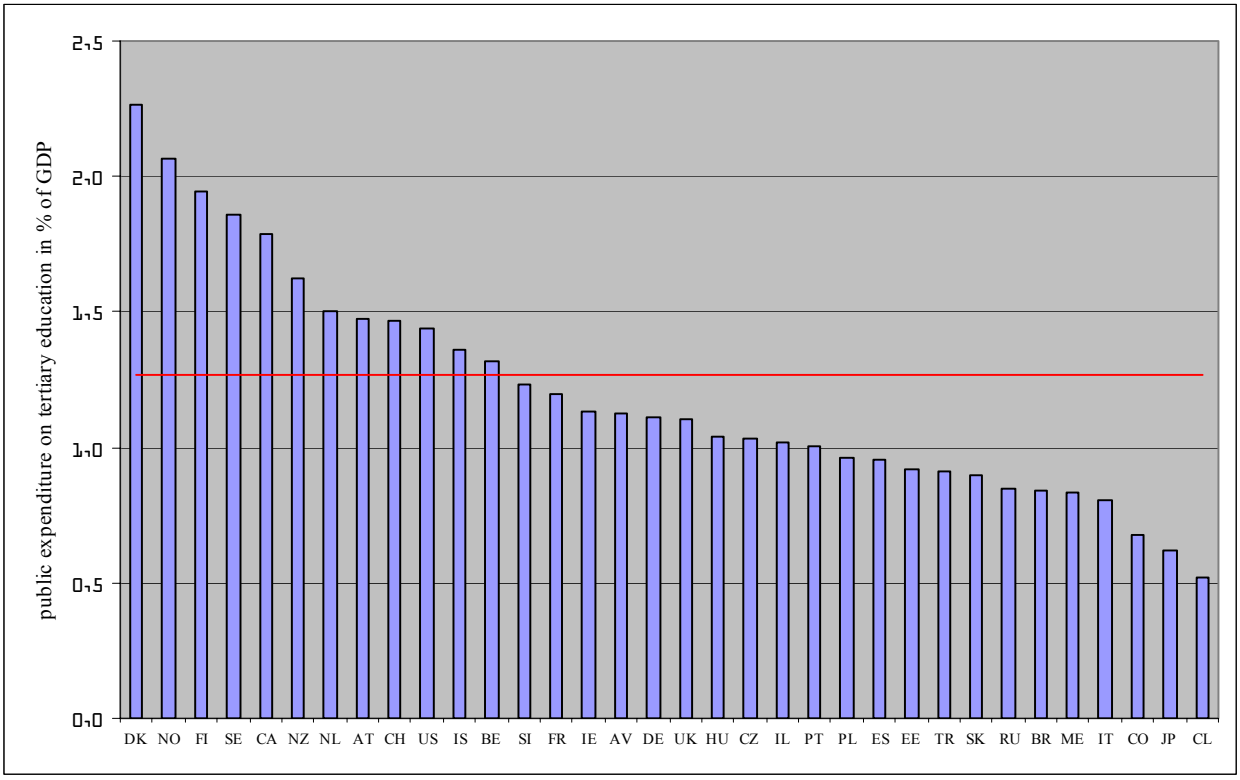

Figure 2: Public expenditure for tertiary education in % of GDP in 2006 (Education at a Glance, 2009, OECD)

However, European investments in education, research and development, especially from private sector, do not place the EU close to the USA and Japan, but on the contrary, increase the gap between the countries. EU investments in HE lag behind those of the USA and Japan. Therefore, Europe in the so-called Lisbon strategy set the goal to invest 2% of GDP in financing HE (1% from public and 1% from private sources). As demonstrated in Figure 2, the goal of 1% of GDP from public funding has been achieved by many countries. However, the remaining problems are the matching investments from private sources which can, but not necessary, mean tuition fees.

HE funding systems and mechanisms

The direct influence of funding on HE has been acknowledged also by the Bologna process in 2009 when it included among its priorities the funding of HE with the need for new and diversified funding sources and methods. Governments are facing a challenge of ensuring equitable access to HE and accountability of HEIs without breaching their autonomy. Although in the past decade the financial autonomy of HEIs in EU countries has increased,

the recent recession has revealed weaknesses of many HE funding mechanisms and national policies they have been more or less supporting.

A key factor which clearly demonstrates the trend from complete and direct governmental control over HE is its funding. Relatively high presence of public spending (taking into account the budget volume) is not enough to meet financial needs and requirements of constantly developing and growing HE systems. Thus, new and mixed financial resources are needed and, consequently, also monitoring and »control« instruments and mechanisms. Governments have realised that control and oversight are not the only way to steer the behaviour of HEIs and that institutions would be able to use the public funds more cost-effectively than the government if they were given the appropriate financial autonomy. The current trend in public funding became performance-based funding (not taking into account "history") and looking for ways and means of cost-sharing through additional non-public funds (tuition fees, commercialisation of research, private use of staff, etc.).

Funding mechanisms differ between countries. Among important factors are national funding rules (especially for funds allocated to HEIs), evaluation systems and staff policy. What is getting increasingly obvious is the fact that countries do not properly relate their HE funding mechanisms to their HE policies which contributes to the inefficiency and ineffectiveness of public (and private) spending on HE. Furthermore, in these instances HEIs are not stimulated to actively follow up on the situation and trends in the economy and society and position themselves as the driving force in the development of the economy as well as wider society.

Efficient and economical use of these resources depends on the system of financing of HE in individual states. During the past 10 to 20 years, the majority of European countries changed the system of their HE financing. The scope of these reforms varies considerably with regard to individual states, but not a single country could have avoided these changes completely. There are many similarities in these reforms (Kaiser et al., 2002; Strehl et al., 2006; CEGES, 2007; Lepori et al., 2007, EUA: Financially Sustainable Universities – Towards Full Costing in European Universities, 2008):

- in general, there is a trend of increased autonomy of the use of public finances within HEIs;
- there are efforts regarding the introduction or use of the full-cost model for HE activities by HEIs. According to EUA, the primary question for universities in the 21st century are risks related to the sustainability of their mission, due to increasing expenses of HE activities;
- the introduction of more transparent and simple financing of HE on a national level,
- cost of education should be only one i.e. government responsibility.

Mutual interdependence between financing systems and HE and its policy differ considerably among individual countries, as can be seen from the OECD research mentioned in Strehl et al. (2006).

According to the OECD (Tertiary Education for the Knowledge Society, 2008), the main challenges in funding tertiary education are ensuring the long-term financial sustainability of tertiary education, devising a funding strategy consistent with the goal of the tertiary

education system and using public funds efficiently. To match these challenges the following policy directions are suggested to the governments:

- Develop a funding strategy that facilitates the contribution of the tertiary system to society and the economy.
- Publicly subsidise tertiary study programmes in relation to the benefits they bring to society.
- Use cost-sharing between the state and students as the principle to shape the funding of tertiary education.
- Back the overall funding approach with a comprehensive student support system.
- Make **institutional funding for instruction formula-driven**, related to both input and output indicators and including strategically targeted components.
- Improve **cost-effectiveness**.

Tariff groups and funding formulas

Tariff groups appear in HE funding formulas for the redistribution of public funds as parameters for setting value of individual fields of study. To account for differences in the costs of training across disciplines, different funding rates – tariff factors are applied (to the number of students and degrees), which are more or less based on the estimation of teaching costs per student in a particular field of study. Studies that take place in classrooms (*classroom-based subjects*) have lower tariffs i.e. a lower amount of public funding than studies taking place also in laboratories (*laboratory-based subjects*).

The value of tariff groups (relative factor) represents a ratio to the value of funds for financing of studies in the tariff group with the lowest factor.

The number of tariff groups varies among different countries (e.g. the Netherlands and the United Kingdom have 4 while Australia has 16). The variation is also in the difference between values of factors of individual tariff groups. Both can be seen in Table 1 which includes data from the CHEPS study (Deen et. Al: Bekostigingstarieven in het hoger onderwijs, Een vergelijking tussen zeven landen, 2005) and data for Slovenia.

Table 1: Relative factors set for public financing

Field of study	Aus	D	NL		NZ	N	S	UK	Avg.	SLO*
			Coll.	Uni.						
Arts/Other Humanities	2.8	1.1	1	1	1	1	1	1	1	1.75
Commerce/ Economics	1.6	1.2-1.3	1	1	1.5	1	1	1	1.1	1
Law	1	1	1	1	1	1	1	1	1	1
Other Social Sciences	4.4	1	1	1	1	1	1	1	1	1.75
Languages	6	1.1	1	1	1	1	1	1	1.1	1.75
Maths/Stats	3.3	1.6	1.3	1	1	1	1	1.3	1.2	3
Teaching	4.8	1.2	1	1	1.5	1.25	2	1.3	1.3	1.75
Behavioural Science	4.4	1.1	1	1	1.5	1	2.1	1	1.2	1
Visual&Performing Arts	6	1.7	-*	-*	1.5	3	5+	1.3	1.7	4.5
Computing	4.9	2.1	1.3	1.5	1.5	1.25	2.4	1.3	1.6	2.5
Science	8.2	2.1	1.3	1.5	1.6	1.5	2.4	1.7	1.8	3
Nursing	6.5	1.8	1.3	1.5	1.5	1.5	3.5	1.3	1.7	2.5
Pharmacy	4.9	2.4	1.3	3	1.6	1.5	2.4	1.7	2	3.5
Agriculture	10.9	2.4	1.3	1.5	2	1.5	1.9	1.7	1.9	3
Engineering	8.2	2.4	1.3	1.5	1.9	1.5	2.4	1.7	1.9	2.5
Medicine	10.2	2	1.3	3	5.8	4	2.5	4	4.5	4.5
Dentistry	10.2	2.1	1.3	3	4.5	4	2.6	4	4.5	4.5

* The financing is regulated by special rules.

Deen et al: Bekostigingstarieven in het hoger onderwijs, Een vergelijking tussen zeven landen, 2005; data for Slovenia is set by the Decree on public financing of higher education and other institutions from 2004 to 2009 (Official Gazette of the RS, no. 132/04, 72/04, 4/06, 132/06 and 99/08)

A comparison of seven countries shows that relative amounts for the same field of study are similar. In Austria and Sweden the amounts differ more than in other countries. Australia, Sweden and Denmark have higher factors for technical and natural sciences than other countries. In all eight countries the relative amount of public financing for education of students (or for a different work unit invested in education) is the lowest for law. On the other hand, it is the highest for medicine.

There are differences among countries with regard to the number of tariff groups. Table 1 shows that the UK and the Netherlands have the lowest number of tariff groups, only four. In Scandinavian countries and in New Zealand the number of tariff groups varies, with Australia having the largest number of tariff groups. The range of factor value is also the greatest in Australia. In Australia, the most expensive studies (medicine, agronomy) get more than ten times the amount of funding than the least expensive studies.

When studying tariff groups and their factors, it is necessary to take into account institutional differences among countries (how education is integrated within HEIs, how much public funds are received directly by HEIs and how much funds are given directly to students). The allocation of public finances is also influenced by political and governmental decisions. First,

it is necessary to decide on the relative volume of public and private financing. Then, it is necessary to decide on the acceptable share of funds for educational activities of HEIs, depending, for instance, on the number of students, and how much money is allocated as a fixed amount (the fixed amount can vary among HEIs). In addition, it is necessary to take into consideration if a country has tuition fees. Relative factors are more equalised in systems with tuition fees.

HE funding in Slovenia[3]

Slovenia introduced lump-sum financing based on formula in 2004. The so-called integral financing of HEIs teaching activities meant abolishing norms and standards set by the government and to some extent turned towards remuneration of educational results – determining funds with regard to the number of students and graduates which together influence the allocation of 30-40% of funds for educational activities. The main reasons for the introduction of lump-sum financing were the weaknesses of the previous system of financing:

- The funds for study activities were mostly distributed by the ministry on the level of salaries and material costs, which prevented HEIs to govern received funds.
- The controls[4] were focused mainly on how the money was spent and not on the quality of the performance of HEIs.
- Slow responsiveness of HEIs to the trends and needs of the economy and society.

Desirable qualities of the new funding model were:

- Flexibility: the funding mechanism should recognise differences between HEIs and allow their flexibility to maximise autonomy (academic and financial) so that they can achieve their mission.
- Choice: HEIs should not be limited in offering a selection of study programmes.
- Quality: funding should reward and promote excellence of results in education.
- Simplicity/efficiency: the model must be simple for governing by the state and comprehensible for HEIs and students. It should assure the best results for invested funds.
- Predictability: the system of financing must enable planning with a certain level of predictability both, for the state and HEIs.

The introduced formula fulfilled some of these criteria. It is composed of a fixed and a flexible part. For the initial year the value of the fixed amount represented 80% of the annual funds for study activities of HEIs in 2003. The percentage decreases every year and was set at 60% in 2009. The flexible amount of the financing is calculated on the basis of the number of enrolled students in the ongoing academic year, number of graduates of the past calendar year and the field of study, which are classified in six tariff groups. The factor of the tariff group expresses the ratio between the funds allocated for the provision of study in an individual tariff group compared to the first tariff group. The values of factors range from 1.00 to 4.50.

[3] The information in this paragraph is related to the funding of full-time undergraduate studies and 2nd cycle study programmes.

[4] The controls of the use of public expenditure conducted by the ministry, the Budget Supervision Office of the Ministry of Finance and the Court of Auditors.

Tariff groups in Slovenia combine study programmes (until 2009 they combined HEIs) by fields or subfields of study defined by ISCED classification (UNESCO, November 1997) taking into the account the annual public funds received by HEIs in 2003 based on old norms and standards. This way the factors reflected the cost ratio between different fields of study including the anomalies of the old funding system.

The described formula was introduced for a limited transition period into lump-sum funding which was supposed to end in 2008, but is still in use with some minor adjustments in 2010. Management and administration of both, HEIs and the government, had to adapt to the new funding mechanism. The government had to learn how to work in a system which gives it less direct power and brings new type of monitoring tasks. Already at the beginning they realised that certain vital data for monitoring the efficiency of HE was not being collected on the national level or was only available on an aggregated level. On the other hand, HEIs realised that by establishing a more efficient internal use of resources they could redirect "additional" funds to underfinanced activities and development and increase the quality of teaching.

EMPIRICAL STUDY: TARIFF GROUPS IN SLOVENIAN FUNDING MECHANISM

Purpose (objectives) of the study

We decided to research tariff groups because disadvantages of HE funding in Slovenia are becoming increasingly obvious, especially its justification and the issue of the number of tariff groups and values of their factors. Due to the following reasons, it is also questionable how fair the allocation of public funds among HEIs is:

- historical reason: funds allocated to HEIs in 2003 were used as a basis for the new system of funding without looking into whether HEIs received funds in accordance with their activities and expenses,
- number of tariff groups and their factors which should reflect differences in costs of carrying out different study programmes according to their fields of study, which require groups of different sizes as well as different material and spatial conditions.

That was the reason that we wanted to tackle tariff groups with the appropriate analysis.

Methodology (type, data collections, techniques of analysis and data treatment)

The analysis of suitability of the existing system of HE funding in Slovenia was carried out on a basis of the analysis of the existing method of distributing funds for study activities among HEIs, with the emphasis on their placement in tariff groups for 2009, which means that we have taken into account:

- the number of undergraduate full-time students (49,818) and graduates (7,825) in 2003 since this year was the basis from the perspective of HEIs funds on which lump sum was introduced;
- the number of undergraduate full-time students (50,622) and graduates (7,850) in 2004 since these numbers were used in the first lump-sum formula; and
- the number of undergraduate full-time students (53,021) and gradates (8,418) in 2009 since these numbers were used in the latest formula.

Table 2: Students and graduates in tariff groups as included in the lump-sum formula*

Tar. Gr.	Year 2003				Year 2004				Year 2009			
	Stud. 02/03	Grad. 2002	Stud. in total	Grad. in total	Stud. 03/04	Grad. 2003	Stud. in total	Grad. in total	Stud. 08/09	Grad. 2008	Stud. in total	Grad. in total
1.	15,221	2,929	30.6%	37.4%	15,515	2,899	30.6%	36.9%	14,417	3,262	27.2%	38.8%
2.	13,234	2,480	26.6%	31.7%	13,577	2,447	26.8%	31.2%	14,594	2,192	27.5%	26.0%
3.	12,727	1,470	25.5%	18.8%	12,905	1,313	25.5%	16.7%	14,457	1,634	27.3%	19.4%
4.	4,052	411	8.1%	5.3%	3,969	531	7.8%	6.8%	3,259	455	6.1%	5.4%
5.	2,206	119	4.4%	1.5%	2,189	265	4.3%	3.4%	2,953	349	5.6%	4.1%
6.	2,378	416	4.8%	5.3%	2,467	395	4.9%	5.0%	3,341	526	6.3%	6.2%
Tot.	**49,818**	**7,825**	**100%**	**100%**	**50,622**	**7,850**	**100%**	**100%**	**53,021**	**8,418**	**100%**	**100%**

*The number of enrolled students and graduates differs slightly from the actual number of enrolled students and graduates due to the calculation of these numbers for new HEIs based on offered study places and not actual enrolment.

As demonstrated in Table 2, from 2004 to 2009 the number of students in the formula increased for 2,399 or 4.7%, and the number of graduates increased for 568 or 7.2%. It is interesting that in the period analysed the number of students decreased only in the 1st tariff group, namely for 1.098 or 7.1%, while in all other tariff groups the number of students increased. In 2004, students of the 1st tariff group represented 30.6% of all students, while in 2009 their share decreased to 27.2%. However, the number of graduates in this group increased the most (for 363 or 12.5%), representing 38.8% of all graduates in 2009 (in 2004 they accounted for 36.9% of all graduates).

Reasons for these changes are mainly the following:
- new Bologna study programmes were first and to the highest extent introduced in the 1st tariff group, where at least in the field of business studies new programmes were introduced according to the formula 3+2;
- policy of promoting enrolment in study programmes in the fields of science, medicine and technology, implemented by the previous government.

Findings and discussion

To be able to correctly analyse and understand tariff groups and their role in the funding formula we have to take into account that the factors such as students and graduates have influence only on the variable (normative) part of the formula which represents a relatively small part of total funding (20% in 2004 and close to 40% in 2009). The rest, i.e. 80% in 2004 and 60% in 2009, depends on the basis of funds given to HEIs in 2003.
Annual Funds (AF) = Fixed AF (FAF) + Normative AF (NAF)

$$AIV = (AF - \Sigma FAF / \Sigma ((S + G * Wg) * f(tg))$$

The annual initial value (AIV) represents the standard annual funds per student in the first tariff group and is calculated as the quotient of the difference of annual budget funds (**AF**) and the basic annual funds of all HEIs (Σ FAF) and the total number of students (**S**) and the number of graduates (**G**) multiplied by the weighting of the graduates (**Wg**) and the factor

f(tg) of the tariff group to which HEIs or their study programmes belong. Wg represents the length of a certain study programme and is calculated on the basis of the number of semesters divided by 2 for the old study programmes. The Bologna study programmes have a fixed value of the weight at 4.

With the analysis of tariff groups we wanted to compare the calculated factor of tariff groups (on the basis of funds per student in a particular tariff group) to factors of tariff groups to see how they match in the first year when the formula was used (2004) and in 2009 (see Table 3).

Table 3: Comparison of the ratio between factors of tariff groups as set by the formula in 2004 and calculated on the basis of the funding allocated to HEIs in 2004 and 2009

Tariff groups	**Ratio of amount per student in a tariff group in comparison to the first tariff group**			**Factors set by the formula**
	Fixed amount	**Variable amount**	**Total funding**	
Year 2009				
1.	1.00	1.00	1.00	1.00
2.	1.35	1.50	1.41	1.75
3.	1.65	1.96	1.76	2.50
4.	2.17	2.48	2.28	3.00
5.	2.14	2.80	2.36	3.50
6.	3.67	4.49	3.95	4.50
Total	**1.58**	**1.81**	**1.66**	**-**
Year 2004				
1.	1.00	1.00	1.00	1.00
2.	1.94	1.73	1.89	1.75
3.	2.15	1.99	2.12	2.50
4.	2.47	2.68	2.51	3.00
5.	3.46	3.00	3.36	3.50
6.	5.51	4.89	5.38	4.50
Total	**1.99**	**1.86**	**1.96**	**-**
Year 2003 (the base year)				
1.			1.00	1.00
2.			1.84	1.75
3.			2.16	2.50
4.			2.40	3.00
5.			3.41	3.50
6.			5.50	4.50
Total			**1.95**	**-**

Main findings:

- Due to the use of lump sum the ratio of allocated funds per student has gradually begun to decrease which is clearly evident from the average factors calculated for 2009 compared to those for 2004 and 2003. Factors of the fixed amount have decreased significantly (from 1.99 to 1.58) and so did the total funding (from 1.96 to 1.66).

- It is understandable that this is not obvious from the factors calculated for the variable amount since they mostly depend on the factors of tariff groups. However, we can note that values of all calculated factors of the variable amount are lower than values of factors of tariff groups (for the 2nd tariff group the calculated factor is 1.5 which is 0.25 lower than the factor of the tariff group, for the 3rd tariff group the calculated factor is 1.96 which is 0.54 lower than the factor of the tariff group; similar goes for other tariff groups).

The calculation demonstrated that calculated ratios, in particular normative annual funds per student, are much lower than the factors of tariff groups. We also found out that factors calculated for the 2nd and 3rd tariff group, and in particular for the 4th and 5th tariff group, are rather similar which indicates the possibility to reduce the number of tariff groups and values of their factors.

Another problem highlighted by this calculation is the fixed part, i.e. fixed annual funds, that carries the history of 2003 which should be eliminated and a new method of calculating the (potential) fixed part of funds received by HEIs should be found.

CONCLUSION

We tried to highlight the role and dilemmas of tariff groups as instruments to ensure efficient and effective "distribution" of public funds for HE by the government and its use by HEIs. The question is whether HE funding based on the formula using a system of tariff groups supports and encourages the key components of the HE reform imposed by contemporary knowledge-based society, and whether the system of financing motivates and stimulates HEIs to manage their funds more efficiently and economically than the government could on a centralised level.

As demonstrated by the international comparison and the Slovenian example, tariff groups are a complex and demanding subject. Their main role is to follow the actual costs of conducting various study programmes. This raises the question of the capability of HEIs to determine actual costs of teaching activities carried out.

As demonstrated in the Slovenian example, HEIs cannot ensure appropriate data for determining efficiency and economy of HE activities. To be able to estimate, i.e. measure, efficient use of funds, the question arises on the national level, namely the appropriate cost of HE activities. This also requires from governments to define the minimum quality criteria for the delivery of HE at the institutional level.

Another aspect of tariff groups and factors is to what extent they should relate to the actual costs of HEIs activities in a given time and to what extent they should include quality factors and additional funding to stimulate HEIs to experiment with new approaches and solutions concerning the innovation in teaching and research.

The findings have led us to the basic question whether the formula is still the right instrument to ensure the effective use of public funding. The reason for this dilemma lies partly in the

fact that many countries (like Slovenia)[5] have not introduced a fully flexible funding formula but have kept a part of funding fixed (e.g. based on historical trends or past costs) for the sake of the stability of HEIs. Furthermore, the government should be able to ensure that the public funding invested in HE will be efficiently returned to society in the form of a more responsive and innovative labour market and consequently improved social conditions and increased economic growth.

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THE EFFECTIVENESS OF E-MAIL REFERENCE SERVICES OF MALAYSIAN ACADEMIC LIBRARIES IN FACILITATING E-LEARNING

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ABSTRACT

E-mail reference services are becoming widely available in Malaysian academic libraries. The purpose of this study was to examine the effectiveness of e-mail reference services in selected academic libraries in Malaysia. The researchers attempt to focus on the awareness, usage and at the same time look at the perceived needs, issues and problems faced by librarians and students. The research methodology employed was a case study approach that combined three data collection methods, i.e. questionnaires, interviews and systematic observations. This paper concludes that e-mail reference services are effective forms of service delivery in Malaysian major academic libraries. E-mail reference was the main format used in providing digital reference, although academic libraries are planning to implement synchronous DRS and collaborative digital reference.

Keywords: digital reference, academic library, e-learning, email reference

INTRODUCTION

Reference work has been an integral part of library activities for more than a century (Ford, 2003). Over time, new technologies have been used to assist in a variety of functions in library and information units, including in the provision of reference services. Smith (2001) urged that there is no need to limit reference interviews to in-person or face-to-face and telephone conversations, especially when many users are researching from their home and office computers. Librarians should take full advantage of e-mail, web and other means of digital reference services in this digital library environment.

STATEMENT OF PROBLEM

New technologies have dominated all spheres of human activity and the academic libraries are not an exception to this. McClure, Lankes, Gross and Choltco-Devlin (2002) noted that people have become increasingly comfortable utilizing and indeed relying on digital services as part of their way of life. For instance, many people are now using various electronic and digital technologies. They also communicate with others in their personal and business lives by using e-mail or real-time services such as online chat, instant message services, or video

conferencing. In the context of library science, the users are hoping libraries to provide more services online. These services include access to on-line catalog, the ability to place request on-line, access to electronic resources and the provision of some type of on-line reference services.

The researchers' realized that most academic libraries in Malaysia have moved towards digital concept. However the reference services and the digital reference services were not fully utilized and the services provided not being used effectively. Despite the advances brought by technology and they are in the more privileged position to provide better and more services, the structure and organization of reference service in academic libraries have changed little since its inception. Services continue to be tied to the physical desk, requiring that users come into the library building for assistance. Reference librarians in academic libraries should play an important role in assisting students and faculty in teaching, learning and research process by providing digital reference services.

OPERATIONAL DEFINITIONS

The following definitions are used in this research:
Effectiveness can be defined as the capability of producing an effect. In this study, effectiveness was measured based on Whitlatch's (1990a) measurement of reference effectiveness mainly through users' satisfaction, users' perception and library's performance. The other key factors used were awareness, usage and perceived needs.
Academic libraries in this study refer to libraries attached to academic institutions above the secondary or high school level, serving the teaching and research needs of students and staff (Feather and Sturges, 2003, 3).
Case study is a research design that entails the detailed and intensive analysis of a single case (Bryman, 2004).
E-mail reference is a major format of digital reference services which user sends the library an e-mail with a reference query and the library may reply by e-mail, telephone, fax, correspondence etc.
Digital reference service refers to a mechanism by which people can submit their questions and have them answered by a library staff member through some electronic means (e-mail, chat, web forms, etc.) not in person or over the phone (Janes, Carter and Memmott, 1999, 146). A digital reference service generally comprises the following elements: (1) the user of the service, (2) the interface (e-mail, web form, chat, videoconference, etc.), (3) the information professional, and (4) electronic resources (including electronic or CD-based resources, web resources, local digitized material etc.), as well as print resources (Berube, 2003, 1)

STUDY OBJECTIVES

The study attempts to achieve the following objectives:

a) To examine the awareness of e-mail reference services in Malaysian higher educational institutions
b) To identify the usage of e-mail reference services in academic libraries in Malaysia

c) To determine the effectiveness of e-mail reference services in academic libraries in Malaysia

RESEARCH QUESTIONS

The study explores the following research questions:

a) How aware are the students of the availability of e-mail reference in academic libraries in Malaysia?
b) How are e-mail reference services used by students of universities?
c) How effective is the e-mail reference services offered by academic libraries in Malaysia?

LITERATURE REVIEW

Academic libraries have experienced major changes in technology over the last two decades. The emergence of the Internet and its related technology has challenged academic libraries to provide digital reference services to their university populations. Nowadays, more and more academic libraries are developing their own websites and the interest has shifted from processing printed materials to providing access to information via the web.
Tenopir and Ennis (2002) conducted four surveys over a decade (in 1991, 1995, 1997 and 2000) to the academic members the Association of Research Libraries (ARL) provide insights about changes that have occurred in academic library reference services due to new and rapidly evolving technologies. The surveys contained both open-ended questions to gather opinions and factual questions to measure what libraries offer. Libraries adopted digital information sources and services at an increasingly accelerated rate in the 1990s due to the availability of the Internet, in particular the World Wide Web. Digital sources have brought about changes in the physical environment of the reference room, in the type and range of resources available, and in the attitudes and expectations of reference librarians and users. The Web is changing what resources are searched, how results are distributed, how instruction is delivered, and relations with faculty. The reference librarians surveyed think that as the reference environment has changed, it has helped them to provide better services to users.

In 2002, Janes surveyed a total of 648 reference librarians in USA on the use of digital and networked technologies and resources in the libraries. Some 83% of academic libraries at that time offered digital reference service. Others were still in the planning stage. The researcher found that the use of digital reference service by the university students had reduced the number of reference questions received by 39.1%. Some 78.8% of the reference librarians surveyed had used e-mail while only 46.6% used web forms. A majority of the respondents strongly agreed that the use of digital technologies had made reference work more accessible, more challenging and more interesting. According to the respondents, 80% of ready reference questions would be well served by digital reference services.

Johnson (2004) carried out a survey at two four-year public universities in South Atlantic region in USA. The survey inquired about university affiliates' awareness of, use of, and the interest in reference services, with a particular focus on online chat reference (synchronous digital reference). Survey respondents reported strong prior use of face-to-face reference and

a desire to use this service first when pursuing research topics. Awareness and use of the online chat reference service at each institution was comparatively low, but respondents forecasted the service would be among the most heavily used in ten years.

Looking at the earlier studies, the researcher found the following: (1) There were no local studies on e-mail reference. Most of the studies were conducted in the context of United States and United Kingdom, (2) There were lack of studies on the perception, usage, satisfaction and effectiveness of e-mail reference.

METHODOLOGY

The case study was designed to collect information needed to fulfill research objectives and to provide responses for research questions. Case study is a valuable method of research, with distinctive characteristics that make it ideal for many types of investigations. Eisenhardt (1999, 138) noted that case studies typically combine data collection methods such as questionnaires, interviews, observation and archives. The evidence may be quantitative (e.g. numbers), qualitative (e.g. words), or both.

The population of this study comprised the following: a) The students (n=1,250) of the Faculty of Information Management, UiTM and Faculties of Computer Science and Information Technology in UiTM, UM, UKM and UPM.

Questionnaires were chosen as the main research instruments in data gathering. To measure the effectiveness of DRS the researcher developed the questionnaires based on series of quality standards that can be used to evaluate quality of DRS by McClure, Lankes, Gross and Choltco-Devlin (2002) and Kasowitz, Bennett and Lankes (2000).

DATA ANALYSIS AND FINDINGS

The findings of the study are presented according to the research questions. Analysis for the survey questionnaires was done using the Statistical Package for Social Sciences (SPSS) version 12.0 for Windows. The descriptive analysis has been performed to produce significant result that can be used to reflect the research objectives.

Data Analysis for Questionnaire

A total of 1,250 questionnaires were distributed to students of the Faculty of Information Management, UiTM and Faculties of Computer Science and Information Technology in UiTM, UM, UPM and UKM.

A total of 670 (53.6%) questionnaires were returned of which 121 (18.1%) were from Faculty of Computer Science and information Technology, UM, 223 (33.3%) were from the Faculty of Information Management, UiTM, 105 (15.7%) from Faculty of Computer Science and Information Technology, UPM, 108 (16.1%) from Faculty of Information Science and Technology, UKM, and 113 (16.9%) from Faculty of Quantitative Sciences and Information Technology, UiTM.

Demographic Data

The demographic data of students' respondents are as follows:

Table 1: Demographic Data of Students

Demographic variable	Categories	Percentage (Frequency)
Gender	Male Female	34.3 (230) 65.7 (440)
Age	Below 20 20-22 23-25 Above 26	35.2 (236) 45.1 (302) 14.2 (95) 5.5 (37)
Student Level	Undergraduate Postgraduate	82.7 (554) 17.3 (116)
Semester	Semester 1 Semester 2 Semester 3 Semester 4 Semester 5 Semester 6 Semester 7	4.6 (31) 38.7 (259) 24.9 (167) 11.9 (80) 7.8 (52) 7.0 (47) 1.8 (12)
Currently Living	On Campus Outside	62.8 (421) 37.2 (249)
Mode of Study	Full Time Part Time	80.9 (542) 15.5 (104)

Table 1 shows that majority of the respondents 440 (65.7%) were female and 230 (34.3%) were male. This is expected due to the fact that the numbers of female students were larger compared to male student in Malaysian public universities. In terms of age, 236 (35.2%) of the respondents were below 20 years. The largest group of respondents 302 (45.1%) belonged to the age group of 20-22 years, 95 (14.2%) of the age group of 23-25 years and only 37 (5.5%) respondents were in the age group of 26 years and above.

Majority of the students 554 (82.7%) were undergraduate and 116 (17.3%) were postgraduate students. The breakdown of the respondents represented a reasonable cross-section of users in the campus. In this study, 31 (4.6%) of the students were in semester 1, 259(38.7%) semester 2, 167 (24.9%) semester 3, 80 (11.9%) semester 4, 52 (7.8%) semester 5, 47 (7.0%) semester 6 and 12 (1.8%) from semester 7. Most of the students 421 (62.8%) were staying on campus and 249 (37.2%) outside. In terms of mode of study, 542 (80.9%) of the students were full time and 104 (15.5%) were part time students. **Awareness of E-mail Reference**

Respondents were asked whether they were aware of their university library's offering e-mail reference or not. As can be seen in Table 2 that majority of the respondents were aware of their university library's offering e-mail reference.

Table 2: Awareness of E-mail Reference (N=670)

Awareness of E-mail	Frequency	Percentage
Yes	456	68.1
No	214	31.9

Usage of E-mail Reference among Students

Respondents were asked to tick the appropriate formats of reference service/digital reference services that they have used. Referring to Table 3, the study found that face-to-face consultation were used by 426 (63.6%) respondents, telephone consultation 77 (11.5%) and correspondence 48 (7.2%). Web forms were used by 273 (40.7%) of the respondents, Ask-A Librarian 265 (39.6%), online chat reference by 40 (6.0%) respondents and 15 (2.1%) others.

Table 3: Usage of DRS

Reference Services/DRS	Frequency	Percentage
Face-to-face consultation	426	63.6
Telephone consultation	77	11.5
Correspondence	48	7.2
E-Mail Reference	175	26.1
Web form	273	40.7
Ask-A Librarian	265	39.6
Online Chat Reference	40	6.0
Others	15	2.1

The finding is similar to Johnson (2004) who found that the survey respondents reported prior use of face-to-face reference and a desire to use this service first when pursuing research topics.

Table 4: Frequency of Use

	Frequency	Percentage
Always	33	4.9
Frequently	93	13.9
Sometimes	185	27.6
Rarely	211	31.5
Never	117	17.5

Referring to Table 4, 33 (4.9%) of the respondents always used DRS, 93 (13.9%) frequently, 185 (27.6%) sometimes, 211 (31.5%) of the respondents used DRS rarely and 117 (17.5%) never used DRS last semester.

Table 5: Time of Use

	Frequency	Percentage
12.00 am – 6.00 am	48	7.2
6.00 am – 12.00 noon	53	7.9
12.00 – 6.00 pm	157	23.4
6.00 pm – 12.00 mn	80	11.9
Not sure	286	42.7

Table 5 shows that 48 (7.2%) of the respondents used the service from 12.00 am to 6.00 am, 53 (7.9%) used the service from 6.00 am to 12.00 noon, 157 (23.4%) from 12.00 to 6.00 pm, 80 (11.9%) from 6.00 pm to 12.00 midnight and 286 (42.7%) were not sure of the time they used DRS.

Table 6: Do Not Use the Service

	Frequency	Percentage
Do not need for it	118	17.6
Not Interested	119	17.7
Don't Know How to Use	118	17.6
Complicated	102	15.2
Others	25	3.6

For the respondents who did not use the services, as shown in Table 6, the reasons were 118 (17.6%) do not need for it, 119 (17.7%) not interested, 118 (17.6%) do not know how to use, 102 (15.2%) complicated and 25 (3.6%) others.

Effectiveness of E-mail Reference Services in academic libraries in Malaysia.

In this study, the three factors used to measure the effectiveness of DRS are: users' perception, users' satisfaction and library's performance.

Users' Perception

In this section, respondents were asked to rate the quality of service/information they acquire from DRS. The study found that 338 (50.4%) of the respondents regard the service as somewhat high quality, 216 (32.2%) high quality and 31 (4.6%) as very high quality. It is also found that 19 (2.8%) of the respondents regard the service as poor quality and 3 (0.4%) as very poor quality.

Table 7: Quality of Service

	Frequency	Percentage
Very High quality	31	4.6
High quality	216	32.2
Somewhat High Quality	338	50.4
Poor quality	19	2.8
Very poor	3	0.4

Respondents were also asked to rate the usability of DRS. The study found that 312 (46.6%) respondents regard the usability as somewhat easy, 214 (31.9%) as easy, 44 (6.6%) as difficult, 35 (5.2%) as very easy and 4 (0.6%) as very difficult.

Table 8: Usability

	Frequency	Percentage
Very Easy	35	5.2
Easy	214	31.9
Somewhat easy	312	46.6
Difficult	44	6.6
Very Difficult	4	0.6

In terms of typical access time, majority of the respondents 339 (50.6%) rated it as somewhat fast, 145 (21.6%) as fast and 25 (3.7%) as very fast. 96 (14.3%) of the respondents rated it as slow and 3 (0.4%) as very slow.

Table 9: Typical Access Time

	Frequency	Percentage
Very Fast	25	3.7
Fast	145	21.6
Somewhat Fast	339	50.6
Slow	96	14.3
Very Slow	3	0.4

Users' Satisfaction

In order to investigate how satisfied the users were with DRS the survey asked the respondents to indicate their level of satisfaction. From the table 10, it can be seen that overall respondents were very satisfied, satisfied or somewhat satisfied with the DRS provided by the libraries.

Table 10: User Satisfaction of DRS

	Very Satisfied	**Satisfied**	**Somewhat Satisfied**	**Unsatisfied**	**Very Unsatisfied**
Access to Information	34 (5.1%)	221(33%)	206 (30.7%)	27 (4.0%)	4 (0.6%)
Availability of Resources	34 (5.1%)	210 (31.3%)	204 (30.4%)	37 (5.5%)	4 (0.6%)
Accuracy	32 (4.8%)	201 (30%)	204 (30.4%)	23 (3.4%)	3 (0.4%)
Current Information	45 (6.7%)	217 (32.4%)	226 (33.7%)	23 (3.4%)	2 (0.3%)
Response Time	24 (3.6%)	185 (27.6%)	196 (29.3%)	52 (7.8%)	5 (0.7%)
Answer Given	25 (3.7%)	194 (29%)	218 (32.5%)	41 (6.1%)	5 (0.7%)
Efficiency of library staff	27 (4%)	218 (32.5%)	217 (32.4%)	23 (3.4%)	4 (0.6%)
Knowledge of library staff	30 (4.5%)	222 (33.1%)	202 (30.1%)	23 (3.4%)	1 (1%)
Courtesy of library staff	21 (3.1%)	194 (29.0%)	202 (30.1%)	29 (4.3%)	1 (0.1%)
Cooperation of library staff	27 (4%)	221 (33%)	228 (34%) 190 (28.4%)	39 (5.8%)	5 (0.7)

Library's Performance

The study found that most of the respondents also agree that the libraries have provided sufficient access to electronic resources, information literacy skills' programs and guidance and training on how to use DRS.

Table 11: Library's Performance

	Strongly Agree	Agree	Somewhat Agree	Disagree	Strongly Disagree
Library provide sufficient access to electronic resources	43 (6.4%)	348 (51.9)	192 (28.7%)	29 (4.3%)	5 (0.7%)
Librarians offer sufficient information literacy skills	35 (5.2%)	240 (35.8)	274 (40.9%)	61 (9.1%)	6 (0.9%)
Library provide sufficient guidance and training	34 (5.1%)	229 (34.2)	250 (37.3%)	90 (13.4%)	9 (1.3%)

Perceived Needs of E-mail Reference among university students in Malaysia

In this section, respondents were asked on the options of assistance that they would most likely choose. Table 12 shows that majority of the respondents would like to choose face-to-face consultation 422 (62.9%). It was followed by E-Mail Reference 186 (27.8%), online chat reference 81 (12.1%), telephone consultation 61 (9.1%) and others 27 (4.0%).

Table 12: Options for Assistance

	Frequency	Percentage
Face-to-face Consultation	422	62.9
Telephone Consultation	61	9.1
E-Mail Reference	186	27.8
Online Chat Reference	81	12.1
Others	27	4.0

Respondents were asked to predict the most heavily used of reference services in the next five years. The study found that 285 (42.5) of the respondents choose online chat reference, 263 (39.3%) respondents choose video conferencing and 257 (38.4%) choose E-Mail reference. It was followed by face-to-face consultation 163 (24.3%), telephone consultation 95 (14.2%) and others 39 (5.8%).

Table 13: Most Heavily Used in Five Years

	Frequency	Percentage
Face-to-face	163	24.3
Consultation	95	14.2
Telephone	257	38.4
Consultation	285	42.5
E-Mail Reference	263	39.3
Online Chat Reference	39	5.8
Video Conferencing		
Others		

The respondents were also asked to give their perception to describe the future. The study found that 484 (72.2%) of the respondents thought that as technology makes more information accessible, people will need less human help in doing research. 125 (18.7%) thought that as technology makes more information accessible, people will need more human help in doing research. 29 (4.3%) thought no human help at all. The finding is similar to Johnson (2004) who noted that respondents forecast DRS would be the most heavily used in 10 years.

Table 14: Best Describe the Future

Statements	Frequency	Percentage
As technology makes more information accessible, people will need less human help in doing research	484	72.2
As technology makes more information accessible, people will need more human help in doing research	125	18.7
No human help at all	29	4.3

IMPLICATIONS

It is hoped that the findings of the study can be a useful guide for the Ministry of Higher Education and university administrators to draw up policies for provision of academic library services in the country. For the university administrators, especially the Chief Librarians who involved in planning and implementing online services in academic libraries in Malaysia, this research provides insights into a range of digital reference services' format that can assist students' awareness, learning and motivation. Leadership is the key factor to improvement and effectiveness in the institutions of higher learning. Chief Librarians play a crucial role in establishing new systems and policies as well as a positive and healthy work environment for better organizational performance.

This research also provides academic librarians (particularly those working in the Reference Division/unit) with snapshots of the effective digital reference services' formats that can be used by students and at the same time can increase students' knowledge, awareness and motivation. The process of solving problems would be time consuming if done manually but with the advancement of ICT had allowed the libraries and other organizations to get things done faster. Although it will burden the library, it will definitely help improve their service and encourage them to work harder. The study findings also show that professional reference librarians were still needed to handle complicated searches and to help users deal with information overload.

For the students/users, they should work hard to move forward in the ICT era. With the development of information and communication technology, people could find out the answers or what is happening on all parts of the world in just seconds. If the students want to keep up with the pace of the world, they must shift from doing things manually to using the computer technology. Students can ask questions by visiting the websites of their own library or the library elsewhere.

The present services for example E-Mail reference, Web forms and Ask-A Librarian have to be more effective and efficient. Based on students' comments, the DRS offered need to be improved in terms of systems instability, answers given need to be fast (faster answer), accurate and complete and user friendly services. The students also need more sophisticated DRS /synchronous DRS (real time) online chat reference and web cam services. They also suggest for working culture change in the library.

The findings of the study revealed that in spite access to DRS, most students still prefer to use face-to-face formats. One possible reason for this might be due to the lack of knowledge about their availability and/or unfamiliarity with their capabilities and proper use. Users should be exposed to the benefits and effectiveness of DRS in getting current and up-to-date information. In fact, user education program may also be useful in this regard. Such user education program may help library users learn the effective use of DRS.

It was also noted that a considerable number of respondents raised the issue of promoting the service to the user, providing training programs and giving more help guidance to users which are related to the above issue. The training of the end users in the use of DRS and online resources should be one of the central activities in academic libraries so that students and other users can effectively search and utilized these resources.

The findings can also be used as inputs on how far ICT can be used in teaching and learning. DRS hold great promise in enhancing learning as well as improving the quality of education. There are a number of learning characteristics that can be identified in DRS in enhancing learning especially in the institution of higher learning such as active learning promotion, interactivity and can increase motivation.

FUTURE RESEARCH

The results of the study suggest a more detailed coverage of DRS in academic libraries which will include other public universities, teacher training institution libraries, private universities

and colleges in Malaysia. Further research also should include students from other faculties such as from social sciences and humanities, science and technology faculties. Lecturers as well as general staff can also be involved.

RECOMMENDATIONS

Below are some recommendations for further improvement of DRS in academic libraries in Malaysia:

1. Adequate training should be conducted in public academic libraries in Malaysia to make staff feel confident of using the new technology as well as to persuade positive attitude and enthusiasm towards the use of DRS. They also need to be trained on interview techniques, communications' skills, organization of information as well as other aspects of knowledge so that they will provide standard answers/information to the users and this will increase the quality of service.
2. The main responsibilities of the academic library managers is to promote and encourage the use of all library services including DRS. The introduction of DRS requires users to be informed of their existence by means of well coordinated promotional programs.
3. The academic libraries that have introduced access to DRS should make an effort to educate users on how to use it. There is also a need to educate the users on asking serious reference questions, instead of simple frivolous enquiries that can be done by themselves with knowledge of library use.
4. The academic libraries in Malaysia should also use the latest formats of digital reference services such as online chat reference, video conferencing and collaborative DRS.
5. The academic libraries in Malaysia should stabilize the system and infrastructure of the services. The academic libraries need to increase their own IT staff that would solve any technical problem.
6. Academic libraries in Malaysia should co-operate each other in offering the digital reference services. Collaborative DRS provide many benefits, such allowing individual institutions to share expertise and resources, expanding hours of service and providing access to a larger collection of knowledge resulting from digital reference services (e.g., question-answer archives).

CONCLUSION

This study has identified the effectiveness of e-mail reference services in academic libraries in Malaysia. It provides data on the extent to which format of e-mail reference has contributed to reference services in online environment. The study also has revealed several important profiles, practices of librarians and students from information studies, computer science and information technology background with regard to DRS in academic libraries. It contributes to the understanding of the awareness, uses, satisfaction and perceived needs of DRS in academic libraries in Malaysia. The effective use of DRS in academic libraries helps to increase motivation and a lifelong love of learning. It is hoped that this study will contribute positively towards the development of online services in academic libraries in Malaysia. The study is also hoped to encourage future research in the area of reference services by both researchers and librarians.

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HUMAN CAPITAL SCENARIO ANALYSIS FOR PERFORMANCE ANALYSIS AND MANAGEMENT

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ABSTRACT

Purpose – Article describes human capital scenario analysis that is used at performance development and human related risks identification. Organization is complex system including human intangible assets. Scenario analysis is needed for understanding organization as a system.

Design/methodology/approach – Human capital scenario analysis is part of M. Kesti Doctoral thesis study and is using system dynamics methodology. Organization intangible assets are included as competences which are identified as management, leadership, culture, skills and processes. Competences can be measured by tacit signals. Scenario analysis equations are developed at empirically grounded research that has been done at several years period.

Findings – Scenario-tool connects human competencies and other HR-metrics to business scenario forecast. Through interaction with the scenario-tool the managers can improve their mental models and learn about the organization behavior in long term perspective. Human resources and competences can be analyzed so that the factors affecting to the performance comes in attention at management decision making.
Research limitations/implications – Scenario analysis principles are developed during steady economical growth period in Finland. Equations are tested and improved at global depression where many steady growing companies were downsizing business to changed market. Analysis mental models and equations are created using literature and empirically grounded research at several business organizations and is applicable at companies where revenue is created through human resources.

Originality/value – Article describes how human resource metrics and competences affect to business scorecards. Competences development improves the performance which is visualized at business results. Competences can be measured and developed using tacit signals so the managers have possibility to affect the positive scenario realization.
Keywords – tacit signal, competence, human capital, employee performance, scenario analysis.

INTRODUCTION

Human capital productivity has been calculated with metrics like revenue, sales margin, staff expenses, transfer, absence, revenue/person e. g. (Kesti 2007). One of the best human productivity indicators is HCROI (Human Capital Return On Investment), which is sales margin divided by staff costs. Following these metrics is essential but there should also be understanding on how these scorecards can be affected and how they affect to business. Jack Welch (2005) point out that human capital metrics should be as important for management decision making as financial data. If human related metrics could be linked to business scorecards they will be more considered when deciding investments on human resources. Investments in human capital are shown to be profitable and important in preventing business risks. (Kesti et al. 2009, Kesti & Syväjärvi 2008, TYKES 2009).

Tacit signal based organization development research has raised the possibility to estimate human capital risks and business possibilities in advance (Kesti et al. 2009). This scenario-analysis includes human related metrics like absence and transfer but also organization competences as intangible assets. This research study will present Human capital scenario-analysis (HC-scenario) where mathematical link is created between HR-metrics and business scorecards. Scenario helps in planning human capital development investments and avoiding human related risks like workforce ageing or staff transfer. This way management gets more strategic view to organization human capital development.

Scenario analysis is used for analyzing possible alternative future outcomes. Using scenario analysis at business possibilities and risks forecasting support management in their decision making so that desired outcome can be achieved. Shell has used scenario planning for helping managers constructing new mental models for alternative future trends (Senge, 2006). Managers should observe possible crises assuming worst possible scenario can happen and take responsibility on preventing the crisis or recovering from it the best possible way (see Welsh 2005).

Human resource scenario planning consist the intelligence how human capabilities affect to business. This has been difficult to analyze because the pluralistic nature of human resources. For understanding human working capabilities and limitations it is essential to know in-depth the complex factors of the overall work system (Kleiner, 2006). Managers should be able to generate knowhow of the organization as a system to see the actions implications in longer term. Generative learning is not gained if only event thinking is driving the decision making (Senge 2006).

HUMAN CAPITAL SCENARIO ANALYSIS THEORETICAL BACKGROUND

It is strategically wise to improve human capabilities in advance. Underestimating human behavioral psychology is shown to be pad for the business (Goleman 2002). Stress and mental workload has great effect on productivity and therefore it is important for management point of view (Putkonen, 2009). In Everaert and Bruggeman (2002) case study the high time pressure with cost targets lead to a longer project time without a desired cost advantage. It seems that mental workload can be kept at a manageable level by predicting or avoiding possible unfavorable work situations (Young and Santon, 2001).

System dynamics is a method for modeling complex systems by using computer aided simulation. During the mid-1950s Jay Forrester was able to show with his simulation calculations that instability in General Electric employment was due to the internal structure of the firm and not due to external forces as business cycle (Forrester, 1961). His system dynamics used stock-flow-feedback structure of GE plants with equations describing corporate decision-making system for hiring and layoffs. Personnel performance has been modeled using system dynamics approach which consider workload and exhaustion (Rodrigues et al., 2006; Lyneis et al., 2001; Sterman, 2000).

Human Capital Scenario Analysis aim is to describe complex organization system contributing business results using system dynamics methodology. It links organization human resource (HR) metrics, competences and organization competence development to the business scorecards. Organization competences are guiding the human resources utilization efficiency as known performance drivers. These competences are management, leadership, culture, skills and processes (Kesti & Syväjärvi, 2009).

Organization competences can be measured and improved by tacit signal based development process. Scenario analysis principles are developed at large Finnish company with 19 business units during steady economical growth period in Finland (years 2005 – 2008). Later on the equations are tested and improved at global depression where many steady growing companies were downsizing business to changed market.

System dynamics validation has two main viewpoints: structure and behavior validation (Barlas et al., 2000). Structure validation means that the model includes necessary factors that consist also in the real world system. Human Capital Scenario Analysis hypothesis are developed during several years with multiple empirically grounded field tests, corrections and adjustments of the equations. Boundary tests have been done using existing field data and increasing or reducing chosen variables and finding out that outcome is predictable and derivative. Sensitivity tests have been carried out by statistical average business data of some different branch of business. According Sterman (2000) the simulation model can be gradually evaluated with expertise and available field data. This is necessary since the expertise and field data increase requires time to evolve (Sterman, 2000).

HUMAN CAPITAL SCENARIO ANALYSIS

The basis of the scenario analysis is that there has to be causal relationship between human resources and business results. Analysis main calculation principles should meet the three cause-effect rules which are (Cascio and Boudreau, 2008):

- effect does not happen until after the cause
- cause and effect is actually shown to be related
- cause-effect has no rival plausible rival hypothesis

Human Capital Scenario Analysis has following three meta-principles that in most companies meet the cause-effect requirements:

- Revenue comes from staff activities (effective working time)
- Staff cause direct costs (pay and benefits)
- Staff activities cause indirect costs (quality costs)

In addition to these meta-principles the analysis utilizes a number of simultaneously affecting sub-hypothesis:

- Organization performance continuous development will
- reduce employee absence and transfer
- increase competences
- bring quality cost savings (reduce quality costs)
- Transfer will increase work orientation time which decrease effective working time.
- Absence will decrease effective working time.
- Competence improvement will increase effective working time.
- Competence are improved by systematic own development and training.
- Reducing the number of employees will increase competence development needs.
- Increasing the number of employees will increase competence development needs.
- Increasing effective working time will increase the revenue.
- Business branch depression will decrease the capacity utilization.

Before actual scenario estimations the analysis tool adequate reliability can be checked using realized scorecards. Some of the calculation variables may be estimated if the exact value is not available. In the estimation there can be used the business branch statistics or some suitable research studies. If competences are not measured it is also possible to estimate them roughly by using three years realized business and HR scorecards.
Finnish ministry of trade and industry launched research indicate that known quality costs are approximately 6 % from revenue and the main cause for these quality costs are human error and waste labor (Andersson at al. 2004). By continuous organization competence improvement the quality costs can be reduced significantly. Beside the quality cost the reduced absence and transfer will also bring cost savings. Studies show also that high competence working society will orientate new worker much faster and this way profitable growth is possible (Kesti et al. 2009).

Competencies and effective development

Organization intangible performance drivers can be identified as competences which are management, leadership, operating culture, skills and processes (Kesti & Syväjärvi 2009). Competences include critical attributes which are essential for productivity and growth. These work quality and engagement improving competence attributes can be listed and they seem to be quite similar for different type of organizations (Kesti 2005, 2007; Bakker & Demerouti 2007; Hackman & Oldham 1980). Competences can be measured from each organization group using tacit signal method (Kesti et al. 2008). Measured competences are linked to the scorecards like 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). In system dynamics point of view the competences determine the human resource capacity utilization as flow parameter like valve controlling the flow between two tanks.
Competence development is done with systematic process that will lead to the most optimal improvement actions at each working unit (Kesti & Syväjärvi, 2009). When each group starts optimal improvement there seems to be positive cumulative effect to the organization productivity (Kesti and Syväjärvi, 2009; Welch and Welch, 2005).

Empirically grounded studies at several private and municipal organizations indicate that tacit signal development process where each group collectively agree optimal improvement action requires approximately 0.25 % yearly working time from each group member (Kesti and Syväjärvi, 2009; Kesti, Syväjärvi and Stenvall, 2009). This means for example at 8 person team that one week working hours are needed to find out, agree and implement the chosen improvement action. In scenario analysis the effective development correspond to this phenomen in average.

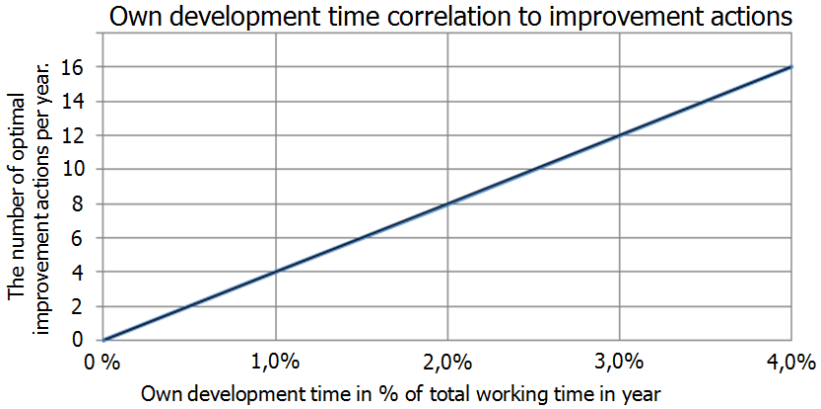

Figure 1. Effective own development time correlation to improvement actions at each team.

This means that succeeding to implement 4 optimal improvement actions throughout the organization, will need 2.5 days or 18 to 20 hours invested to systematic development for each group and its member. The systematic development process can be seem as one accomplished improvement action since agreeing the optimal development seems itself improve the group performance (Kesti & Syväjärvi 2009).

Effective systematic work practices development means that 1 % invested in own development contributes 4 optimal improvement actions at each working community in year. These actions are best value practices for the group. Contingency theory implies that there is no absolute best solution or design but rather multitude of possibilities where we can choose the most valuable choice that is contingent on the situation being analyzed. (Hunt 1992). If group use 4 % (10 days) to development but achieves only 4 improvements in practice, the effective own development is 1 % at scenario analysis. Development can include improvements at different areas of importance like working practices, co-operation, communication, skills and tools depending on the groups needs.

Empirically grounded studies indicate that working group structural changes affect to the competencies and increase their development needs. Therefore the changes at group size tend to reduce the competencies (Kesti & Syväjärvi, 2009). At the scenario analysis the group size increase and decrease reduces the competence at the same rate. Both changes need some rearrangement of the work practices and organizing which cause the development needs at the existing competences. In learning organization this phenomen create possibilities for learning and development. Each working community reflects the competencies towards the existing needs and challenges. The more they feel development needs the smaller the percentual competence level is.

Next figure illustrates how 70 % level competence development can be simulated. If for example group size decreases 7 % then investing 1 % (2.5 days) to own development will increase the competence to 78 % (8 % increase). If new staff is more than the decrease of group the new staff percentage is used for it gives the lowest absolute value as decisive factor. In the scenario analysis it is recommended that no higher competence values than 95 % is used for in practice the higher values have been very unusual.

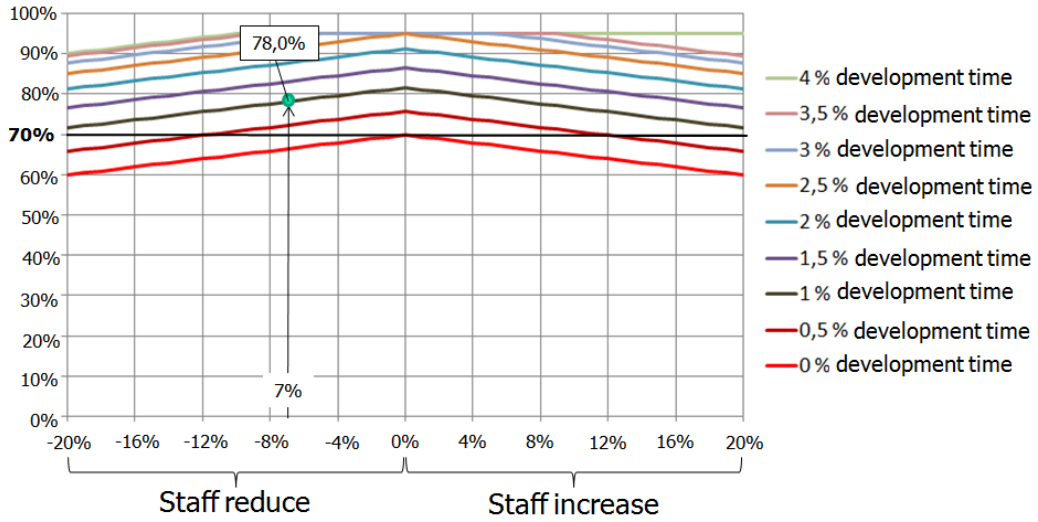

Figure 2. Competence (70%) change when combining the development and group changes.

Effective own development affect to competences is according sine curve and staff increase and reduce affect linear. When these two phenomen are simultaneous the result can be shown by set of curves.

In Human Capital Scenario analysis the performance increase or decrease can be analyzed proactively so that the causal connections to human capital and competences development can be seen. Management competence is important for organization strategy and sustainable development. Leadership and culture competences include attributes that are essential for group emotional intelligence (see Goleman 2002). Process competence attributes are chosen so that they corresponds the group working tasks and procedures for example production or sales. Processes are also seen as social competence because process development should be collective. Skills are more personal related and therefore skills development is estimated according effective training time consumed. In scenario-analysis the competences are estimated for each competence area separately.

Introduction of performance indicators HCROI, HCROI(2) and OSVA

Human capital productivity ratio HCROI (Human Capital Return On Investment) tells how staff investment creates sales margin (Fitz-Enz 2000). HCROI is calculated by dividing sales margin (€) by staff costs (pay and benefits, €).

$$\text{HCROI} = \frac{\text{Revenue} - (\text{Materials and supplies} + \text{Outsourcing costs})}{\text{Staff costs}}$$

Sales margin is revenue reduced by organization variable costs (materials, supplies and outsourcing costs). Therefore sales margin includes part of the quality costs (material waste ect.). HCROI is good employee profitability index. Sales Margin level is determined at initial data, which is then used at basis for calculating the performance development.
In the HCROI equation the staff costs are denominator so the staff increase will drop the ratio until staff increase investment starts to pay back which should happen soon after new persons are fully trained and oriented to the organization. To see that HCROI has this investment related phenomen we have created additional HCROI which includes the affect of staff increase investment.

$$\text{HCROI(2)} = \frac{\text{Revenue} - \text{Variable costs}}{\text{Staff costs}} * (1 + \text{Staff increase\%})$$

It should also be noticed that HCROI varies quite a lot between different business branches.
Outsourcing has become very popular way to reduce costs. Sometimes it has been argued whether the outsourcing has been valuable or not. We have created ratio for evaluating outsourcing return on investment. This ratio is called OSVA (OutSourcing Value Added) and it follows the same principle as HCROI and is calculated with following equation.

$$\text{OSVA} = \frac{\text{Revenue} - (\text{Materials and supplies} + \text{Staff costs})}{\text{Outsourcing costs}}$$

All there human capital and outsourcing return on investment ratios should be followed together.

Initial data for human capital scenario analysis

Initial data to the scenario comes from last annual account figures added with business prospect and certain human related estimations like new worker orientation time. For example if orientation time is decreased from 12 months to 10 months it should be justified. Initial data specifies the possibilities to improve performance and reduce the costs. For example if competences are low there are possibilities to improve the performance.

In the tool the red marked data is for realized data and after that the scenario-data is either calculated automatically or can be input manually. Scenario includes following initial data:
Organization size is average full time equivalent (FTE) personnel per year. It includes all wageworkers. Part time workers are included calculated by working time divided by total working hours (1850 h). For example if part time worker has done 140 h, her full time equivalent is 140/1850 = 0,076 FTE worker.
Revenue is from one year period.
Sales margin is revenue reduced by organization variable costs. Therefore sales margin includes part of the quality costs (material waste e.g.).
Employee costs include pays and benefits with additional labor costs.
Quality costs can be estimated for example using PAF quality cost division. Finnish ministry of trading and industry has studied that average known quality costs are 6 % from revenue. (Andersson et al., 2004) However there are major differences between business areas and

companies. In the analysis the value of 6 % from revenue is used at default value. Chosen value estimates the organization cost savings potential.

Generally quality costs can be divided to following areas (PAF):
a. The cost of preventive actions (prevention costs)
- Training, guiding, instructing, quality system, preventive maintenance, auditing, cleaning, alarm systems, maintaining order.
b. Appraisal costs)
- Checking, testing, measuring, quality control, piloting, sample taking and analyzing.
c. Internal failure costs)
- Waste, scrap, redoing, fixing, rechecking, defects finding, correction, repairing.
d. External failure costs
- Customer reclaims corrections, returned products, guarantee costs.

Orientation time means average period for new employee to become experienced. This means that after orientation time the new worker can achieve same effectiveness in work as experienced staff. Orientation time depends on business area competence requirements. Scenario analysis maximum orientation time is two years (24 months).

Labor cost increase are normally in accordance with general consumer prize costs.

Business area market change can be estimated for example by business statistics. When business area change is positive the organization can fully benefit the effective working time increase (capacity). When business market is in depression the organization effective capacity convert to revenue is downsized by the negative change.

Additional labor costs are taken from human resource account. Additional labor costs are needed for calculating average employee salary per hour. Salary is used when absence and employee transfer cost savings are estimated. Default value 21.5 % is taken from general statistic (StatFin 2007).

Increase of personnel has great affect to the business scorecards for it increases the orientation time and decreases competences. Organization size is a strategic figure which should be planned in several years ahead. Increasing personnel is investment which payback time is usually several years or at least the general orientation time. Therefore this investment return should be ensured as good as possible.

Average employee absence is calculated in percentage from total working time. Both short and long absence is included. For example if there has been 970 days absence in 100 persons organization, percentage is calculated following way:(970*7,5)/(100 * 1850) * 100 = 3,93 %.

Employee transfer means that for every person leaving there is taken one new employee so that FTE does not change.

Continuous improvement and training

Continuous performance development means organization own development which leads to improvement actions. In scenario planning the development has to be done effectively. This means that each 1 % time used at development there should be average 4 improvement actions implemented in each working community (team). Training increase skills and other competences are improved by continuous development. Personnel training are given in percentage of the total working time (1850 h per year in Finland). For example if each employee has average 40 hours training per year the percentage is 40/1850 *100 = 2.2 %.

Training affect to skills competence same way as continuous performance development affects to other competences.

Competences (management, leadership, culture, skills and process)

Continuous development improves organization intangible drivers of performance. Competences can be measured using tacit signal method and they affect to work time distribution and costs. Default competences 76.5 % comes from measured average competences from approximately 150 working groups from 20 different organizations covering around 2000 employees. To get more accurately scenario the competences should be measured ones a year.
Outsourcing is outside service costs in general. Value is used at calculating OSVA index. Outsourcing costs are part of variable costs.
Revenue change per year is essential feedback data. This change is calculated automatically based on the effective working time capacity correlation to revenue.

	1. year				
Organization size (FTE)	965	kpl			
Revenue	227 950 370	€			
Sales Margin	91 180 148	€			
Employee costs	34 411 900	€			
Estimated quality costs from revenue	6,0 %				
		2. year	3. year	4. year	5. year
New worker average work orientation time	8,0	8,0	8,0	8,0	8,0
Labour cost increase per year	1,0 %	0,0 %	2,0 %	3,0 %	3,0 %
Business area market change per year	0,0 %	2,5 %	3,0 %	3,0 %	3,0 %
Additional labour costs from total costs	21,5 %	21,5 %	21,5 %	21,5 %	21,5 %
Increase of personnel-%	0,0 %	5,0 %	3,0 %	4,0 %	5,0 %
Average personnel absence (%)	8,70 %	8,7 %	8,4 %	7,7 %	7,1 %
Personnel annual transfer (%)	5,00 %	5,0 %	4,8 %	4,4 %	4,1 %
Personnel training	0,5 %	0,5 %	0,7 %	1,0 %	1,0 %
Continuous performance development	0,5 %	0,5 %	0,7 %	1,0 %	1,0 %
Management competence	76,5 %	77,8 %	81,3 %	85,7 %	88,2 %
Leadership competence	76,5 %	77,8 %	81,3 %	85,7 %	88,2 %
Operating culture competence	76,5 %	77,8 %	81,3 %	85,7 %	88,2 %
Skills	76,5 %	77,8 %	81,3 %	85,7 %	88,2 %
Process competence	76,5 %	77,8 %	81,3 %	85,7 %	88,2 %
Outsourcing	18 669 135	19 560 415	21 180 184	23 203 262	25 242 877
Revenue change %		4,8 %	8,3 %	9,6 %	8,8 %

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Summary of initial data	1. year	2. year	3. year	4. year	5. year
Personnel (FTE)	965	1013	1044	1085	1140
Personnel transfer (pcs)	0,0	48,3	30,4	41,7	54,3
Number of new employees (pcs)	48,3	98,9	80,8	89,8	100,6
Number of terminated employment (pcs)	48,3	50,7	50,4	48,1	46,3
Absence days per employee (days)	21,5	21,5	20,7	19,0	17,4
Training time per employee (days)	1,2	1,2	1,7	2,5	2,5
Performance improvement per employee (days)	1,2	1,2	1,7	2,5	2,5
Revenue	227 950 370	238 832 904	258 610 301	283 312 107	308 215 842
Staff costs	34 411 900	36 132 495	37 960 799	40 504 045	43 585 976
Sales Margin	91 180 148	95 533 162	104 126 426	115 218 380	127 155 309

Figure 3. Scenario-tool initial data and scenario at example Company.

Cost savings achieved by continuous development

Organization continuous development brings along cost savings which comes from reduced absence transfer and quality costs.

At workforce absence the maximum reduce is 20 % which is possible by effective own development of 2 % from working time. This means at least eight improvement actions per each working community per year. This development must be collective and solution based. Minimum calculated absence is 3 % for it is not intention that employees are working sick. The absence cost savings calculation principle is so that absent persons effective working time has to be done by overtime work by other workers. Reduced absence decrease next year staff costs.

Employee transfer is depending on workforce commitment and many other things. Continuous development is estimated to reduce transfer. Maximum reduce is 25 % which is possible by at least 2 % effective development per year in each working community. In employee transfer the 3 % level is desired for maintain organization renewing. Each transferred person costs half a year average salary cost (Fiz-Enz, 2000). Transfer cost savings increase sales margin by reducing variable costs.
Quality costs can be decreased by effective continuous improvement and employee training. Continuous own development affects 80 % and training 20 % to the quality cost. One percent working time investment to training and own development will reduce quality costs for 10 %. This means that 2.5 days training per employee and four improvement actions per working community is needed for 10 % quality cost savings. Maximum savings is 20 % per year which needs 2 % training and development time investment. Quality costs decrease will increase the sales margin.

Improving competencies reduces quality costs, absence and transfer. Competence improvement by continuous development increases the performance with cost savings. To illustrate the phenomen the cost savings are divided to each competence. Management, leadership and operating culture competences development brings 30 % from absence and transfer cost savings and also 20 % from the quality cost savings. Skills and process competences development brings 20 % savings from quality costs. These cost savings calculation and distribution is of course rough and for visualizing how the saving are formed. In our own empirically grounded studies the leadership and culture competences seemed to have clear correlation to the business scorecards (Kesti et al. 2008).
Cost savings are divided to five competences so that management, leadership and culture will each affect one third of absence and transfer cost savings. Quality cost saving are divided even to all five competences.

	1. year	2. year	3. year	4. year	5. year
Organization size	965	1013	1044	1085	1140
Average absence	8,7 %	8,7 %	8,4 %	7,7 %	7,1 %
Employee transfer	5,0 %	5,0 %	4,8 %	4,4 %	4,1 %
Development affect in reducing quality costs	5,0 %	5,0 %	7,0 %	10,0 %	10,0 %
Revenue	227 950 370	2,39E+08	2,59E+08	2,83E+08	3,08E+08
	Estimated cost saving from continuous performance development				
Competence development	1. year	2. year	3. year	4. year	5. year
Management	136 770	136 461	261 484	448 427	447 691
Leadership	136 770	136 461	261 484	448 427	447 691
Operating culture	136 770	136 461	261 484	448 427	447 691
Skills	136 770	136 461	198 106	292 841	293 441
Processes	136 770	136 461	198 106	292 841	293 441
Estimated benefit per year	683 851	682 306	1 180 663	1 930 961	1 929 954
Kumulative benefit	683 851	1 366 157	2 546 821	4 477 782	6 407 736
Outsourcing costs	18 669 135	19 560 415	21 180 184	23 203 262	25 242 877
Own development work cost	172 060	180 662	265 726	406 636	439 777
Personnel costs	34 411 900	36 132 495	37 960 799	40 504 045	43 585 976
Sales Margin	91 180 148	95 533 162	104 126 426	115 218 380	127 155 309
HCROI	2,650	2,644	2,743	2,845	2,917
OSVA	4,041	4,072	4,124	4,189	4,234

Figure 4. Scenario-tool cost saving scenario.

In this cost saving calculation the revenue growth has important meaning since it increase especially the quality cost volume despite the percentual potential reduces.

New worker orientation

Organization work resources are increased in two ways:

- increase effective working time consumption
- increase organization size with new workers

Effective working time consumption is increased by improving the competences and this affects to the absolute working capacity directly without increasing the costs. Increasing organization employees affect to absolute capacity in delay, depending on the orientation time needed. At the beginning the new worker cost is usually more than generated new gross margin. During the orientation time the new worker consumes own time and trainers time on orientating to the work. Total orientation time needed is estimated using linear decline curve. It the orientation time is more than 12 months the exceeding part is transferred to second year (see figure). It the orientation time is less than 12 months the time consumption is ½*Pt, where Pt is the orientation time. After the orientation time the new worker is as effective as experienced average worker.

Working time distribution

Scenario-analysis estimates automatically the employee average working time distribution. Effective working time means time consumed to the work done in accordance with the organization mission, creating the organization revenue. This effective working time includes the necessary breaks which are part of normal effective working. First the time spend to absence, orientation, training, vacation and own development is summed. This sum is multiplied by average competence percentage which set the effective working time. The rest is other working time including waste labor time.

	1. year	2. year	3. year	4. year	5. year
Organization size (FTE)	965	1013	1044	1085	1140
Absence	8,7 %	8,7 %	8,4 %	7,7 %	7,1 %
Orientation	1,7 %	3,3 %	2,6 %	2,8 %	2,9 %
Training	0,5 %	0,5 %	0,7 %	1,0 %	1,0 %
Vacation	12,0 %	11,9 %	12,0 %	12,0 %	11,9 %
Own development time	0,5 %	0,5 %	0,7 %	1,0 %	1,0 %
Other working time (e.g. waste labour)	18,0 %	16,7 %	14,2 %	10,8 %	9,0 %
Effective working time	58,6 %	58,5 %	61,5 %	64,7 %	67,1 %
	100 %	100 %	100 %	100 %	100 %

Figure 5. Scenario-tool working time distribution scenario.

At initial data there is certain effective working time that contributes to the revenue. In accordance to this the change on effective working time changes also the revenue. Effective absolute working time generates certain revenue in linear connection determined at initial data. This way the revenue is influenced by all factors that change the absolute effective working time (FTE, transfer, absence, vacancies, orientation and competences).

BUSINESS RESULTS

In business results the necessary scorecards are collected for five years scenario period. Basic initial data is for organization that is in steady growing market and is improving performance through continuous development and training. This case organization is also investing to personnel increase which is visible in HCROI(2) index.

	1. year	2. year	3. year	4. year	5. year
Organization size (TFE)	965	1013	1044	1085	1140
Revenue	227 950 370	238 832 904	258 610 301	283 312 107	308 215 842
Employee costs	34 411 900	36 132 495	37 960 799	40 504 045	43 585 976
Sales Margin	91 180 148	95 533 162	104 126 426	115 218 380	127 155 309
Sales Margin %	40,00 %	40,00 %	40,26 %	40,67 %	41,26 %
HCROI	**2,65**	**2,64**	**2,74**	**2,84**	**2,92**
HCROI(2)	**2,65**	**2,78**	**2,83**	**2,96**	**3,06**
OSVA	**4,04**	**4,07**	**4,12**	**4,19**	**4,23**
Organization development cost savings	**683 851**	**682 306**	**1 180 663**	**1 930 961**	**1 929 954**
Outsourcing costs	18 669 135	19 560 415	21 180 184	23 203 262	25 242 877
Own development work cost	209 052	219 505	322 857	494 063	534 329
Change in organization size	0 %	5 %	3 %	4 %	5 %
HCROI change	0 %	0 %	4 %	4 %	3 %
OSVA change	0 %	1 %	1 %	2 %	1 %
Sales Margin change	0 %	5 %	9 %	11 %	10 %
Revenue change	0 %	5 %	8 %	10 %	9 %
Growth profitability (Revenue*HCROI, index 1)	1	1,05	1,17	1,33	1,49

Figure 6. Scenario-tool business results scenario.

Strategic human capital risk factors like transfer and absence should not let rise too much because it complicates or even totally prevent organization development. By continuous competence development these risks can be prevented and same time the organization capacity and productivity will be increased.

Scenario-analysis has shown to be realistic and based mostly on actual measured scorecards. Some factors like orientation time and quality costs are not so easy to determine. Those factors are however important to estimate for initial data so that their meaning can be included. Those values are chosen values for as initial data and the changes must be justified

by actions. For example if orientation time is decreased from 12 months to 10 months it should be justified.

CONCLUSION

Article describes the principles of human capital scenario analysis that has been construed to a scenario-tool. This tool is so-called beta version which is under tests and improvements. However it is already shown to be useful for management decision making so that human resource issues could rise as important as financial calculations. Tool represents human resource business intelligence (HR-BI). We believe these kinds of tools are the part of new generation human resource management. It connects human competencies and other HR-metrics to business forecast and survey which helps managers preventing human related risks and utilizing better the possibilities. Improving the business via employee performance development needs management commitment and mental attitude, because the human resources have to be developed in longer term to get sustainable results. This mental attitude can be achieves when human capital can be analyzed so that the factors affecting to the performance comes in attention and can be improved by right investments on human resources.

Management should be able to balance productivity, profitability and fairness by utilizing the resources as good as possible (Naylor 2004). Through interaction with the scenario-tool the decision makers can improve their mental models and learn about the organization behavior as a system in longer-term. For example the business meaning of ageing can be analyzed by increasing the retention and absence which are expected due to workers age distribution. Managers understand better the nature of the organization, which helps in deciding the investments on employee performance development more sustainable perspective. Results are promising; however there are plenty of issues that need more practical research studies and verification. Evaluating the organization system and finding mental models for describing the phenomen has been valuable process in itself.

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Managing Intellectual Capital and R&D Knowledge in the Successful Research Units in Thailand

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ABSTRACT

Knowledge and Intellectual Capital (IC) are recommended as the most important assets of innovative organization. Research units in the public university are the main organizations to conduct research for creating new knowledge and innovation in the developing countries. As such, knowledge management (KM) and intellectual capital management (ICM) are likely to play significant roles in enhancing research performance.

This paper presents the findings on integration between knowledge management and intellectual capital management for enhancing the research performance, achieving research goals and creating intellectual properties at three successful science-based research units of public universities in Thailand. Initial findings indicate that IC and knowledge can create a high potential strategy for managing science based R&D processes. IC has a direct and substantial impact on managing knowledge in the R&D processes. KM can improve the quality of intellectual capital. A strong impact of human capital and relational capital can improve the potential of KM practices which help organization to achieve research goals. Human capital supports knowledge creation, relational capital and organizational capital support knowledge acquisition, knowledge transfer/sharing and research collaborations.

These three successful R&D units have extended their research potential to create new R&D knowledge by the integration of human capital and relational capital through in-house research development and a strong interaction with external research partners.

Keyword: Intellectual Capital, Knowledge Management, Innovation, Science-Based R&D

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INTRODUCTION

The knowledge management (KM) and intellectual capital management (ICM) are the rising topics being of interest of organizations that derive their competitive advantage. Knowledge becomes not only an important factor but also the main asset of organizations. Knowledge is described as the main source and potential element of creating both innovation and sustainable competitive advantage [Johannessen et al, 1999]. Knowledge is more than information. It is considered as the most important source of innovation that represents the organization's future potential.

Intellectual capital (IC) is simply the collection of intangible resources [Bontis, Dragonetti, Jacobsen, and Roos, 1999]. Many academic researchers and practitioners propose different models and elements to classify intellectual capital**.** Indeed, IC is generally composed of two main sets of intellectual assets: human capital and structural capital [Edvinsson and Sulivan, 1996; Bontis et al, 1999]. Human capital is the collection of intangible resources that are embedded in the members of organization [Edvinsson and Sulivan, 1996; Bontis et al, 1999]. Employee competence, one of elements in human capital, is regarded as the capability to act in a wide variety to create both tangible and intangible assets [Sveiby, 1997]. Structural capital is the infrastructure that organizations develop to commercialize their human capital [Edvinsson and Sulivan, 1996]. Structural capital can be divided into relational capital, organizational capital, and renewal and development [Bontis et al, 1999]. Relational capital represents the relationships between internal and external actors [Roos, 1998]. The organizational capital is referred as knowledge that stays within an organization [Roos, Roos, and Edvinsson, 1997]. In this study, IC is composed of human capital, organizational capital and relational capital. Therefore, intellectual capital management (ICM) requires the capability to manage intellectual capital and transform it into research results such as new products, patents, publications, and innovations.

Successful research units often face a big challenge to sustain their competitive advantages when they lose knowledge workers. In order to build up and sustain competitive advantage, the knowledge and expertise of an organization's staff (human capital) is a critical resource and needs to be preserved as the organizations intellectual capital. Accordingly, the research units should benefit tremendously from the implementation of the KM and ICM for building up their knowledge and intellectual capital that helps them to achieve their research goals that lead to innovations and intellectual properties.

KM AND ICM IN THE R&D PROCESSES

Coombs and Hull [1998] define knowledge management practices (KMP) as specific routines that shape the knowledge base of the firm and make it accessible in the innovation process. Knowledge sharing allows organizations to access the basic knowledge inputs and to transform those inputs into new knowledge. Johannessen et al. [1999] state that organization has to manage the processes to create new

knowledge, especially tacit knowledge for creating innovations. The integration of employees' knowledge is a fundamental enabler for innovation [Tang, 1998].

Innovation is expected as one of needed R&D results from research processes. It is perceived as a competitive strength needed for successful organizations. Tang [1998] argues that the core process of innovation is enabled by knowledge, skills, and motivation. Braganza, Edwards, and Lambert [1999] suggest that KM contributes to an organization's ability to innovate, and ultimately to be competitive. Numprasertchai and Igel [2005] suggested that knowledge management supported the management of research and innovation through creating, transferring and integrating new knowledge with the existing knowledge in order to enhance research capability and achieve innovation. The use of KM leading to innovation is found critical for increasing new products and service development within the organization [McAdam, 2000]. Concisely, KM is an important catalyst in the R&D process for managing innovation success.

Managing knowledge for innovation in the science-based research have grown to touch so many different disciplines that it is almost impossible for a specific R&D unit to keep up to date in every field of such complex research. Knowledge integration is most effective when it draws on diverse sources of knowledge, through organizational partnerships with government agencies, universities, and industries [Wen and Kobayashi, 2001]. Thus research unit needs a good relationship (relational capital) with research partners and stakeholders for acquiring and integrating research knowledge to fulfill research gap from external sources. However, none of the previous studies described above is satisfactory in depicting the relationship between ICM and KM in the R&D process.

SCIENCE-BASED R&D UNITS IN THAI PUBLIC UNIVERSITIES

One of the primary mandates of Thai public universities is to conduct research, discover new knowledge, make a contribution to the society. However, academic researchers are also burdened with other mandates, namely teaching, community service and administrative duties, all of which drain time away from the research activities. As a result, most academic research units have adopted some systematic approach to manage R&D processes. For example, many leading research units of public universities in Thailand have implemented their own KM strategies to enhance their research capability and reach research goals [Numprasertchai, Kanchanasanpetch and Numprasertchai, 2009].

Although the National Innovation System (NIS) of Thailand has been found less developed than the ones of more successful and innovative countries [Intarakumnerd, Chairatana, and Tangchitpiboon, 2002], some research units in the leading Thai universities have done excellent research especially, in the fields of agriculture and biotechnology. A central research funding organization called the "National Research Council of Thailand (NRCT)" was established to support high potential researchers to conduct quality research projects. Science-based research projects are usually considered as high impact research area on social issues and the economic

development and given priority in the selection process. Through this funding, a lot of research units in the universities have improved their research potential and increased the quality of projects to compete with research conducted by other leading units worldwide.

The R&D processes of academic research units differ in some aspects from innovation in industry. Unique tasks added to the management process are the submission of research proposal to the president of university for approval, while other process elements are frequently omitted, namely market research before conducting projects and the commercialization of research results**.** Most academic R&D units manage the innovation process until they achieve product prototype while a few R&D units continue involvement until final products, services, or processes are launched to the market.

RESEARCH METHODOLOGY

A Case study with a qualitative approach was used to gain in-depth insights into the managerial practices of managing intellectual capital and knowledge within the R&D process [Rowley, 2002]. The reason for this approach is that there is an unclear boundary between phenomenon and context. Information was obtained by conducting in-depth interviews with research stakeholders. The KM and ICM of these research units relate to their research routines for developing research outputs.

In this research, three successful science-based research units were selected as case studies for exploring the management of IC and knowledge in the R&D processes. These science-based researches are very important to Thailand and other developing countries, in which a major part of economic growth and quality of life depend on this research area. These three units were selected based on their excellent research outputs in terms of publications, patents and new products from their research. In addition, research members of these three units have been awarded by the National Research Consortium (NRC) as excellent researchers. This award is indeed granted yearly to only few outstanding researchers. However, due to the requests from these three research units to keep confidential some of the information provided to us, we refer these three research units as research unit A, B, and C.

In these three research units, ICM and KM practices in the R&D processes were obtained from interviews with the research team over a period of two years. During each round, detailed semi-structured interviews were conducted with the research heads, researchers, and their students. In addition, research and project data of these units were collected from several sources such as scientific journals, research proceedings, annual reports, research news, announcements from research funding organizations and universities.

ICM AND KM IN THE R&D PROCESS MANAGEMENT

These three research units have their own ICM and KM practices in academic research units for managing knowledge throughout the entire innovation process from

idea generation until the practical products are launched in the market [Igel and Numprasertchai, 2004]. Most previous research outputs in these three units have been produced as incremental and radical innovations. All research units have emphasized researcher selection process and improvement of research capability for creating new knowledge and building all types of intellectual capital.

Team building

All research units give a high priority on selecting researchers for their team. They have selected highly skilled research personnel and research partner to increase the quality of their human capital. All researchers were selected through intensive interviews. This allows them to handle complex research projects covering many areas of biotechnology. All research units also invest budgets to improve structural capital by creating the research environment and culture (relational capital) to facilitate their researchers doing their jobs and motivate them to transform new created knowledge to organizational competence (organization capital).

Idea generation & projects selection

Research ideas in science-based projects are not generated easily. They emerge through the integration of research experience, existing research knowledge of the researchers, research teams, partners, and knowledge created in the previous research. Research ideas in units are also acquired from the related research projects, significant and high-impact problems, the need of research outputs, and other internal and external sources of information and knowledge. When integrating researchers with different educational background into same projects, usually interesting ideas occur and a wide variety of knowledge is gathered. Some ideas in laboratories are created through conflicting ideas in research discussions and brainstorming.

Researchers of these three research units have supporting tools and knowledge resources to implement their research ideas. They have sufficient capability to identify and access needed knowledge to support ideas. Researchers usually share their ideas, opinions, and comments with others.

All these research units evaluate and select research projects based on available budgets, the readiness of researchers, existing knowledge and research contribution. For example, R&D unit A has its own research strategy to submit research proposals to research funding organizations only if the projects are evaluated as high-impact projects and can be managed on schedule.

Multiple R&D process and knowledge integration

The strategy for managing research projects in unit A and Unit C is a combination of in-house development (human capital & organization capital) and network research with alliances (human capital and relational capital). Responsibility is distributed to a researcher in a team based on their research potential, skills, and readiness in order to optimize research outputs. A project team usually consists of 2 to 3 researchers. A

young researcher of unit C asserted that good teamwork and experience of professors were important factors for success. He stated that "*We usually reach our research goals with help from professors' invaluable direction and comments*".

The research strategy found in unit B is a combination of in-house development and research network, supported by information technologies. However, it was difficult to find research partners in the research network model. Most projects were conducted by researchers through in-house development. Only a large project of rice gene discovery was collaborated with research partners. This is due to the fact that it is very complicated and its cost is very high. This unit manages an in-house R&D through the cross functional teamwork. Research students were assigned to join at least 2 teams for improving their research skills through learning by doing and sharing experience with other members.

In summary, the heads of these research units usually monitors research activities by working very closely with their staff and students in the phase of knowledge integration. They track the research status through shared notes and discussion in formal and informal meetings. This helps them to understand, interpret, and integrate the research information and knowledge from their members and to internalize new knowledge.

Testing and overall evaluation

Research prototypes in these three research units are preliminary tested and evaluated by the research members under the support of professors. Research prototypes are tested again and again until they are accepted as appropriate prototypes. However, there are some different activities among research units. For example, the final prototypes of research unit A and unit B are evaluated and tested in parallel by groups of experts and partners. The parallel testing strategy does not only help this research team to reduce testing time and increase the number of tests, but also to increase credibility of the product. Research prototypes of R&D unit C are usually developed by each cross functional team in the lab under the supervision of the head and two senior researchers. All test results are captured and stored in the shared database such as CD-ROM, web-based knowledge pool, and shared research notes for reuse in the future.

In this stage, research units need past experiences for judging whether to do the next step or to go back to the previous design phase.

Production and market entry

Several research units managed their projects until they submitted publications or research report to research funding organizations. A few research projects have reached commercialization. The research funding organizations in Thailand have created policies to improve the quality of research in Thailand and help private companies to reduce costs by creating collaboration among government, university, and industry (GUI). The final research prototypes and outputs of academic research

laboratories are the properties of research funding organizations. Therefore, a decision on production and market entry is managed by the research funding organizations. Many research prototypes with market potential, created by the successful research units, were commercialized by local private companies.

The head of Unit A has a long experience in his research area and conduct lots of research projects which are contributive to the country. The research projects with market potential of this unit are carried on and collaborated with a local company and adapted for commercial purpose. Therefore, the stage of production and market entry is normally managed by the partners.

Many prototypes of unit B and unit C are developed in-house for commercial products. The heads of both units are usually invited to present their research outputs and new products in both national and international exhibitions and conferences. Both units also disseminate their research results to the public through a large local company.

A summary of KM Practices in research units classified by R&D process is as shown in Table 1.

Table 1 KM Practices in research units classified by R&D process

R&D Processes	Research Unit A	Research Unit B	Research Unit C
Idea generation and projects selection	• Acquire research ideas from several sources such as alumni, conferences, journals, magazines and so on • Acquire research ideas by discussing with other researchers in national and international conferences • Create meetings and brainstorming with research partners abroad • Create ideas from a multidisciplinary research team • Acquire new research knowledge from academics papers • Invite alumni to discuss about research trends • Invite visiting professors to join projects • Use the evaluation and selection policy based on social impact, budget, and existing knowledge • Mapping the readiness of research teams and needs and impact of research projects to the country	• Acquire ideas from other researchers in international conferences • Integrate research ideas from several sources such as in-house R&D, experience, and organizational knowledge • Generate ideas from the country's problems • In-house team-based research design • Designing research details by research team • Use previous research knowledge as a basis for designing new research plan in terms of costing, timing and impact of expected outputs. • Brainstorming with team leaders and researchers • Use the evaluation and selection policy based on social impact and existing knowledge • Mapping the readiness of research teams to research projects	• Acquire ideas from several sources such as journals, magazines, external experts and funding organizations • Generate ideas from the country's problems • Continue and extend the previous projects • Design and create research plan by discussing with research team • Invite external partners help to design research plans and research details only for large projects • Analyzing projects based on the readiness and research potential of teams • Use the evaluation and selection policy based on research contribution • Select plans by team leaders •

Table 1 (continued)

R&D Processes	Research Unit A	Research Unit B	Research Unit C
Multiple R&D processes Knowledge integration	• In-house R&D using cross functional team • Acquire external knowledge by exchanging researchers with 39 research partners in 19 countries. • Conduct multiple research experiments in the critical parts at least by two teams in parallel • Create formal and informal meetings for transferring and integrating knowledge • Keep information about both success and failure in research experiments for the reuse.	• In-house R&D using cross functional team • Conduct research experiments • Use knowledge repository to share and retrieve internal knowledge • Use knowledge portal to acquire external knowledge • Conduct only informal meetings for transferring and integrating knowledge from research teams. • Store Information and knowledge about success and failure in research experiments in research repository	• Create research team based on skills and personal relationship • Conduct experiments at the research stations or partners' laboratories • Research collaboration with domestic academic partners • Integrates research results, information and knowledge from research results and analysis reports • Track and collect research results from members and partners through informal meetings
Testing and overall evaluation	• Keep information and knowledge in this process in shared research notes for tracking errors if any unexpected results occur and reusing in the future. • Internal testing by researchers. • External testing by partners. • All outputs and evaluation results are stored in the CD-Rom for analysis and reuse	• Keep information and knowledge in a web-based knowledge pool for tracking errors and reuse • Internal testing by researchers. • External testing by research partners. • Outputs and testing results are stored in a web-based knowledge pool.	• Internal testing by other research members in different team and staff. • Research analysis and evaluation is done by team leaders and researchers • Store testing results&information in shared research notes

Production and market entry	• In-house development. • Transfer knowledge to company for mass production • Patent is owned by research funding organization • Publicize research knowledge by presenting their work at research exhibitions, international conferences, and journals.	• In-house development • Mass production by local companies • Publicize research outputs through commercializing new products and service • Distribute products through government agency and private companies	• In-house production • Supported by industries and funding organizations • Distribute research results to public or funding organizations • Publicize knowledge and research results through training classes

DISCUSSION

The KM practices found in these three successful R&D units are embedded in the R&D processes which require knowledge and IC as important resources (See Figure 1). Most new research knowledge is created based on research experience of the research head and the integration of knowledge from research teams.

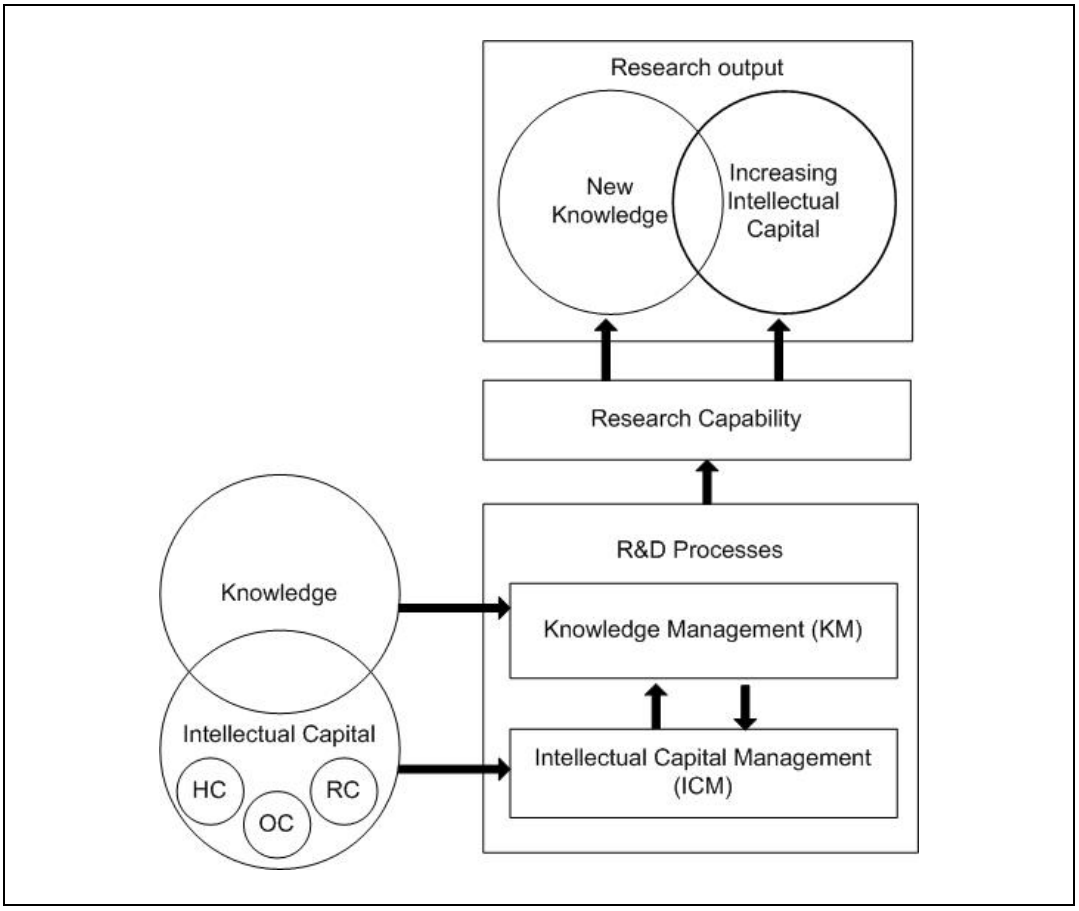

Figure 1. KM and ICM in the R&D processes

In the team-based research of these three successful research units, all researchers are encouraged to share research knowledge including tacit knowledge within research team. In this context, trust, personal relationship, and commitment are very important factors for the success of knowledge transfer, sharing and integration.

These three research units have research staff to work as the knowledge bridge to fill a gap between the professors and research students. Researchers are encouraged to store research experiment and knowledge in shared media such as research notes and web-based knowledge pool for both success and failure cases. Even though professors and research students work together very closely, a good personal relationship among

research members also creates a better opportunity for knowledge sharing. Therefore, relational capital is a critical for transferring and sharing research knowledge.

All research units try to sustain their research capability by transforming their research knowledge and intellectual capital to innovation and intellectual property. For example, alumni of the research unit A are invited as partners for transforming research prototypes to commercial products and launching products to the market. The R&D unit B provides funds and opportunity for their staff to enhance their research competency, encouraging them to further their study for a higher degree, utilizing resources in the research unit. Consequently, after their graduation, they commit to continue research work as full-time researchers. The research head of R&D unit B stated that "*We are interested in not only the quality of current research outputs but also the improvement of our researchers who are the most important key for the success in a long-term*".

The new knowledge from research processes are codified and stored as organization capital in the different formats. For example, unit A stores its research knowledge in CD-ROM for internal access. Unit B stores research knowledge in web-based research database and unit C stores in the shared research notes.

In summary, IC increases the performance of KM practices. On the other hand, effective KM practices help researchers improve their skills and create the excellent outputs which strengthen the organizational competence and the increase of IC. All research units confirm that IC and knowledge are important for research success and try to preserve them in organization as an intellectual property. The research head of unit B stated that "*The success or failure of research depends on the competence of researchers and relationship between researchers. Therefore, we have to improve and maintain human capital and relational capital in my research unit by creating research climate, culture, and incentive system to motivate researchers*".

CONCLUSION

Based upon the assessment of the managing IC and knowledge in the R&D processes in these three research units, we found that IC and knowledge were important assets for research organizations. IC is used as a resource for supporting KM. Human capital supports knowledge creation. Relational and organizational capital support knowledge acquisition, knowledge transfer/sharing, and research collaborations. IC has a direct and substantial impact on managing knowledge in the research processes.

The relationship between ICM and KM can create a high potential strategy for managing R&D processes in science-based research which requires multi-disciplinary knowledge. KM can improve the quality of intellectual capital. There is no doubt that these three successful research units have extended their potential to create new knowledge by combining human capital and relational capital through in-house research development and a strong interaction with external research partners.

In summary, our case studies found a strong impact of human capital and relational capital on the improvement of KM which helps research units to achieve research goals. To improve the country's competitiveness, the research units in the developing countries still need to improve those ICM and KM that create a strong basis for relevant research outputs of good quality and thus become an innovation. .

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ASSESSING COST OF QUALIY IN A PLASTICS INJECTION MOLDING COMPANY: A CASE STUDY

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ABSTRACT

Quality is considered by many to be a critical strategic importance for achieving competitiveness in the global market. Many quality and productivity improvement techniques are generally implemented to rise up its performance. The cost of quality (COQ) system can be one of the most effective performance measurement techniques. The objective of this paper is to present results of quality costing practices at a case company since the quality costing approach was introduced. Then the four basic elements of COQ were collected namely prevention, appraisal, internal failure and external failure. The total cost of quality was computed and benchmark against the quality improvement level. The correlations between COQ and difference performance indicators were determined by the Spearman's rho correlation coefficient. The findings show that 70.14% of the COQ is expended for corrective action while prevention and appraisal costs are spent on 25.72% and 4.14% of the COQ, respectively. From correlation analysis, it illustrates the total quality cost per unit have significantly strong positive relationships between prevention cost and failure cost. Methodology and findings of the study can be further strengthened through implementation at others.

Keywords: Cost of quality (COQ), Injection Molding, Case study

INTRODUCTION

Many companies have promoted quality as the central customer value and regard it as a key concept of company strategy in order to achieve the competitive edge. They have worked hard to create methods and execute activities to minimize costs and improve the quality of their products and services. There is one factor that makes the difference between the costly way and beneficial way of achieving quality. This factor is quality costs. Measuring and reporting cost of quality is very important in building the foundation for quality improvement. One must stress the fact that the objective of understanding and measuring cost of quality is not just to reduce the costs but to ensure that the costs associated with quality are right kind of costs that maximizes benefits. In the literature, there are several methods that can be used to collect, categorize and measure quality costs. The traditional P-A-F method suggested by Juran (1951) and Feigenbaum (1991) classifies quality costs into prevention,

appraisal, and failure costs. Prevention costs are associated with activities taken to ensure that a process provides quality products and services. Examples of prevention activities are quality planning, quality circle meetings, training programs, written procedures, and quality improvement projects. Appraisal costs are incurred to ascertain the product or service whether it conforms to quality standards. Examples of appraisal activities are inspection of incoming work, supplies and materials, periodic inspection of work in process, final inspection and collecting quality data. Failure costs are incurred to correct quality in products and services before (internal) or after (external) delivery to customer. Examples of internal failure costs are scrap, rework, and machine downtime while examples of external failure are warranty, complaint administration, sales return, and product liability.

Establishing the quality cost (COQ) program becomes useful technique in increasing business competitiveness and improving profit margin within manufacturing sector. The quality cost information can be used as a basis for decision making. It allows for more accurate setting of future budgets; the setting of realistic improvement targets and goals; and focused investment in prevention techniques to produce quantifiable savings (Bamford and Land, 2006). Typical figure given in the literature for quality costs range from Crosby's (1996) view of 25 to 30 percent of turnover while Dale and Plunkett (1991) suggested that quality costs can range from 5 to 25 percent of a company's annual sales turnover. Furthermore, Burgess (1996) gathered quality cost data from several studies between 1970s and 1990s; for example, Webb (1972) presented the percentage of total quality costs in the general industry: prevention costs (10 percent), appraisal costs (25 percent) and failure costs (65 percent); Veen (1974) indicated quality costs categories at average: prevention costs (9.1 percent), appraisal costs (27.3 percent) and failure costs (63.6 percent). As literature, even though there has been found on various methods of categorization, collection and measurement of quality costs see Dale and Plunkett (1991), Schiffauerova and Thomson (2006) and Desai (2008), there is scare available quality costing literature particularly from industry within Asian countries. This paper intends to contribute and share experience of COQ measuring from Thai small-medium sized enterprises based plastic injection molding sector.

OBJECTIVES

The objective of this paper were to collect and monitor the practical aspects of data concerning the quality cost system within a plastic injection molding company as a case study. The COQ approach is used to gather the four main classifications of quality costs: prevention, appraisal, internal failure and external failure costs.

RESEARCH METHODLOGY

The methodology adopted was the carrying out of a case analysis. The following major analysis steps were carried out in sequence as below detail:

- Identifying and collecting the data for each element of quality costs.
- Measuring and quantifying the elements.
- Analyzing the quality cost scenario and locating the improvement areas.

RESULTS AND DISCUSSIONS

The case company

The company selected for the study started in 1995 as a SMEs manufacturing firm producing a variety of plastic injection for electric, electronic, machinery, furniture, automotive parts and components. The operation is mainly of a 'made to order' nature. Design and specification demanded by the customers are being met and the company says that they are capable of providing a solution to the special needs for any customers. Many quality tools and techniques like 5s, QCC, KAIZEN, Zero Defect and ISO9000, have been continuously implemented within the company to improve the product quality in order to satisfy the customer's requirements. Around 90% of the company output is mainly supported for domestic markets within electric, electronic, and automotive industries.

Identifying and collecting the elements of quality costs

The list of quality cost elements are detailed and collected during January to December in 2009, see as Table 1 and Table 2, respectively.

Table 1: The elements of quality costs

Cost Element	
Prevention Cost	**Internal Failure Cost**
P1:Training	IF1: Scrap
P2: Quality audit	IF2: Defect Disposal
P3: Quality improvement	IF3: Breakdown Maintenance
P4: Preventive maintenance	
P5: Equipment upgrade	
Appraisal Cost	**External Failure Costs**
A1: Material Testing	EF1: Product returned due to defect
A2: Calibration	

Table 2: Summary of total COQ for twelve months data of 2009 (x1,000 Baths)

Cost Element	Jan'09	Feb'09	Mar'09	Apr'09	May'09	Jun'09	Jul'09	Aug'09	Sep'09	Oct'09	Nov'09	Dec'09
P1	0.00	0.00	0.00	1.20	3.80	4.50	0.00	1.21	9.00	0.00	0.00	5.00
P2	0.00	0.00	0.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	44.00	0.00
P3	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P4	0.00	0.00	5.15	0.00	0.00	5.15	0.00	0.00	5.15	0.00	0.00	5.15
P5	0.00	0.00	48.00	54.50	51.05	0.00	27.72	16.90	0.00	119.15	53.50	29.83
TPC	0.00	0.00	53.15	105.70	54.85	9.65	27.72	18.11	14.15	119.15	97.50	39.98
A1	0.00	0.00	25.00	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
A2	15.18	0.00	17.35	0.00	0.00	2.70	0.90	0.00	6.30	12.00	0.90	1.80
TAC	15.18	0.00	42.35	0.77	0.00	2.70	0.90	0.00	6.30	12.00	0.90	5.80
IF1	37.49	0.11	71.82	0.00	96.79	62.23	73.30	41.04	94.10	73.91	79.08	84.29
IF2	0.00	0.00	0.00	24.00	0.00	0.00	24.00	0.00	0.00	24.00	0.00	0.00
IF3	21.76	14.51	16.32	18.14	25.39	23.58	21.76	18.14	16.32	27.20	19.95	21.76
TIF	59.25	14.62	88.14	42.14	122.18	85.81	119.07	59.17	110.42	125.11	99.03	106.05
EF1	22.91	11.10	146.59	40.80	17.70	17.41	10.53	9.25	99.94	9.89	46.70	8.76
TEF	22.91	11.10	146.59	40.80	17.70	17.41	10.53	9.25	99.94	9.89	46.70	8.76
TQC	**97.33**	**25.72**	**330.23**	**189.41**	**194.73**	**115.58**	**158.21**	**86.54**	**230.81**	**266.15**	**244.13**	**160.60**
TQC/Unit	**0.13**	**0.08**	**0.68**	**0.20**	**0.48**	**0.11**	**0.19**	**0.14**	**0.27**	**0.28**	**0.31**	**0.15**

Measuring and quantifying the elements

After identifying the relevant quality cost elements, they were quantified Total cost of quality as calculated from four basic cost elements is summarized and illustrated in Table 3. The contribution of four basic categories in the overall quality cost as illustrated in Figure 1 was the scenario of the company in quality expenditure with the present quality level. As Figure 1, failure costs (70.14%) are the highest cost of TQC that have been a critical problem for the company in product recalls. The finding has consistent with the literatures (Webb, 1972; Veen,1974; Dale and Plunkett,1991; Schiffauerova and Thomson, 2006 and Desai, 2008). While the appraisal cost is minimum. This means that the company still has the problem on internal process improvement such as equipment/machine downtime, scrap, and defect disposal. In other word, the company should increasingly focus on the appraisal plans and activities. All equipments and machines must be promptly used for any circumstances.

Table 3: Summary total COQ

Element	Cost (Baths)	Percent contribution into TQC
Total Prevention cost (TPC)	539,981.51	25.72%
Total Appraisal cost (TAC)	86,900.00	4.14%
Total Internal Failure cost (TIF)	1,030,980.62	49.11%
Total External Failure cost (TEF)	441,578.10	21.03%
Total quality cost (TQC)	2,099,440.23	100.00%

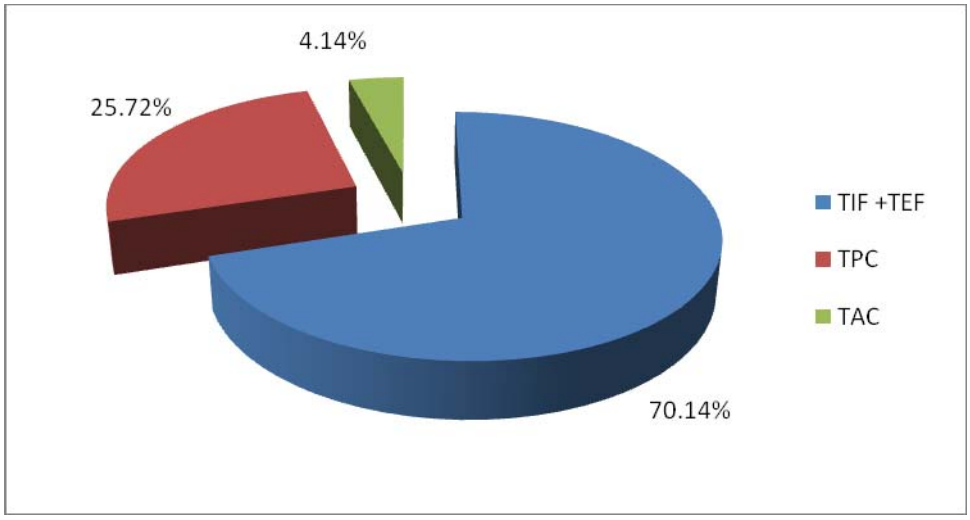

Figure 1: Contribution of four basic elements into total quality cost

Analyzing the quality cost scenario and locating the improvement areas

Referring to Table 1, the element of quality costs can be classified into two types: (1) costs that invest for preventive activities and (2) costs incur for corrective activities. Then, the two types were plotted against each other over twelve months as shown in Figure 2 and is used for giving valuable suggestions for improvements. It has seen that even though the company spent more on preventive activities, the cost for corrective activities still highly remains.

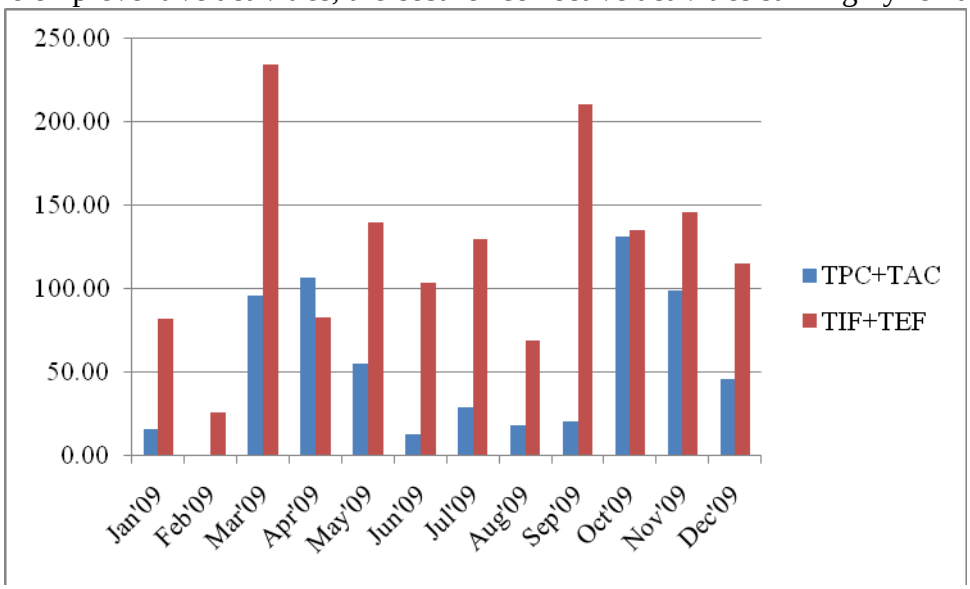

Figure 2: Comparison between quality costs incurred on preventive action and on corrective action

Furthermore, correlation analysis is used to understand the strength of the relationship among cost elements of total quality cost. The degree of the relationship is measured by the Spearman's rho correlation coefficient. The findings show that the total quality cost per unit has significantly strong positive relationships between prevention cost and failure cost at 0.01 level. See as Table 4. It can be said that the expenditure for preventive and failure activities

much more impact on the total amount of COQ. Then the company should more focus on these two types.

Table 4: Correlation analysis between cost elements and total quality cost

		TPC_Unit	TAC_Unit	TFC_Unit	TQC_Unit
TPC_Unit	Correlation coefficient	1.00	-0.03	0.52	0.83**
	Sig. (2-tailed)	.	0.92	0.08	0.00
TAC_Unit	Correlation Coefficient		1.00	0.36	0.25
	Sig. (2-tailed)		.	0.24	0.43
TFC_Unit	Correlation Coefficient			1.00	0.85**
	Sig. (2-tailed)			.	0.00

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

Then, to emphasize the improvement area, firstly collecting the data on percentage of defects in each process section is needed. After that the correlation analysis is also used to investigate the relationship between quality expenditures with failure rate in seven process sections is presented. See Table 5 and 6. The result as shown in Table 6 reveals that the prevention cost has a significantly strong positive relationship with failure rate in the mold section at 0.01 level. This means that as a company expends more of its budget on prevention activities the quality level at the mold section should be improved and increased to meet the target value. On the other hand, the internal failure cost has moderate positive relationship with the press section at 0.05 level. This indicates that increasing the quality improvement the company has to more emphasize on the cost spending for corrective activities at press section. In short it can said that apart from seven section, the mold and press sections are being two significant area for product quality improvement and quality-cost controlling.

Table 5: Percentage of failure in each process section for twelve months of 2009

Process section	Jan'09	Feb'09	Mar'09	Apr'09	May'09	Jun'09	Jul'09	Aug'09	Sep'09	Oct'09	Nov'0
PS	2.83	2.00	2.01	2.01	2.03	2.39	3.64	3.85	2.50	2.15	2.44
AS	0.04	0.08	0.05	0.05	0.04	0.17	0.07	0.08	0.08	0.09	0.32
IS	0.39	0.50	0.21	0.30	0.22	0.15	0.18	0.25	0.67	0.43	0.27
MS	0.00	0.00	0.69	0.35	0.20	0.00	0.00	0.00	0.00	0.24	0.40
PRS	0.49	0.00	0.01	0.03	2.32	0.22	0.24	0.05	0.30	0.14	0.11
MIS	18.45	12.18	19.30	19.40	4.20	14.51	20.00	14.50	19.10	19.45	19.50
MFS	4.00	5.00	7.10	3.00	2.50	5.00	5.00	2.00	1.20	4.00	3.30

Note: PS: Paint Section IS: Injection Section PRS: Press Section MFS: Mainten
AS: Assembly Section MS: Mold Section MIS: Maintenance Injection Section

Table 6: Correlation analysis between cost elements and failure rate of each process sections

		PS	AS	IS	MS	PRS	MBIS	MBFS
TPC	Correlation Coefficient	-0.27	0.10	-0.06	0.73**	-0.15	0.54	-0.14
	Sig. (2-tailed)	0.40	0.76	0.85	0.01	0.65	0.07	0.66
TAC	Correlation Coefficient	0.07	0.01	0.02	0.28	0.17	0.37	0.25
	Sig. (2-tailed)	0.82	0.98	0.96	0.37	0.61	0.24	0.44
TIF	Correlation Coefficient	0.19	0.10	-0.14	0.19	0.59*	0.35	-0.16
	Sig. (2-tailed)	0.56	0.75	0.66	0.55	0.04	0.27	0.62
TEF	Correlation Coefficient	-0.26	-0.33	0.21	0.21	-0.03	0.05	0.15
	Sig. (2-tailed)	0.42	0.29	0.50	0.51	0.92	0.88	0.65

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

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

CONCLUSION

The research was focused on gathering and investigating the practical of data collation and measurement of COQ within plastic injection molding company; and to examine the manner in which the resulting information was used as part of business improvement. From the summary sheet it is noted that appraisal cost is minimum (4.14%). Main target area is failure cost: internal failure (49.11%) and external failure cost (21.03%). The internal failure cost, equipment/machine downtime, scrap, and defect disposal is a majority proportion of COQ, this becomes the root points to be critically analysed. The finding has consistent with the literatures (Webb, 1972; Veen,1974; Dale and Plunkett,1991; Schiffauerova and Thomson, 2006 and Desai, 2008). Beside this, using correlation analysis, it found that prevention and failure costs have significant impact on the total amount of COQ. The findings also pointed that there are two significant process areas; mold and press sections for product quality improvement and quality-cost controlling. Even though a case analysis is used it provided in-depth information on quality cost which is not usually revealed to public. This research has provided a foundation for future work. The interesting areas for future investigation would be to study on a larger-sized company and wider range of industries such as automotive, healthcare, service and education.

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A STUDY OF THE MULTIPLE-SOURCE FEEDBACK FOR GENERAL COMPETENCE AND CORE COMPETENCE PERFORMANCE EVALUATION OF TAIPEI 101

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ABSTRACT

Multisource feedback ratings are related to other measures of competence effectiveness and that different rater sources conceptualize performance in a similar manner. The scale set by the Taipei 101 core value. This study use of Delphi questionnaire to the Taipei 101 manager as an expert on the object to construct the general competence, and finally we use questionnaire survey conducted multi-feedback analysis of general competence and core competence. A total of 250 questionnaires were sent, and use descriptive analysis, T-test to explore the Taipei 101 employees and supervisors on the self-assessment under the assessment, and finally back to the multi-evaluation system to explore the feasibility of the implementation of the objectivity and in the future. We found multiple feedback to assess the general competence and core competence of the overestimate, in general competence are the Financial, Engineering, Operations, Building rental department, Observation deck department, Observation deck souvenirs, Building property management projects up the difference. In the core competence are the Viewing platform sector, Shopping malls property management department, Building lease, Finance shopping accounts, Shopping malls operating and Viewing the most souvenirs sector discrepancies. We focused on evaluation results are different projects, consider them in depth to find self-assessment and the reasons for his assessment of the differences. For the cases of staff can effectively self-understanding and improvement the indicators item.

Keywords - Taipei 101, Multiple-source feedback, General competence, Core competence, performance evaluation

INTRODUCTION

In the last 20 years, industrial and organizational psychology has developed rapidly in Taiwen. This is mostly due to the significant development of economic reform and social changes and the great demand for organizational psychology and human resource management research and applications in Taiwan organizations. As a result, the cross-cultural–socioeconomic perspective has been emphasized in relation to developments in various fields of psychology and human resource management in Taiwan [1][2][3][4][5]. During last few years, competence paradigm has become a standard for the modern Human

Resources Management (HRM). The importance and the impact of this concept have headed industries to develop a set of solutions to help the introduction of Competence Management into organizations [6]. Using Competency model on profit and prosperity of enterprises generally used in the recruitment of functions for selection, Training development, performance evaluation, succession planning and other. The purpose is to help organizations and individuals understand how to improve their organization performance [7]. [8]have suggested In the knowledge economy environment of the change, because science and technology drive global economy and enable receiving employee's engineering, the jobs of human resources expert and management rapidly, besides impelling important information to share, it accords with the challenge of the human resources in the future core competency as the key point. Great manager have management competence in order to change the keen competition with the international market fast in conformity with the environment. It is their key point of the success, what a focal point of operating and setting up the niche efficiently.
In the global marketplace of the twenty-first century, we know that employee are being called upon to lead their organization forward in new and creative ways and that improving their performance is no longer optional, but rather an imperative. Significant increases in competence were perceived by the managers and by their subordinates themselves, development needs were seen to reduce ratings were largely seen to become more congruent. Multisource feedback ratings are related to other measures of competence effectiveness and that different rater sources conceptualize performance in a similar manner. The scale set by the Taipei 101 core value.

Taipei 101 is the most important reason why there is: Invent the most privileged working and life style to the world (External). Define the world's most privileged working and life experiences (Internal). Bring Taipei 101 to the world by being the benchmark of outstanding office leasing, observatory and shopping center in Asia! We look forward to every 101 head of colleagues who can demonstrate a code of conduct:

1. Service: We commit to offer the most privileged and intimate customer services.
2. Passion: We pursue company and personal excellence with great passion for 101 brand and work.
3. Integrity: We insist on integrity and walk the talk.
4. Respect: We respect our clients and people by empowerment and trust.
5. Innovation: We lead the examples by unlimited creativity, aggressive learning and trials.
6. Teamwork: We achieve challenging objectives by helping and encouraging each other.

Taipei 101 Co., Ltd. Organization Chart at Figure 1. Taipei 101 business categories including: Tower, Shopping Mall, Observatory.

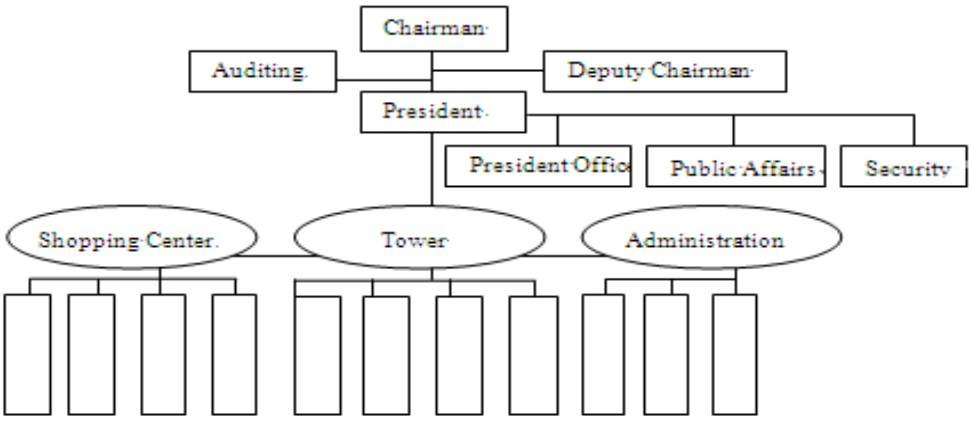

Figure 1 Taipei 101 Co., Ltd. Organization Chart

RESEARCH METHODOLOGY

This study use of Delphi questionnaire to the Taipei 101 manager as an expert on the object to construct the general competence, and finally we use questionnaire survey conducted multi-feedback analysis. A total of 250 questionnaires were sent, and use descriptive analysis, T-test to explore the Taipei 101 employees and supervisors on the self-assessment under the assessment, and finally back to the multi-evaluation system to explore the feasibility of the implementation of the objectivity and in the future.

ANALYSIS

Reliability analysis of the General competence

After the Delphi experts survey and using the reliability analysis, to understand the questionnaire is consistency. In the overall reliability analysis Cronbach α is .963, as shown in Table 1, the Cronbach α was more than .70. The construction of Taipei 101 cases in the general functions of the scale with a consistency and stability.

Table1 reliability analysis of the general competence

Factor	Item	Cronbach α
Word processing capabilities	1-5	.846
Communication and written language	6-10	.857
Problem analysis and solving ability	11-15	.880
Emotional control	16-20	.821
Time management	21-24	.852
Planning capacity	25-28	.877
Continuous learning	29-33	.841
Continuous improvement capability	34-38	.912
Vision and Values drive capability	39-43	.917
Ability of self-reflection	44-46	.825

Multiple feedback analysis

In the multi-feedback analysis, this case study the company paid all employees, not net manager of their own assessment, pre-assessment of its employee's total of the 400 questionnaires, 200 staff self-assessment, 200 manager of assessment, and the total 386 valid questionnaires. The following analysis for the general competence and the core competence of the multiple feedback.

The general competence

From Table 2, all the staff self-assessment and director assessment of the general competence were significantly different ($p < .05$), from average point of view, self-assessment are higher. Therefore, this study further feedback from the department self and manager assessment to explore, the departments of number of people are less than 30, so using non-parametric analysis.

1. In word processing capabilities, self-assessment overestimation department of the, Building lease, Engineering Operations, Market Operations, Viewing platform sector, Viewing platform souvenirs.
2. In Communication and written language, self-assessment overestimation department of the, Building Rental Department, Trading Department, viewing platform sector, viewing platform ticket.
3. In Problem analysis and solving ability, self-assessment overestimation department of the, Building Rental Department, Trading Department, Financial Market Accounts.
4. In Emotional control, self-assessment overestimation department of the, Engineering Operations, Financial Market Accounts, shopping malls, marketing service, shopping centers, operations, viewing platform sector.
5. In Time management, self-assessment overestimation department of the, Building, property management, finance shopping accounts, shopping malls property management department, observation deck department, Viewing platform Souvenirs.
6. In Planning capacity, self-assessment overestimation department of the, Trading department, observation deck department, observation deck Souvenirs.
7. In Continuous learning, self-assessment overestimation department of the, Building Rental Department, Trading Department, Financial Market Accounts, shopping malls property management department.
8. In Continuous improvement capability, self-assessment overestimation department of the, Financial Market Accounts, shopping malls property management department, observation deck department.
9. In Vision and Values drive capability, self-assessment overestimation department of the, Financial Market Accounts, shopping malls Operations.
10. In Ability of self-reflection, self-assessment overestimation department of the, Building Services Management Division, building lease, finance shopping accounts, shopping malls Operations.

Table2 the multiple feedback analysis of the general competence

Item	Group	Number	Mean	Standard	T test	P value
Word processing capabilities	Self-assessment	193	3.2073	.43798	2.643	.009**
	Manager-assessment	193	3.0591	.64423		
Communication and written language	Self-assessment	193	3.1461	.42866	4.602	.000**
	Manager-assessment	193	2.9575	.37480		
Problem analysis and solving ability	Self-assessment	193	3.2093	.42392	4.998	.000**
	Manager-assessment	193	3.0124	.34619		
Emotional control	Self-assessment	193	3.2290	.46903	5.691	.002**
	Manager-assessment	193	2.9865	.36117		
Time management	Self-assessment	193	3.3005	.42738	5.206	.000**
	Manager-assessment	193	3.0725	.43292		
Planning capacity	Self-assessment	193	3.0415	.49368	4.236	.000**
	Manager-assessment	193	2.8381	.44854		
Continuous learning	Self-assessment	193	3.2497	.43447	3.157	.000**
	Manager-assessment	193	3.0860	.57469		
Continuous improvement capability	Self-assessment	193	3.1275	.47623	4.317	.000**
	Manager-assessment	193	2.9347	.39750		
Vision and Values drive capability	Self-assessment	193	3.2228	.41970	4.494	.000**
	Manager-assessment	193	3.0435	.36196		
Ability of self-reflection	Self-assessment	193	3.3368	.47749	5.288	.000**
	Manager-assessment	193	3.0777	.48502		

*P<.05 **P<.01

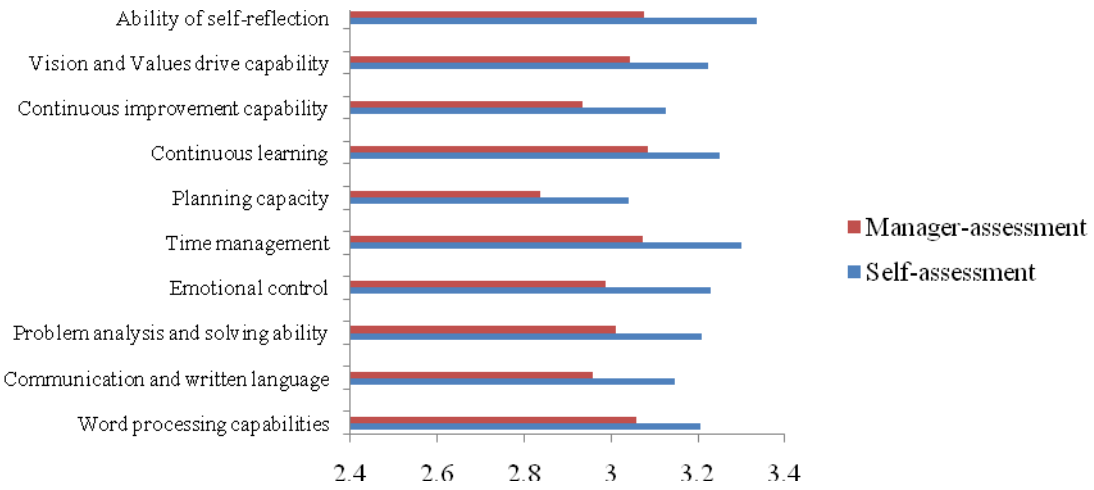

Figure2 the multiple feedback analysis of the general competence Bar chart

The core competence

From Table 3, all the staff self-assessment and director assessment of the core competence were significantly different (p <.05), from average point of view, self-assessment are higher.

Therefore, this study further feedback from the department self and manager assessment to explore, the departments of number of people are less than 30, so using non-parametric analysis.

1. In Service, self-assessment overestimation department of the, Building Property Management Division, Department of Building lease, observation deck department, observation deck Souvenirs.
2. In Passion, self-assessment overestimation department of the, Building lease, finance shopping accounts, shopping malls property management department, observation deck department.
3. In Integrity, self-assessment overestimation department of the, Financial sector, financial accounting business malls, shopping malls property management department, shopping malls Operations, observation deck department, observation deck Souvenirs.
4. In Respect, self-assessment overestimation department of the, Shopping property management department, observation deck department.
5. In Innovation, self-assessment overestimation department of the, Building lease, finance shopping accounts, shopping malls Operations, viewing platform sector.
6. In Teamwork, self-assessment overestimation department of the, Building lease, shopping mall property management, viewing platform sector.

Table3 the multiple feedback analysis of the core competence

Item	Group	Number	Mean	Standard	T test	P value
Service	Self-assessment	193	3.4249	.40286		
	Manager-assessment	193	3.2006	.40675	5.443	.000**
Passion	Self-assessment	193	3.2435	.42415		
	Manager-assessment	193	3.0466	.33285	5.073	.000**
Integrity	Self-assessment	193	3.4839	.42988		
	Manager-assessment	193	3.2684	.42608	4.947	.000**
Respect	Self-assessment	193	3.2617	.42775		
	Manager-assessment	193	3.0538	.30127	5.520	.000**
Innovation	Self-assessment	193	3.1615	.41513		
	Manager-assessment	193	2.9951	.34998	4.258	.000**
Teamwork	Self-assessment	193	3.2242	.41273		
	Manager-assessment	193	3.0446	.31749	4.792	.000**

*P<.05 **P<.01

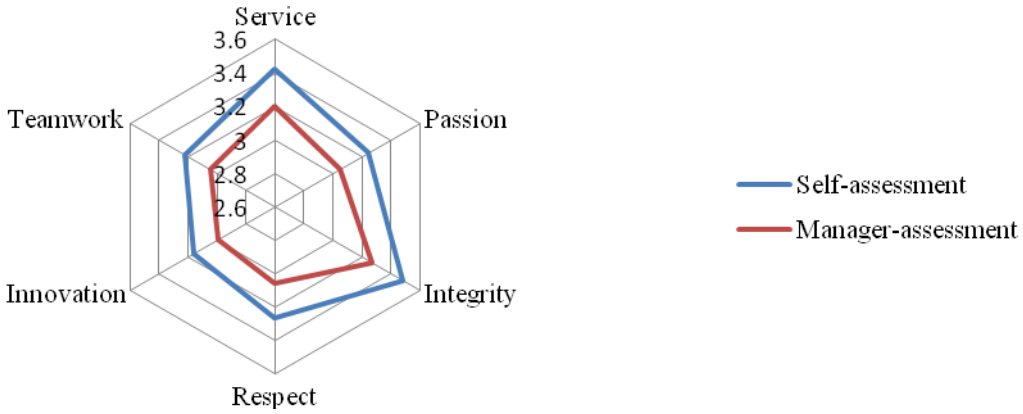

Figure3 the multiple feedback analysis of the core competence Radar chart

SUMMARY AND CONCLUSIONS

We found multiple feedback to assess the general competence and core competence of the overestimate, in general competence are the Financial, Engineering, Operations, Building rental department, Observation deck department, Observation deck souvenirs, Building property management projects up the difference. In the core competence are the Viewing platform sector, Shopping malls property management department, Building lease, Finance shopping accounts, Shopping malls operating and Viewing the most souvenirs sector discrepancies. Self-assessment at this time may be good, but the manager of the assessment or indeed do not agree, it is suggested the case study should address the problem of the department to be depth, or from the individual interviews begin to improve. We focused on evaluation results are different projects, consider them in depth to find self-assessment and the reasons for his assessment of the differences. For the cases of staff can effectively self-understanding and improvement the indicators item.

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THE STUDY OF THE EMPLOYEE USE E-LEARNING BEHAVIOR OF INFLUENCING FACTORS ON MULTI-LEVEL ANALYSIS: THE BASIS OF UTAUT MODEL

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ABSTRACT

The study based on the unified theory of acceptance and use of technology (UTAUT), this study was to investigate the determinants of e-learning acceptance. We create a multilevel variable of learning environment to explore with the other variable context effect and the interaction effects in the acceptance of e-learning. Data collected from 932 respondents in Taiwan were tested against the research model using the Hierarchical linear model approach. The results showed that performance expectation, social impact and learning environment (Group-level) will have positive impact on behavior intention. The Learning environment (Group-level) and performance expectation (Individual-level) will have negative interaction significant effect. And the Group-level of the learning environment with level 1of the effort expectancy will have positive interaction effects.

Key words: Unified theory of acceptance and use of technology Model (UTAUT), e-learning, learning environment

INTRODUCTION

Several global trends have compelled business to reconsider the design and implementation of their technology management education programs. These developments have influenced a wide variety of agents and institutions, including scientists and engineers industry and academia, entrepreneurs, technology managers, firms, universities, federal/national laboratories, science parks, regions, states, and nations. They also have important implications for the manner in which we educate technology managers in business and for those individuals who wish to launch and sustain new technology-based firms (Siegel, 2009). In the information era, knowledge and skills need to be continually updated and refreshed to keep up with today's fast-paced business environment. Gates (1999) pointed out that e-learning system of multimedia streaming technology will facilitate self-paced training. Liaw and Huang (2002) also contended that e-learning make learning less frustrating by making more interactive and engaging, be able to adjust the time, location, content, and speed of learning according to their own personal schedules. Turban et al. (2006) argued that e-learning can be useful as an environment for efficient and effective corporate training and add value to traditional classroom learning settings.

Wang et al. (2009) write acceptance of mobile learning, the objective of this study was to investigate the determinants, as well as the age and gender differences, in the acceptance of m-learning based on the unified theory of acceptance and use of technology (UTAUT) proposed by Venkatesh et al. (2003). The remainder of this paper is organised as follows. In the next section, we review the UTAUT and show our reasoning for adopting it as the theoretical framework of this study. This is followed by descriptions of the research model and methods. We then present the results of the data analysis and hypotheses testing. Finally, the implications and limitations of this study are discussed.

Groupware has been shown to provide a supportive environment for collaborative learning (Sclater et al., 2001; Shaikh and Macauley, 2001; Sikkel et al., 2002). Therefore, this paper breaks with the traditional UTAUT under a single-level research methods, we join to the learning environment of multi-level approach using statistical software Hierarchical linear model. Hierarchical linear model can be improved the accuracy of statistical inference, that is better to ensure that research results are closer to the scene found the reality. This paper review the Unified theory of acceptance and use of technology Model (UTAUT), to explore the factors affecting e-learning, and view the learning environment is capable of interaction effect. This study is structured as follows describe the model and analysis methods, and accordance with empirical information data for statistical analysis and hypothesis validation, finally conclusion and discussion.

THEORETICAL BACKGROUND

Unified theory of acceptance and use of technology (UTAUT)

Many scholars have examined the impact of personal use of information technology in a variety of factors, including the Fishbein and Ajzen (1975) of Theory of Reasoned Action, TRA, Davis (1989) of the Technology Acceptance Model (TAM), Ajzen (1991) Theory of Planned Behavior (TPB), Venkatesh and Davis (2000) of the TAM2, Rogers (1995) Innovation Diffusion Theory, Venkatesh et al (2003) of the Unified Theory of Acceptance and Use of Technology (UTAUT).

In this model, performance expectancy (PE), effort expectancy (EE), social influence (SI), perceived playfulness (PP) and self-management of learning (SL) were hypothesised to be determinants of behavioural intention (BI) to use m-learning. We also hypothesised that age and gender differences would moderate the influence of these determinants on behavioural intention. The proposed constructs and hypotheses are supported by previous literature. Venkatesh proposed a UTAUT, which posited three direct determinants of intention to use (i.e. performance expectancy, effort expectancy, and social influence), two direct determinants of usage behavior (i.e. intention and facilitating conditions), and four moderators of key relationships (i.e. gender, age, experience, and voluntariness), to further integrate the essential elements of eight previously established IT acceptance research models into a unified theoretical model. Venkatesh claimed that UTAUT was able to account for 70 percent of the variance in usage intention and could become a useful tool for IS managers to assess the likelihood of success for new technology implementations. They also argued that UTAUT could help managers to understand the drivers of technology acceptance in order to proactively design intervention (e.g. user training or design participation of users) and increase the utilization of new IT system.

Contingency theory

According to contingency theory, the widely used perspective in understanding the strategy-performance relationship, there is no one best way to strategize, and no strategic choice is universally beneficial in all conditions (Lawrence and Lorsch, 1967; Ginsberg and Venkatraman, 1985; Donaldson, 2000). To achieve a competitive advantage, companies must match their strategic decisions to certain sets of contingency factors, including external (e.g., market conditions, buying behavior) and internal (e.g., organizational structures, characteristics, resources) environments (Lawrence and Lorsch, 1967; Donaldson, 2000). What intrigues strategy scholars most, and also addresses the heart of contingency theory, is how external environments moderate the strength of the strategy-performance relationship (Ginsberg and Venkatraman, 1985: 422). Farashahi and Hafsi (2009) say it is argued that power and legitimacy are key resources for firms' survival in institutionally unstable environments. Some theoretical foundations for the strategy of firms in unstable institutional environments are developed.
Johnson et al. (2008) highlighted the importance of creating a shared, peer-connected, learning environment. Mintzberg et al. (2006) mentioned that the school environment, environmental factors

and leadership ability, organization tied to strategy formation process, one of the three major forces to help give a comprehensive view of strategy formation process to reach its equilibrium. At first, the environment, the so-called contingency theory school, this theory, the specific aspects of the environment and organization between the individual properties with a variety of relationships such as the environment become more stable, the internal structure will be more institutionalized. Schneider (1990) mention the organization of the environment is a common perception of organizational members to the organization's policies, procedures and practices. Such as Altmann (2000) that the organizational climate within the organization attributed to staff awareness of the work environment, their response to the employees to describe their feelings in the workplace and the environment, which is affected by the interaction posed by members of the Organization to form a unique and enduring style, can be by members of the cognition to describe them. The above-mentioned organization, the concept of the environment and organizational climate is like in this study wishes to explore the learning environment.

The organization into information technology system is the concept of a strategy, so into e-learning is also a strategy for the planning, organization into e-learning that is hoped that through this system to assist staff education and training. However, this system is the use of security so that employees will change, whether it is because contingency theory of organizations mentioned in different environments resulting from structural changes within the organization. Special Hellriegel and Slocum (1974) mentioned that the environment is part of the overall non-specific in nature, Naishi organizational system or unit formed. Zohar (2000) referred to climate essentially belong to a multi-level can be derived from observation of team interaction. Therefore, more and more compelling case in this study, analysis of multi-layered approach to be explored.

RESEARCH MODEL AND HYPOTHESES

Performance expectancy, Effort expectancy, Social influence, and Perceived behavioral control

Prformance expectations (PE), Effort expectancy (EE), Social impact (SI), in line with the technology acceptance model, will conduct impact the Behavioral intention (BI) (Chen et al., 2002; Davis, 1989; Davis et al., 1989; Davis et al., 1992; Venkatesh, 2000; Venkatesh and Davis, 2000; Venkatesh et al., 2003). Performance expectations for learners that the e-learning is effective because it allows learners more rapid, flexible and completes the learning activities, and even contribute to learning outcomes. According to UTAUT and previous studies revealed that (Venkatesh and Morris, 2000). There are many scholars TAM's model of e-learning research (Lee and Lee, 2008; Ong and Lai, 2006; Ong et al., 2004; Pituch and Lee, 2006), they have shown the usefulness of cognitive behavioral willingness have a significant impact. In addition, the cognitive usefulness (PU) the main source, that is, to build UTAUT performance expectations (PE) (Venkatesh et al., 2003: 448). Therefore, in UTAUT model, the performance expectations can indeed directly affect behavioral intention (Venkatesh et al., 2003). Therefore, this study believe that performance expectations will be an impact on behavior. H1. (Individual-level) The performance expectancy is positively related to the behavioral intention.

Venkatesh et al. (2003) determined effort is expected that this dimension of the use of the information system. From three different tectonic models, to expect to be considered and ease of use (TAM/TAM2), complexity (MPCU), as well as ease of use (IDT) on Venkatesh, and its willingness to act with The key deciding factor. Therefore, this study believes that hard work will expect an influence on behavior. H2. (Individual-level) The effort expectancy is positively related to the behavioral intention.

Venkatesh determine the social impact, to a certain extent, personal use of new information systems, is important. This study obtained by the existing theory of the social impact of the concept: subjective norm (TRA, TAM2, TPB and C-TAM-TPB), social factors (MPCU), image ((IDT) Venkatesh et al.,

2003). These studies all indicate that the social impact is to create individual intended to use the key concepts of the new technology (Venkatesh and Davis, 2000; Harrison et al., 1997; Moore and Benbasat, 1991; Mathieson, 1991; Thompson et al., 1991). Therefore, this study believe that the wishes of the social impact of an influence on behavior. H3. (Individual-level) The social influence is positively related to the behavioral intention.

Ajzen (1991, 2002) that all human behavior is not controlled by the will, there are more cases are subject to other external environmental factors that influence the objective, in order to be more appropriate increase in rational action theory of human behavior prediction and interpretation of force structure to be extended and therefore proposed an amendment, in addition to attitude and subjective norms, the increase in perceived behavior control an important variable. The so-called perceived behavioral control (perceived behavioral control) refers to the behavior of individuals perceived to take a certain degree of easy or difficult, which reflects the individual's past experience and anticipated obstacles. Forecasts for the behavior of the intended impact. Again from perceived behavior control-related empirical studies found that, in addition to perceived behavioral control on behavioral intentions for the positive impact of perceived behavioral control for the effects of behavioral intentions as the first priority (Atsalakis and Sleap, 1996; Mummery, 1994; Suzanne et al., 1996). If the personal view is that they lack resources and opportunities to complete an act, it cannot form a strong intention to act, so this study, perceived behavior control that can directly affect behavior. H4. (Individual-level) The perceived behavioral control is positively related to the behavioral intention.

Learning environment

In the virtual world, we are able to create an environment where young people learn by doing. They encounter obstacles that are relevant to what they are trying to do and figure out how to overcome these obstacles (Shaffer, 2007). Gee (2003) notes that such lateral movement, as opposed to mere linear progression, is itself a new cultural model of learning, one in which students learn to appreciate the importance of fully exploring and interacting with the environment to help them make better decisions and come up with better solutions. For an open learning environment with no identifiable structure, such individualized support is not feasible. However, because participants in any given affinity group vary in knowledge and experience, it is possible for those who are less accustomed to negotiation to pick up skills from observing their peers. Students could have worked in pairs to conduct negotiations with representatives of the other groups (Rappa et al., 2009). During the course of the project implementation, the authors noted that several measures were necessary to enhance that ‘real world’ quality of the students’ online interaction and the learning environment. Accordingly, H5. (Group-level) The learning environment is positively related to the behavioral intention.

Work climate concept is rooted in social psychology, the general organization decided to organize the influence of environmental factors, such as the incentive structure, so a direct investigation of employees of the organization's existing policies and practices of awareness, it is feasible to be used to study learning environment (Kaplan and Norton, 2004). When the organization implementation e-learning to encouraged and authentication mechanisms of the environment, was to make staff performance expectations, and strive to expectations, social impact, the higher the perceived behavioral control, may cause higher willingness behavior. Therefore, the research hypotheses are follows:
H6. (Group-level) The learning environment and the performance expectations are relation interaction to the behavioral intention.
H7. (Group-level) The learning environment and the Effort expectancy are relation interaction to the behavioral intention.
H8. (Group-level) The learning environment and the Social impact are relation interaction to the behavioral intention.

H9. (Group-level) The learning environment and the perceived behavioral control are relation interaction to the behavioral intention.

Research model

Furthermore, member loyalty and intention to use should be positively influenced by member satisfaction. Fig. 1 depicts the research model of this study.

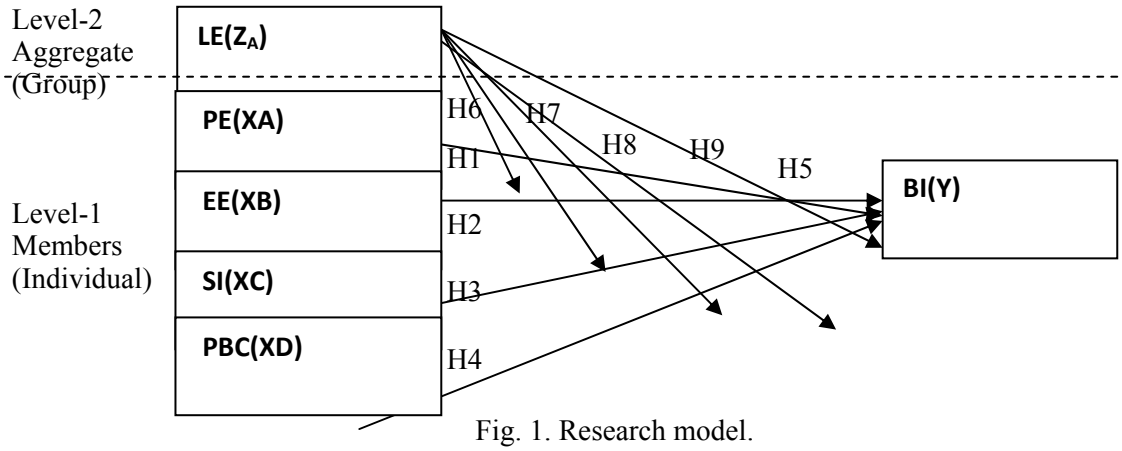

Fig. 1. Research model.

METHODOLOGY

Sampling and data collection

On this basis, a sample of 330 usable responses was obtained from a variety of respondents with different levels of computer or Internet experience. The respondents had an average of 11.39 years of use e-learning experience. The characteristics of the respondents are shown in Table 1.

Table 1 Characteristics of the respondents

Characteristics	Frequency	Percentage
Gender		
Female	444	47.6
Male	463	49.7
Missing	25	*2.7*
Age		
<25	117	12.6
25-30	284	30.5
30-35	254	27.3
35-40	110	11.8
40-45	64	6.9
>45	103	11.0
Education		
Senior high school	69	7.4
Colleges or University	673	72.2
Graduate	181	19.4
Missing	9	1.0
Industry		
Services industry	294	31.5
Traditional manufacturing	30	3.2
High-tech manufacturing	323	34.7
Finance industry	245	26.3
Other	40	4.3

Measures

To ensure the content validity of the scales, the items selected must represent the concept about which generalisations are to be made. Therefore, the items used to measure performance expectancy, effort expectancy, social influence and the behavioural intention were adapted from Venkatesh.
The items were modified to make them relevant to the e-learning context. Pretesting of the measures was conducted by users and experts selected from the e-learning field.
The instrument's survey items were derived from the existing literature and modified slightly to fit the context of e-learning. We developed outcome variables, which were measured using a five-point Likert scale (1, strongly disagree; 5, strongly agree).
Table 1 contains descriptive statistics and reliabilities for the variables in this study. Since Learning environment is considered to be on different levels of analysis, we use Hierarchical Linear Modeling (HLM) (Raudenbush and Bryk 2002) for our analyses. In addition, we also followed Hofmann and Stetzer's (1996) recommended procedures for testing mediation in a multilevel framework.
The internal consistency reliability of the variables was assessed using SPSS 17.0 to compute Cronbach's alpha. The Cronbach's alpha values of all the variables, ranging from .836 to .912, were well over .7, which is considered satisfactory for measures (Nunally, 1978).
A principle components factor analysis with VARIMAX rotation was conducted to assess the validity of the constructs. The items loaded at .5 or better with their corresponding constructs, which is considered very significant. Thus, convergent validity was confirmed. In addition, with respect to discriminant validity, the items loaded higher on their predicted construct than on their cross-loadings. Six factors were identified: learning environment, performance expectancy, effort expectancy, social influence, perceived behavioral control, and behavioral intention.

Table 1 Descriptive statistics and correlations

	Mean	SD	1	2	3	4	5	VIF
Group-level								
learning environment	**3.26**	**0.91**						
Individual-level								
1. PE	**3.75**	**0.66**	**(0.870)**					**1.560**
2. EE	**3.60**	**0.73**	.515**	**(0.850)**				**3.204**
3. SI	**3.51**	**0.79**	.530**	.735**	**(0.911)**			**2.342**
4. PBC	**3.64**	**0.78**	.542**	.750**	.606**	**(0.860)**		**2.477**
5. BI	**3.74**	**0.75**	.650**	.547**	.567**	.587**	**(0.899)**	

N = 932; reliability coefficients for the scales are in parentheses along the diagonal
* p<0.05; ** p<0.01
[a] Although the correlations between all variables were computed by using N = 932, This variables scores were assigned down to individual. Thus, the effective N for Group level is 33
[a] BI is DV， other variable are IV， if VIF<10， no multicollinearity.

HLM analysis

This study collected the learning environment variables are shared construct, data collected from individual employees (Klein et al., 1994). Prior to conducting cross-level analysis, one must view the variables of aggregating to the appropriateness of group-level variables. In order to verify the information within the existing homogeneity within a group and the degree of interrater agreement, use r_{wg} to test indicators (James et al., 1993), if r_{wg}> .70 judgments suited to integrating data table. The difference between the validation group to η2 calculation, if the outcome was a significant difference between the standard form groups that may affect the level -2. Assessing the hypotheses of this study requires a sequence of hierarchical linear models: the null (one-way ANOVA), random-coefficient regression (member-level predictors only), intercepts-as-outcomes (adding group-level predictors), and slopes-as-out-comes models (testing cross-level predictors).

Null model

Dependent variable is behavioral intention. The ICC (1) was 0.332(Chi-square=478.327, p<0.01). ICC (2) was 0.956. Both of them were greater than 0.12 (James 1982), indicating that appropriate variance in Individual contracts exists between-groups. In addition, using information estimated in the null model, an intraclass correlation coefficient (ICC(1)) and reliability of the mean (ICC(2)) were computed, representing the percentage of the total between-group variance in the dependent variable (Raudenbush and Bryk, 2002). The result of ICC(1) marginally satisfied the critical value, .331 (Wen, 2006). Meanwhile, ICC(2) value was satisfactory at .956, which surpassed the minimum .7 requirement (Schneider et al., 1998).

Random-coefficient regression model

After examining the null model, we assessed whether significant between-group variance existed in the intercepts and slopes using a random-coefficient regression model. Hypotheses 1 to 4 predicted that the proposed factors would contribute to member satisfaction. We estimated a level-1 model including these variables, with no predictors specified for the level-2 model. Specifically, performance expectancy (τ_{00} = 9.471, p < .01), and social influence (τ_{00} = 4.104, p < .01), and PBC (τ40 = 6.023, p < .01) had significantly positive relationships with behavioral intention. Therefore, Hypotheses 1, 3 and 4were supported. Contrary to the prediction of Hypothesis 2, off-site interaction was not significantly related to behavioral intention.
Intercepts-as-outcomes model

After establishing that significant variance exists across groups in the level-1 intercepts, the cross-level hypothesis was directly tested. To test Hypothesis 5, we estimated an HLM model in which the member engagement variables were the level-1 predictors and then regressed the intercept coefficients obtained from level-1 on the measures of aggregated learning environment at level-2. aggregated learning environment ($\tau 00 = 7.511$, $p < .001$) demonstrated a significant learning environment with behavioral intention, after accounting for member-level predictors. As a group, the specified group-level variables accounted for 66.5% of the between- VCs variance in behavioral intention. Hence, Hypothesis 5 was supported.

Slopes-as-outcomes model

After confirming that significant group variance in the slopes was present in the random-coefficient regression model, we then examined whether the variance in the slope across groups was significantly related to the group-level independent variable (behavioral intention). This is a direct test for the cross-level moderator (Hypothesis 6-9). Performance expectancy, effort expectancy, social influence, and perceived behavioral control were significantly related to behavioral intention. Add Learning environment will change the four variable (PE, EE, SI, and PBC) impact on behavioral intention. We further investigated whether aggregated learning environment was related to desirable behavioral intention. An HLM analysis was performed, with behavioral intention as the dependent variable, at the group-level, aggregated learning environment was significantly related to behavioral intention ($\tau 00 = -2.768$, $p < .05$; $\tau 00 = 3.633$, $p < .01$). Therefore, Hypothesis 6 and 7 were supported, but Hypothesis 8 and 9 were not supported ($\tau 00 = 0.923$ $p > .05$; $\tau 00 = -0.912$, $p > .05$).

CONCLUSINS

Many studies discuss e-learning models such as the TAM (Ong et al., 2004; Pituch and Lee, 2006) and to explore the UTUAT model of gender and age differences (Wang et al., 2009). But few care about the environment factors into the model (Walumbwa et al., 2008; Tse et al., 2008; Miller, Murdock, 2007; Brutsaert, 2004; Davis, 1989; Davis et al., 1989; Venkatesh and Davis, 2000; Venkatesh et al., 2003; Ong et al., 2004; Pituch and Lee, 2006; Ong and Lai, 2006; Wang et al., 2009; Venkatesh et al., 2003). This study based on the UTAUT in order to level the concept, to discuss context effect and interaction effect. The research confirms the direct effect, the performance expectations and social influence will have a direct impact on behavior intention. And considering the group level of the learning environment, the performance expectations is negative impact the behavior intention. Organization incentives or related to certification e-learning were high, employees will lower behavior intention. And the social impact of the interaction with the learning environment but not significant, but to look forward to interaction with the learning environment has a significant positive effect, Organization has more incentives to employees, or e-learning related to certification and more employees are e-learning easy to use, the staff of its e-learning behavior intention.

SUGGESTIONS AND FUTURE RESEARCH

Future research can be considered collecting data from different organizational cultures, and more variable for research. In addition to adding age, gender, experience, etc. the individual-level variables of the conditioning effect; even try to multi-moderator-mediation. Secondly, the research data collection in order to cross-sectional research, can be added to the time order to Longitudinal data collection will come back to explore the factors influencing behavior. Finally, this study due to time constraints, only the recovery of 932 questionnaires were distributed, a total of 33 different companies, it is recommended to increase the number of samples next study to conduct the three-level(individual, unit departments, organizations) of the study.

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PROFILE OF CONSUMER DECISION-MAKING STYLES AS THE PREDECESSOR OF PREFERENCES FOR RETAIL FORMAT CHOICE

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ABSTRACT

In this paper profile of consumer decision-making style is treated as predecessor of preferences for retail format choice. Particular consumer's decision-making styles profile influence shopping behavior. The authors wanted to explore if, and in what sense, the revealed preferences for choosing particular retail formats (measured as declared frequency of shopping) can be described in more detail, and connected with perceived consumer decision-making styles concept. Results shown, that eight form nine consumer decision-making styles are predecessors of retail format choice in terms of causality assessed using structural equation techniques. More pronounced styles like: compulsive orientation toward shopping, recreational/hedonistic style as well as price-value consciousness are influencing shopping activities in 4 to 8 retail types. Research has been done on sample of Polish consumers representative to Internet users (regarding Internet shopping), gathered using paper-and-pencil interview. Presented analysis uses a data from research project funded by Polish Ministry of Science and Higher Education (grant number 1 H02C 077 30).

Keywords: retail format perception, retail format choice, decision-making style, Polish consumers

INTRODUCTION

The main aim of this paper is to explore connections between profile of consumer styles and preferences for retail format choice. Main approach taken by authors is to:

- look into perception of different retail formats by consumers comparing 12 store formats using multidimensional scaling,
- explore typical profile of consumer decision-making styles (PCS) of Polish consumers,
- estimate structural equations testing significance of relationship between particular styles and shopping behavior.

In Poland domestic trade (including retail and wholesale) is the second source of GDP (after industry), having a share in GDP creation close to 15.8% in 2008, and slightly decreasing during last 10 years (GUS, 2009; p. 29). The increase in total turnover of retailers in 2008 was 9.5% comparing year 2007 in current prices, giving a growth of about 5% in real prices

(GUS, 2009; p. 39). Economic slowdown during 2009 decreased growth rate of retail turnover, which is estimated on the level of 2.7% (GUS, 2010).

Polish Central Statistical Office estimates number of retailers as close to 385 thousand (excluding internet shops using "pure-play" business model), increasing with rate of 3.9% year over year (GUS, 2009; p. 41). In Polish retail structure, 92.4% of stores have sales area 99m^2 or less, but in total sales area, this group has a share of 52.8%. From mentioned 385 thousands of stores slightly more than 3600 outlets is classified as supermarkets (ca. 0.9%) and about 460 ones – as hypermarkets (ca. 0.1%) according to Polish CSO (GUS, 2009; p. 41).

There are also over 7000 internet stores (Internet Standard, 2009; p. 11). From them about 39% were a "brick-and-mortar" model followers, and ¾ of such store owners also performed come sales activities on Internet auction platforms (Internet Standard, 2009; p. 19) The share of the Internet channel (internet stores and auction platforms together) in total retail turnover is estimated as close to 2% (Internet Standard, 2009; p. 5). The share of Internet stores in this turnover is over 41%, the rest is the share of auction platforms, mainly Allegro.pl (Internet Standard, 2009; p. 5).

There should be noted that our research and conclusions refers to Polish consumers only, and to Polish retail structure. For other markets and countries, also from cultural differences reasons, the care must be taken when this approach is applied.

PREFERENCES FOR RETAIL FORMAT CHOICE

Preferences for retail format choice depend on factors external to the consumer and internal ones. External factors among others include (Peter & Olson, 2002): perceived price level (for the format, and particular place), physical effort to buy (including commuting), amount of time designated for shopping – most of external factor are creating perceived total cost of buying for the consumer. Among internal factors there are i.e.: consumer demographics, and – which is important from this paper aims – consumer personality manifesting in decision-making styles and perceived level of emotional effort connected with shopping (mostly in terms of perceived risk and trust for retail format and particular shop).

There should be noted that literature devoted to store choice issues has a long tradition, starting mainly in the 70's of the 20th century. The authors of many of earlier studies - among others: Monroe & Guiltinan (1975), Darden (1979), Arnold, Ma & Tigert (1978), Arnold, Oum & Tigert (1983), Mason, Durand & Taylor (1983), Keng & Ehrenberg (1984), Eagle (1984), Louviere & Gaeth (1987), Spiggle & Sewall (1987), Dawson, Bloch & Ridgway (1990), Burke et al. (1992), Arnold, Handelman & Tigert (1996) - have tried to rationalize store choice using different approaches, regarding external and internal factors to the consumer. For instance the store attributes and situational factors were studied, as well as shoppers and their households demographics, shopping patterns, attitudes toward stores, implied importance weights of factors like price level.

Some more recent research examined i.e. the impact of task definition on store choice (Kenhove, Wulf & Waterschoot, 1999), but most of mentioned store choice studies have been restricted to the same format, i.e., supermarkets, discount stores. Another problematic approach is arising when a complete overlap of assortments in different formats is assumed, like in studies by Lal & Rao (1997) or by Krider &Weinberg (1998), because is very easy to empirically observe that only for selected product categories it can be true. There also exist some studies examining the influence of retail pricing formats on shopping behavior (Bell, Ho & Tang, 1998; Ho, Tang & Bell, 1998), often assuming that one store format has in general higher prices than the other one.

Bhatnagar, & Ratchford (2004) represent interesting approach, but limited to non-durable goods. Exploring fixed and variable costs of shopping, including assumption about consumers preferring to shop at minimum total cost, and different price levels between formats, they found conditions in which the store format choice would be optimal.
Looking for general factors influencing store format choice, we assumed that consumer mental characteristic should explain attitudes to particular store formats and chains/outlets. Because of exploratory character of this study, we focused on measuring shopping outcome only, dropping attitudes from direct consideration.

CONSUMER DECISION-MAKING STYLES

A consumer decision-making style concept introduced by Sproles & Kendall (1986), is defined as "a mental orientation characterizing a consumer's approach to making choices" (p. 268). Those styles should be perceived as "basic buying-decision making attitudes that consumers adhere to, even when they are applied to different goods, services or purchasing decisions" (Walsh et al., 2001, p. 121). They are relatively stable constructs, connected to consumer personality (Sproles & Kendall, 1986), and particular shopping activities and attitudes toward shopping are direct outcomes of consumer's decision-making style (Tai, 2005).

Sproles & Kendall (1986) developed two multidimensional scales to measure consumer decision-making styles – "longer" version called CSI – Consumer Styles Inventory (with 40 items), and more concise one – PCS – Profile of Consumer Style (with 24 items) (Sproles & Kendall, 1986). Both have eight following dimensions (decision-making styles):

1) perfectionism or high-quality consciousness (PERF),
2) brand consciousness or "price equals quality" (BC),
3) novelty-fashion consciousness (NFC),
4) recreational or hedonistic consciousness (RSC),
5) price-value consciousness or "value for money" (PVC),
6) impulsiveness or carelessness (IMP),
7) confusion from overchoice (CO),
8) habitual, brand loyal orientation toward consumption (HBL).

Perfectionism as a consumer decision-making style exhibits in tendency to buy or prefer only the best quality and/or high tech products offering unique value for the user. Perfectionists "must have" those special products, i.e. advanced smartphones, high-end audio equipment,

not considering high prices as a barrier to buy. Consumers higher in this style often shop carefully, systematically and compare many products before take decision. This style is typically more pronounced in men, and consumers with high income.

Brand consciousness is connected with high preference to buy particular more expensive and well-known world and national brands, mostly having large market share, and intensive advertising. Brand conscious consumers often think that "price equals quality", and perceive buying cheaper brands as risky in terms of quality or image, so not worth considering. Sometimes they are strong brand's "advocates" swearing loyalty for i.e. Apple products.

Novelty-fashion consciousness is a tendency to seek new products, recently introduced on the market, products that are perceived as stylish, trendy (i.e. clothing, electronics), not because of their utility value but because of fashion issues. High scores on this style are likely for people gaining pleasure from seeking new up-to-date things, including shopping from variety-seeking reasons. Usually women have higher scores in this style than men, and similarly younger people comparing o older ones.

Consumers exhibiting high scores on recreational (hedonistic) style like shopping (in this case not exactly equal to buying, but rather perceived as a form of entertainment), and like to "feel" retail environments, their atmosphere, image and other people.

Price-value conscious consumers represent the "value for money" shopping orientation. They like sales and low prices in general, but are likely comparison shoppers – trying to get the best value for their spending.

Consumers high on impulsive or careless orientation don't like to plan their shopping, not think about the way and amounts they spent, and about "big deals".

Confused by overchoice consumers have difficulty in making choices during shopping – too many brands and/or stores drives them to experience the information overload.

Pronounced habitual, brand-loyal orientation for shopping means that consumers have favorite stores and brands, and formed habits in making decisions, often based on simple repetition of previous choices. Men and older consumers more likely represent this style.

It is important to note, that those styles are not independent – particular person does not possess only a single style, but rather an individual combination of them, creating personal profile of all styles manifesting itself on different levels, from those some are more intense or prominent (Sproles & Kendall 1986). Consequently, each person possesses a specific profile of decision-making styles.

Since original research of Sproles & Kendall (1986) several studies applied consumer decision-making styles approach to different cultures, recently including among others: German consumers (Walsh et al, 2002), Chinese ones (Tai, 2005), and Polish (authors studies – Mącik & Mącik, 2009).

METHODOLOGY

Subjects and procedures

The sample of 1067 Polish consumers (aged at least 15 years old) gathered by paper-and-pencil interview (PAPI) has been used to gather the data. Nationwide sample representative to the Internet users' population has been used, taken during two-stage sampling processes. In each of 16 voivodships (NUTS 3 level territories), three towns were selected on first stage, differing by number of inhabitants. On second stage, quota sampling has been used, taking into account participant gender, age and earned income.

For this sample used data on shopping formats preferences and consumer decision-making styles were only a part of the questionnaire – other gathered data, regarding more detail about Internet Shopping adoption are not discussed in this paper.

Scales development

Scales used in this paper include:

- Polish adaptation of PCS scale,
- multi-item scales measuring declared frequency of shopping at 12 selected retail outlet types (single item for each type), including 10 conventional types and 2 e-retail types and demographic factors (age, gender, disposable income and type of residence place),

Authors of this paper reconstructed the used version of PCS scale by Sproles & Kendall (1986) earlier. Our polish adaptation of PCS consists of 27 items selected using factor and reliability analyses in 9 dimensions. Eight dimensions are styles present in CSI and PCS, and the ninth additional one – compulsiveness (COMP) – has been added on the base of previous authors research on unplanned buying and its determinants (Mącik & Mącik, 2005). For that the Unplanned Buying Scale (UBS) by Mącik & Mącik (2005) has been used, being a reception of hedonic, impulsive and compulsive buying tendencies, described for instance by Hirschman & Holbrook (1982), Rook & Fisher (1995), and Faber & O'Guinn (1992).

Added compulsive orientation toward shopping includes items measuring facets of uncontrolled buying behavior and spending too much in relation to income.

All constructs from PCS scale were measured using Likert-type scale of 1-5 with ends worded "strongly agree" and "strongly disagree". Scale measuring declared frequency of shopping used 5 frequency descriptions ranging from "never" to "daily".

For modeling purposes, data from the focus groups were also used– regarding perceived differences between retail formats and factors influencing consumers' store choices.

Internal consistency and construct validity

Internal consistency of individual scales for measuring particular construct has been assessed by using Cronbach's Alpha coefficient (Cronbach, 1951).

The results are shown in table 1 for PCS. For 6 of 9 identified consumer's decision-making styles Cronbach's Alpha is over or close to typical value 0.70, suggesting enough internal consistency (table 2). For 2 other dimensions Alphas are over or close to acceptable minimum for short scales of 0.6, and for impulsiveness scale the reliability is too low. This suggests the need to improve their wording in the future. Intercorrelations between particular styles are low (the highest less than 0.45) – each style is distinct from others – this suggests good discriminant validity.

Table 1. Internal consistency of consumer styles (PCS dimensions) and their intercorrelations

Con-struct	# of items	Cronbach's Alpha	Pearson's correlation coefficient between constructs								
			PERF	BC	NFC	RSC	PVC	IMP	CO	HBL	COMP
PERF	3	0,58	1,00	0,09**	0,23**	0,10**	-0,16*	-0,13**	-0,04	0,10**	-0,06
BC	3	0,71		1,00	0,38**	0,28**	0,03	0,17**	0,03	0,02	0,27**
NFC	3	0,82			1,00	0,45**	-0,12**	0,12**	-0,02	0,07*	0,24**
RSC	3	0,85				1,00	0,02	0,19**	0,06	-0,05	0,45**
PVC	3	0,65					1,00	0,00	0,18**	-0,01	0,05
IMP	3	0,45						1,00	0,14**	-0,03	0,33**
CO	3	0,69							1,00	0,02	0,07*
HBL	3	0,69								1,00	-0,19**
COMP	3	0,83									1,00

** $p < 0.05$ * $p < 0.01$

Next step in assessing construct validity was exploratory factor analysis using principal component extraction method with varimax rotation. This procedure has been performed to confirm that all scales are measuring distinct constructs. For adapted PCS existence of 9 proposed consumer's decision-making styles was confirmed – table 2. Nine factors with eigenvalues greater than 1 explained about 66.8% of total variance. Each style is separated factor with high loadings in both samples, with no cross loadings above 0.44, this indicates very good discriminant validity.

Table 2. Exploratory principal components analysis for PCS subscales[a]

Scale items	Factors								
	1 (RSC)	2 (COMP)	3 (NFC)	4 (BC)	5 (CO)	6 (HBL)	7 (PVC)	8 (PERF)	9 (IMP)
PERF1								0.818	
PERF2								0.778	
PERF3								0.512	
BC1				0.778					
BC2				0.796					
BC3				0.701					
NFC1			0.825						
NFC2			0.851						
NFC3			0.716						
RSC1	0.820								
RSC2	0.829								
RSC3	0.792								
PVC1							0.755		
PVC2							0.723		
PVC3							0.753		
IMP1									0.768
IMP2									0.720
IMP3									0.424
CO1					0.793				
CO2					0.799				
CO3					0.716				
HBL1						0.848			
HBL2						0.853			
HBL3						0.622			
COMP1		0.747							
COMP2		0.811							
COMP3		0.852							
Eigenvalue	2.44	2.38	2.26	2.05	1.93	1.89	1.83	1.80	1.43
Cumulative % of explained variance	9.05	17.86	26.23	33.82	40.99	48.00	54.80	61.48	66.80

[a] low factor stores are omitted for the sake of presentation clarity, no omitted score has been greater than 0.4

Also for the scale measuring declared frequency of shopping in particular format of retail Cronbach's alpha has been calculated being equal 0.73. Because each format has been treated individually for modeling there was no factor analysis performed in that case.

Data analysis

Presented analyses have been made using SPSS 14.0PL (for preliminary purposes) and AMOS 7.0 structural equation modeling software (used to identify and test causal relationships). Structural equations modeling – a "path analysis" may be shortly explained following way: "Path analysis is a method of measuring the influence of explanatory variables along each separate path in a system and finding the degree to which variation of a given effect is determined by each particular cause" (Teo, Lim & Lai, 1999; p. 30). This approach allowed to calculate measures of fit for models reported in the paper, and made comparisons across those models.

There should be noted that presented analysis has an exploratory character. No exact hypotheses have been settled and tested in this case. The sets of descriptors for modeling influence of particular consumer decision-making style were chosen on the basis of author judgments coming from preliminary study using focus groups and analysis of correlations between styles from PCS and declared frequency of shopping in particular retail format.

RESULTS

Perception of retail formats

For visual interpretation of perceived attributes of analyzed retail formats, one from typical algorithms for multidimensional scaling (namely ALSCAL procedure) has been performed. Figure 1 contains graphical representation of 2 main dimensions got during this phase of research.

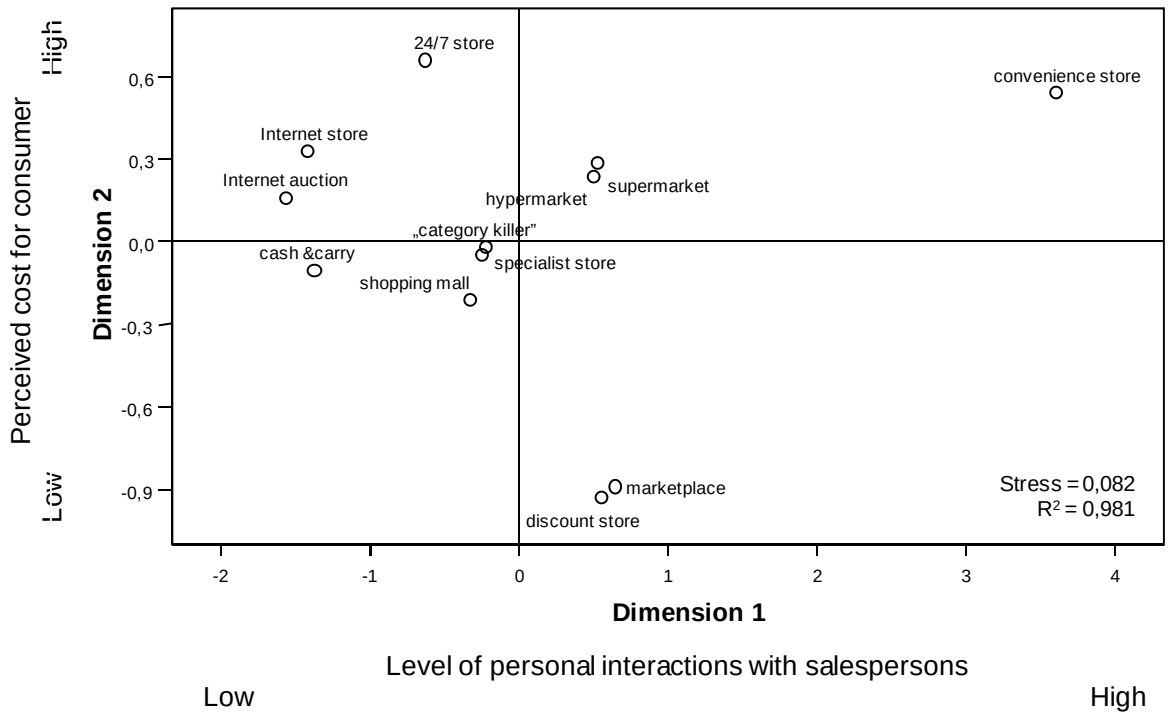

Figure 1. Perception map of retail types on the base of declared shopping frequency – multidimensional scaling approach (ALSCAL procedure, Euclidean distances)

Two-dimensional solution for this case fits the data very well. Stress value is lower than acceptable 0.1, and R^2 statistic is very high, exceeding minimum of 0.6 (Borg & Gronen, 2005; p. 48)

Dimensions in this case can be interpreted as:

- perceived level of personal interactions with the salespersons in particular retail format – dimension 1 – horizontal in figure 1,
- perceived total cost for consumer in sense described by Peter & Olson (2002, p. 459-461) – dimension 2 – vertical in figure 2.

The highest level of personal interactions with the salespersons is perceived in convenience stores (some stores of this type in Poland are still using traditional type service or limited level of self-service). Shopping over the Internet creates the second pole for this dimension – buying in Internet stores and auctions requires mostly "machine-type" interactions with the Internet as a medium (using hyperlinks, forms, e-mails sent by auto responders etc.), and interactions "over the medium" with particular person are much rarer. Such interactions to be successful are performed mostly using instant messaging tools or phone calls. The most similar to both types of Internet shopping is cash & carry format – there are also not too many occasions to interact with sales force. Other formats are "in the middle" between described poles for this dimension.

In second dimension – recognized as perceived total cost for consumer as described by Peter & Olson (2002, p. 459-461) – are included following factors:

- perceived price level for particular retail format,
- physical effort of shopping, including travelling time and cost,
- time spent for shopping – in case of stores and Internet auctions this factor contains also the time of waiting for bought products delivery.

The lowest total cost for consumer is perceived for buying in discount stores and traditional marketplaces (bazaars) – probably because of perception that those places are cheap, and buying there gives opportunity to save money. On the other hand, the highest perceived total cost is for 24/7 type stores and convenience stores, mostly because of relatively higher price level.

There should be noted that in Poland discount stores are rather small comparing to other outlets, and localized often inside or close to larger clusters of inhabitants, so their usage patterns and assortment (in terms of product categories available – not brands) in some situations are more similar to typical convenience store than to the supermarket.

Relatively high position in this dimension of Internet shopping (both formats) is influenced by typically long time for product delivery, and possible problems with purchase handling, product returns ect., despite perception of low prices over the Internet and the most extensive assortment available in this channel. In this dimension buying over the Internet is similar to shopping in supermarkets and hypermarkets – average prices are in this case connected with a perception of loosing time during seeking products and standing in queues, giving mentioned position on the map.

Profile of Consumer Styles – descriptive statistics

Because used sample was representative to the Polish Internet users population and enough large to get relatively low sampling errors, there was calculated descriptive statistics for each subscale of PCS (table 3), giving a reference point to further analyses.

Averages as well as media values for results recalculated to initial code values from 1 to 5 are in most case close to the midpoint of the scales. Only for compulsive decision-making style those measures are substantially lower. Standard deviation is highest for recreational style (RSC), as well as for perfectionist shopping orientation and compulsive dimension, being lowest for impulsive decision-making style.

Table 3. Descriptive statistics for PCS subscales for whole sample

PCS subscale	Mean	Standard deviation	1st quartile	Median	3rd quartile
PERF	3.44	0.73	3.00	3.33	4.00
BC	2.84	0.77	2.33	3.00	3.33
NFC	2.95	0.93	2.33	3.00	3.67
RSC	2.69	0.97	2.00	2.67	3.33
PVC	3.42	0.74	3.00	3.33	4.00
IMP	2.75	0.66	2.33	2.67	3.33
CO	3.09	0.78	2.67	3.00	3.67
HBL	3.42	0.75	3.00	3.33	4.00
COMP	2.06	0.93	1.00	2.00	2.67

Models connecting decision-making styles with shopping frequency

Preliminary analyses gave some suggestions for expecting specific profiles of consumer decision-making styles for consumers preferring particular retail format. For instance consumers preferring buying in shopping malls have more pronounced compulsive style, have relatively high scores on recreational shopping consciousness (hedonic) scale, and also are novelty-fashion conscious and brand conscious.

Because of only slight, but statistically significant differences on the level of particular decision-making styles, for people preferring particular retail type, the results are omitted.

Instead, there is a more detailed description of the results of structural equation modeling for causal relationships between the score on some consumer decision-making styles according to PCS and declared frequency of shopping in particular retail format (as a simplified measured of reveled preferences for choosing retail outlet types in everyday life). Detailed figures showing graphically particular models (there were 12 models estimated) and their paths including covariances between styles are not shown – this would need more space than is allowed for this paper. But detailed description of standardized regression weights in each model for particular styles are shown in table 4.

We need to note, that because of exploratory character of this study we didn't expect to test any hypotheses regarding models, and from each model not significant paths representing influence of particular decision-making style on dependent variable were dropped from the model, "purifying" it from not significant paths, and helping to improve models' fit to the data.

Table 4 contains standardized regression weights for all considered models with typical measures of model fit. In general the models are fitting the data well in all cases, but predictive value of such model in some cases is very low considering their R^2 values, especially for hypermarket, supermarket and convenience store (not exceeding 0.02 for each case). The highest R^2 had models for shopping mall and cash & carry store formats (in both cases over 0.066). Low R^2 values are suggesting that in our models important descriptors are omitted (which was expected), but quite good fit of all models confirms the existence of causal relationships between shopping behavior and profile of consumer styles.

Table 4. Path modeling results for particular decision-making styles explaining usage of particular store formats

a) Standardized regression weights

Decision making styles	Store formats											
	hyper-market	super-market	„category killer"	shopping mall	conven-ience store	discount store	specialist store	24/7 store	market-place	cash & carry	Internet store	Internet auction
PERF	0.065*	ns	ns	0.083**	ns	ns	ns	ns	ns	0.062*	0.064*	ns
BC	ns	ns	ns	0.064*	ns	ns	0.068*	ns	-0.062*	ns	ns	ns
NFC	ns	ns	ns	0.090*	ns	ns	ns	ns	ns	ns	ns	ns
RSC	0.090**	0.121***	0.106**	ns	ns	0.152***		-0.074*	0.074*		0.076*	0.105***
PVC	ns	-0.068*	-0.092**	ns	ns	ns	-0.129***	-0.202***	0.081**	-0.098***	-0.164***	-0.136***
IMP	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CO	ns	ns	ns	ns	0.121***	0.084**	ns	ns	ns	-0.067*	ns	-0.076*
HBL	ns	ns	ns	ns	ns	ns	ns	ns	-0.112***	ns	ns	ns
COMP	ns	ns	0.107***	0.187***	ns	ns	0.065*	0.133***	ns	0.216***	ns	ns

Notes:
ns - not significant * $p<0.05$ ** $p<0.01$ *** $p<0.001$

b) measures of fit

Measures of fit	Store formats											
	hyper-market	super-market	„category killer"	shopping mall	conven-ience store	discount store	specialist store	24/7 store	market-place	cash & carry	Internet store	Internet auction
Variance Explained – R^2	0.012	0.019	0.042	0.078	0.015	0.030	0.028	0.055	0.027	0.066	0.040	0.039
c2/df (below 2 or 3 better)[a]	10.152	0.600	3.062	3.663	n/a	3.600	3.001	3.062	0.998	3.203	5.932	1.902
P (not significant better)[b]	0.001	0.439	0.047	0.056	n/a	0.058	0.050	0.047	0.407	0.022	0.003	0.149
GFI (above .9 is good fit)	0.994	1.000	0.997	0.999	1.000	0.998	0.997	0.997	0.998	0.996	0.994	0.998
AGFI (above .8 is good fit)	0.962	0.998	0.986	0.979	n/a	0.987	0.986	0.986	0.994	0.982	0.972	0.991
NFI (above .9 good fit)	0.586	0.971	0.979	0.991	1.000	0.905	0.948	0.981	0.969	0.936	0.859	0.951
RMSEA (.05 or less better)	0.093	0.000	0.044	0.050	n/a	0.049	0.043	0.044	0.000	0.045	0.068	0.029
PCLOSE (not significant better)[c]	0.060	0.813	0.520	0.389	n/a	0.396	0.530	0.520	0.969	0.529	0.170	0.727

Notes:

[a] "rules of the thumb" suggested by Carmines and McIver (1981, p. 80) or Byrne (1989, p. 55).

[b] for lager samples it is often unreasonable to have significant p value (Jöreskog, 1969, p. 200).

[c] "p value" for testing the null hypothesis that the population RMSEA is no greater than .05 indicating close fit (Browne & Cudeck, 1993).

Preference for buying in hypermarkets is caused by higher level of recreational/hedonistic shopping orientation, and higher level of perfectionism (model fits the data less in comparison to other ones). People more often buying in supermarkets are also recreational shopping-oriented, but also less price-value conscious. More frequent buying in specialized large stores (so called "category killers") is caused by the same styles than shopping in supermarket, with addition of the positive influence of compulsive decision-making style.

As has been observed during preliminary research, shopping malls attract more compulsive consumers, they are higher on perfectionism, novelty-fashion conscious and brand conscious.

Frequent shopping in convenience stores is caused only by one form nine styles: higher than usual confusion by overchoice – not so wide assortment and small infrastructure attracts such consumers to this store format. From the same reason people sensitive on overchoice prefer buying in discount stores, also higher recreational shopping orientation is connected with references of choosing discounters.

Key characteristic of consumers liking and buying more often in specialist stores is low price-value consciousness, higher brand consciousness, and higher compulsiveness. 24/7 stores are opened non stop (some of them excluding some national holidays), and they attracts people more compulsive, less price-value sensitive (sometimes of seriousness of needs to buy something), and less recreational-oriented.

Buying on traditional marketplace/bazaar is likely performed by consumers price-value sensitive, recreational-oriented during shopping, rather not habitual-brand loyal, and not brand conscious.

Cash & carry type outlets are perceived well by compulsive consumers, perfectionists seeking always best products, people less sensitive on price-value issues, as well as not easily confused by overchoice.

Two consumer decision-making styles are predictors of Internet shopping – this means that consumers less price-value oriented and more recreational-oriented are likely to shop more frequently. Additional style connected with buying in Internet stores is brand consciousness – more products of well-known brands is easier available in Internet stores than in conventional retail. Consumers preferring Internet auctions are less likely to be confused by overchoice – large number of items offered on such platforms not confuses them, they often use some strategies to minimize the information overload by using searching tools.

Approach taken by the authors has some limitations discussed in last part of this paper, but if such results will replicated, should give many insights for retail practitioners.

CONCLUSION

As noted before this research gave some answers for similarities and differences between retail formats as perceived by consumers, and also for connections between consumer decision-making styles and actual store format choice.

It seems important to show that some retail formats are perceived as similar, for instance marketplaces and discount stores, hypermarkets and supermarkets, Internet shops and Internet auctions, while convenience stores seem to be very distinct in comparisons to other formats.

From nine consumer decision-making styles analyzed, eight influenced significantly frequency of shopping in at least one type of retail outlets. In two cases: recreational/hedonistic shopping consciousness and price-value consciousness eight from twelve formats are affected.

Level of recreational/hedonistic decision-making style significantly influencd buying in discount stores, supermarkets, hypermarkets, and so called "category killer" specialized stores, as well as in Internet auctions, Internet stores and classical marketplaces (having positive impact on frequency of shopping). However, for 24/7 type stores this style has negative impact, and – rather surprisingly – there is no significant relationship between this style and shopping in shopping malls.

The degree of price-value consciousness had mostly negative impact for shopping in 24/7 stores, Internet stores and Internet auctions, specialist stores, "category killers" supermarkets, and cash & carry places. Only buying in marketplaces was positively connected with mentioned decision-making style.
Compulsive orientation, connects significantly with shopping in cash & carry places (maybe bulk quantities are teasing compulsive shoppers), shopping malls (as expected), 24/7 stores (probably giving "instant relief" for consumers addicted to shopping), "category killers" and specialist stores.

High sensitivity to be information overloaded because of overchoice was present for convenience stores and discounts. In opposite way this style affected buying cash & carry, as well as on Internet auctions.

High perfectionism increases frequency of shopping in shopping malls, hypermarkets, cash& carry and Internet stores, while having more pronounced brand-conscious shopping orientation connects positively with buying in specialist stores, shopping malls (easier to buy better brands), and negatively with buying in traditional marketplaces.

Novelty-fashion conscious orientation, as well as habitual brand-loyal one affected only shopping in shopping malls and marketplaces respectively. Impulsive orientation was not included in any model – there is a possibility that low reliability of that construct is the reason of such situation.

The effects of this research should have several practical implications. Firstly, knowledge of the nature of consumer decision-making style profiles leading to preferences to retail format choice should lead to better marketing planning, positioning and other merchants' decisions. Secondly, the research results should give a possibility to explore similarities and differences between different store formats using gathered data. Thirdly, this study should have also valuable suggestions for e-commerce practitioners connecting some decision–making styles with possible threats and difficulties in e-commerce adoption perceived by consumers: fraud, getting not-original products, information overload, too high prices (adding delivery costs), and lack of enjoyment.

Unfortunately, this study has also some important limitations, including:

- single-item measure for shopping behavior in terms of frequency of buying, as a measure of revealed preferences is too simple – there is a need to develop a better measure for such thing,
- low possibility of results generalization to the other cultures and retail structures – comparative study including at least 3 countries with differences in both mentioned factors should be done,
- results have been not replicated so far,
- demographic factors, not considered here, might influence the results – because of it and also from previous reason there is a need to redesign measures and sample structure (for instant trying to replicate results on the sample which is less diversified in terms of i.e. age, income and so on),
- not best possible reliability of used measures of consumer decision-making style factors, leading to some wording changes for some items,
- lack in the catalog of styles form PCS, the style including some ecological shopping orientation – there is a need to develop items for such style, and test them for possible inclusion to the adapted by authors 9-factor structure of PCS as a 10th factor.

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MODELING THE EVALUATION OF BUSINESS EXTERNAL COMPETITIVE CAPABILITIES

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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 enhance its competitive advantages. 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, which is considered the influence of dynamics of the external environment by referring the "normal mode" of nature science, to evaluate the performance of business capabilities. To explore the conditions of firms and to propose some directions with business tactics are the major contributions of this model. Organizations would enhance their competitive capabilities by reallocating the resources, and make their decisions for sustainable development through the more holistic approach.

Keywords: mathematic model, competitive capabilities, environmental dynamics

INTRODUCTION

Research on the environmental dynamics and strategic management has made significant progress in recent years. In 1950s, system dynamics proposed by Forrester, has been developed to model, it analyzes and describes the dynamics of the scenarios of business operating by providing a kind of simulation program. In 1970s he published "World Dynamics" which tried to find and explain some trends via setting relative variables and parameters through a macroscopic view of industries, using a feed back perspective. On the other side, the early development of business strategy is primarily due to the work of Alfred Chandler and others at Harvard Business School (Chandler, 1962). 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; Nerur, et al., 2008). Therefore, Dynamic strategic management problems are investigated by more and more scholars with different background such as the field of economics, organizations, education and management (Senge, 1990; Sterman, 2000).

Furthermore, 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 (Reeves, et al., 2003). Therefore, one of the critical tasks tackled 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 or in-depth interviews (e.g., Song, et al., 2007; Apigian, et al., 2006; Hult, et al., 2006). In this research, we propose a quantitative method to select the appropriate strategy for firms based on system dynamics and fuzzy theory. The model will be constructed by combining the key factors of external environment and the key performance indicators of internal capabilities, which are involved the influence of dynamic environment. The model can be used to evaluate the degree of environment dynamics, and rank the appropriateness of the four basic strategy types of Miles and Snow (1978). According to considering the effects of the opportunities and threats of industrial environment and impacts of organizational institution of internal environment, the model is useful to support the decision making in selecting the business generic strategy and enhance the competitive advantages of enterprises.

LITERATURE REVIEW

The success of business strategies depends on their capacities in responding to the feedback of dynamic and uncertain environment by avoiding threats and catching opportunities. There are a great number of tools be developed not only to help firms to analyze the situations of them, but also assist firms in implementing, applying and evaluating the strategies.

External Environment

The external environment includes all kinds of elements existing outside the boundary of firms that have the potential to influence the life and development of organizations. The affecting forces of external environment are uncontrollable, because they are made from the uncertain and dynamic environment. The external environment can be conceptualized as two layers: general and industrial environment, the general environment is the outer layer and the industrial is closer to the firms. In 1967s, Aguilar analyzed the external environment by using a framework which combines four perspectives: politics, economics, socioculture and

technology (PEST analysis), and it is important for a firm to consider its environment before making some strategic policies. In step with the progress of science and culture, some widespread use of the PEST analysis such as SLEPT which added legal, and PESTEL which inserted environment and legal, etc. Enterprises can survey themselves and summarize their opportunities and threats in the general environment. On the other side, in 1980s, Porter's Five Forces tool can be used to analyze the influence of the industrial environment, the Five Forces includes potential latest entrants, bargaining power of buyers, bargaining power of suppliers, threat of substitute products and rivalry among competitors. This tool is a powerful for assessing the nature of competition in the industry, and it will help firms to understand the strength of the current competitive position.

Internal Environment

Adopting key performance indicators (KPI) of balance scorecard (BSC, Kaplan and Norton, 1992) is suitable to evaluate the performance of organization in the internal environment. Companies can design the KPI to estimate the performance of organizations, and assign the responded goal to achieve. Due to the model in this research is constructed by the concept of mathematic method, herein, the quantitative KPI are chosen from the indicator pools. The KPI of our model are shown in Table 1 as below.

Table 1 The KPI of the internal environment

BSC perspective	Financial perspective	Customer perspective	Internal process perspective	Learning perspective
KPI	- Return on investment - Return on assets	- Market value - Sales Growth Rate	- R&D efficiency index - Operating cycle	- Operating revenue per employee - Employee

The tools mentioned above are useful for describing the conditions of companies by using qualitative or nominal term, but they can't show up the information in number formats. The next section will review the concept of system dynamics, which is a quantitative approach to investigate the performance of a "system."

System dynamics

In 1950s, Forrester pointed out the perspective of system dynamics, he argued that this new method is useful to model, analyze and describe the dynamics of the scenarios of business operating. People can find the developing trend in the system which they are interested by using this approach. In this research, we will combine the elements of PEST analysis, Five Forces analysis and BSC, and describe them via the concept of system dynamics. Figure 1 is the research framework in this study, and we will propose a mathematic model to evaluate the competitive capabilities through the dimensions mentioned in Figure 1.

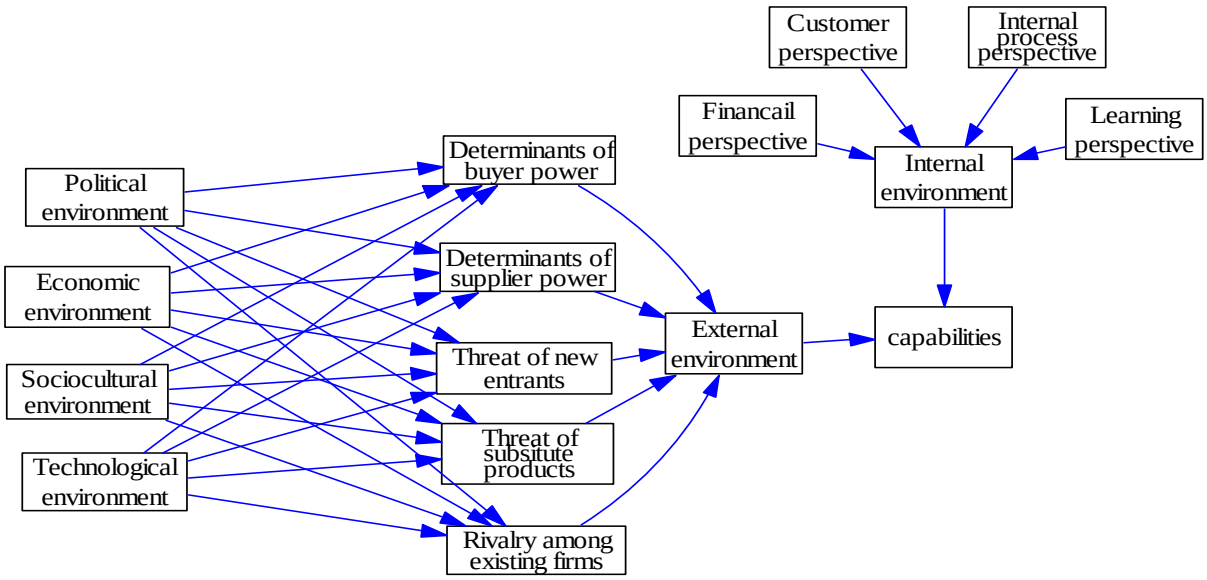

Figure 1 Research framework

MODELING

The challenge of modeling interdependent variables had recently received considerable attention in the economics and management literatures. Our model was revised and derived from the "utility function of risk" to adapt it to the problem about the uncertain and dynamics of external environment in this research. Adapted from Arrow-Pratt measure of risk taking, three commonly used types are employed in the model as alternative decisions for firms: risk averse, risk neutral and risk prone. The three decisions will bring different performance of the business, and can be represented by three kinds of utility functions, respectively. (Keeney, 1980).

$$U_1(x) = a_i + b_i(-x^{-c(t_i)x}) \quad \text{risk averse}$$
$$U_2(x) = a_i + b_i\left(c\left(t_i\right)x\right) \quad \text{risk neutral}$$
$$U_3(x) = a_i + b_i(x^{c(t_i)x}) \quad \text{risk prone}$$

$U_i(x)$ represents the performance of organization which use ith risk type, and a_i, $b_i > 0$ are constants, and $c(t_i)$ indicates the degree of risk aversion, neutral and proneness in time t. Our model combines the decision variables (x) of the operating process in internal environment and the moderating variables between industrial and general environment in external environment to describe the growth of the businesses. Based on the dynamics of external environment, we refer the concept of "Normal mode" in the nature science to describe the dynamics in the general environment, and apply the perspectives of "life cycle" to express the development in the industrial environment. Herein, we assume that the dynamics of external environment as "Normal mode", and based on the Hooke's Law, the conditions and scenario in a dynamic system can be expressed as following functions.

$$c(t_i) = c_0 \cos \omega t_i$$

c_0 is the initial value of the normal mode system. ω represents the intrinsic characteristics of the external environment, and the more intense environmental turbulence, the larger value of ω. In order to the impacts of external environment are important to the utility function, we redefine the parameter c_0 to be the influence of the external environment. And then,

$$c_0 = (O^G + O^I) - (T^G + T^I)$$

$$O^G = \sum_{k=1}^{4} (\sum_{j=1}^{n} w_{kj} \times v_{kj}^{o})$$

$$T^G = \sum_{k=1}^{4} (\sum_{j=1}^{n} w_{kj} \times v_{kj}^{T})$$

$$O^I = \sum_{m=1}^{5} (\sum_{s=1}^{s} w_{ms} \times v_{ms}^{o})$$

$$T^I = \sum_{i=1}^{4} (\sum_{j=1}^{n} w_{ij} \times v_{ij}^{T})$$

O^G, T^G is the opportunities and threats of general environment, respectively. W_{kj} represents the weight of j^{th} factor of k^{th} general factor, and $v_{kj}{}^{o}$ is the value of opportunity of j^{th} factor of k^{th} general factor. k = 1,2,…,4. O^I, T^I is the opportunities and threats of industrial environment, respectively. w_{ms} represents the weight of s^{th} factor of m^{th} general factor, and $v_{ms}{}^{o}$ is the value of opportunity of s^{th} factor of m^{th} general factor. m = 1,2,…,5.

DATA COLLECTION

The data of internal environment can be collected in Compustat database (S&P), and the data of external environment can use the format and content of Table 2.

External factors	Opportunities					Threats			
	9	7	5	3	1	3	5	7	9
Political Factors									
Economic Factors									
Sociocultural Factors									
Technological Factors									

Table 2 the values of external factors

CONCLUSION

The main contribution of this research is involved with the influences of dynamics of external environment and capabilities of internal environment on the risk functions. The Figure 2 shows the dynamics of the organizational environment.

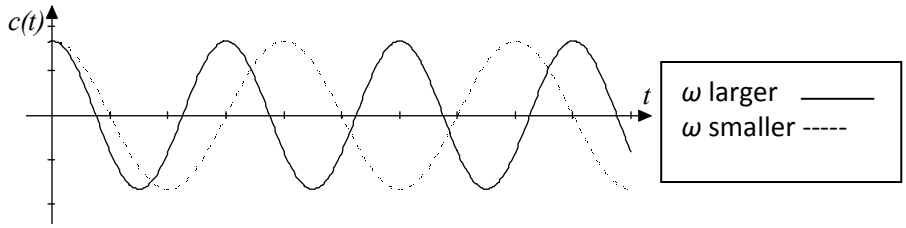

Figure 2 The dynamics of organizational environment

At the same level of external forces, the capabilities of internal environment will determine the dynamic situations of the companies. If the capability of internal environment is larger, the ability of fighting the influence of external environment is larger.

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THE ROLES OF QUALITY, MARKETING AND KNOWLEDGE SYSTEM IN BUSINESS COMPETITIVENESS

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ABSTRACT

The fast changing internet world has revolutionized the way firms conduct business, relate to partners, customers and suppliers. The internet technology has also enabled a competitive business landscape, which has created opportunities and challenges for a variety of businesses in meeting customers' needs. Customers are now better educated and informed on specific products and services, partly, because of the roles of the internet, hence greater alternatives for customer. This research provides three key management-focused constructs for building business competitiveness. The objective of this paper is to examine the key determinants of firm competitiveness on three fronts: Quality Management, Marketing Management, and Knowledge Management. We collected the data for this research through questionnaire survey from a sample of 690 participants in Malaysia. The analysis was based on a valid response of 193. The findings revealed significant relationships between the dependent and independent variables. This research provides useful information for businesses in building critical capabilities to create and maintain competitive positions in the marketplace. The paper would also be useful in enriching theory for future research.

Keywords: Quality Management, Marketing Management, Knowledge Management, Business Competitiveness, Malaysia

RESEARCH BACKGROUND

Most companies are struggling to sustain business revenue because of the global financial crisis. Most companies find it difficult to sustain their business with existing customer due to the slump down global demand. In addition, the fast internet technology diffusion creates avenues for customers to search for alternative products. More companies are trying to expand their businesses in to global market via internet, which could help to expand their market share. As a result, firms are not only facing local competition and also the global competition pressure, firm need to develop comprehensive strategies to overcome rival competition and survive in contemporary marketplace.

Firms now find it difficult to maintain customer loyalty as opposed to decades ago. This is because most companies work aggressively to expand new market base as they strive to compete for better positions in niche market. Rival competition force companies to formulate idea strategies to survive in this recession market. Therefore, company need to develop an effective defensive strategy, and also offensive strategies in order to strengthen their firms' competitive advantage. This is because defensive strategies do not sustain competitive

advantage. They enable firms to remain afloat in the market, but the danger it posses is that competitors could easily imitate firms that use defensive strategies as the strategy does not aid in improving advantages. Beside, offensive actions will delay competitors speed to attack existing market share. Consequently, defensive and offensive actions are required to implement maintain a strong market position. .

Defensive strategy plays an important role in sustain customer loyalty and in securing profitability. The defensive tool in this paper will be quality management; this is because offering customers higher quality would positively influence customer satisfaction. Thus, quality serves as key criteria for firm to gain competitive advantage. In other words, better quality enables a firm to have sufficient defending power to prevent competitors from taking over its market share. Generally, there are various quality perceptions from the customer view point and therefore we will focus on the view of intangible quality service such as knowledge service, commitment and responsiveness in this paper. The intangible quality service is difficult to imitate by competitors and this could have business competitiveness building capability.

Besides the aforementioned, a company is required to defend its existing customers. Offensive strategy also plays an important role in improving the firm's competitive advantage, marketing management should consider as one of the offensive strategy in the marketing world. Usually explore new market or attack competitors market base is consider as offensive activity in the company, and a series of offensive activity will support by marketing tools such as promotion, differentiation and diversification strategies. Therefore, this paper will focus on the impact of promotion, differentiation and diversification on the business competitiveness. For example, company need effective promotion and differentiate product to attract new customer, diversification will enable firm to expand their business revenue and achieved business competitiveness.

Both defensive and offensive strategies are important for the firm to sustain their competitive advantage. It is important to note that, both strategies correlate with each other and that they should used in a complementary manner to help achieve specific objectives for the firm. Thus, interfacing instrument is essential in between the defensive and offensive strategies. Information system will act as a communication centre for the information sharing. For example, company can adapt the successful selling method on existing customer and apply to the new customer, this method will enable firm to have better convincing power to convince new customer. Or company may discover new opportunity from new customer and firm may find a similar opportunity on their existing customer. Therefore, information system is essential for the interaction between internal and external.

As a result, companies need to develop comprehensive strategies to sustain business competitiveness. We will focus on the impact of quality management (QM), Marketing management (MM), and Knowledge management (KM) on the business competitiveness. As mentioned earlier, companies require defensive, offensive and the knowledge manipulation systems to form as a complete solution to sustain business competitiveness. Furthermore, the comprehensive model would serve as a proactive solution for the firm to think ahead of competitors, the complete solution would help to overcome the competitive intensity in the industry, as competitors may find it difficult to imitate the firms' capabilities. Therefore, the

framework would help companies act effectively to improve business competitiveness, which may in turn enable firms to overcome economic crisis such as the one we have been facing since late 2008.

CONCEPTUAL FRAMEWORK

Many firm are not only competing with the local competition because many firm enter global market to compete with domestic firm. Most of the firms need to develop comprehensive and proactive strategies to over come rival competition and continuing improves company competitive advantages. Therefore, this paper examines the impact of quality management, marketing management and knowledge management on business competitiveness.

Figure 1 shows the research framework for this paper and illustrates nine independent variables for the three constructs: knowledge service, commitment, responsiveness, promotion, differentiation, diversification, interactive data base, knowledge sharing and web services. We also generated nine hypotheses – three for each of the constructs namely quality management, marketing management and knowledge management – to test the influence of each independent variable on business competitiveness.

Figure 1: A Research Framework for Business Competitiveness

Hypotheses Development

Quality Management

Quality Management can be considered as business a survival instrument in a firm. Cheng & Choy [8] also points out that quality management plays an important role to enable firm to achieve superior performance. Excellent quality provided by the firm will enhance the satisfaction level of the customer. In addition, higher customer satisfactions will positive influence the customer loyalty. Thus, the level of quality a firm provides plays an important role in a firm's ability to achieve competitiveness. Cheng & Choy [8] also identified company commitment, continuous quality improvement and measurement, customer focus as a success factor of quality management. Therefore, we identified three quality dimensions that could be used to build business competitiveness in the firm: Knowledge service, Commitment, and Responsiveness in this paper.

Knowledge Service

Knowledge service in this paper will focus on customer knowledge and product knowledge. According to Liang, Liang & Duan [16], higher customer information would have a positive on product knowledge and that would induce customer purchasing behaviour. Customer knowledge would result in better understanding of customer's needs according to the well exposure of customer information. A firm can define its direction from existing customer information, and therefore satisfy customer expectation. Product knowledge would be a secondary stage of knowledge service after identifying customers' needs made possible with the exposure to customer information. Firms will also deliver appropriate product information to customers based on the identified customer needs. According to Mersha, Tigineh, Adlakha & Veena [17], knowledge service is one of the important factors of good quality service**.** As a result, this factor would help to achieve good quality serive, and as a consequence, would enable business competitiveness.

Many firms find it difficult to maintain their revenues from its existing customer base. Most firms are trying to expand customer base by seeking avenue to win competitors' market share Increased knowledge service would result in higher level of customer service by address customer knowledge and product knowledge to achieve better customer satisfaction. For example, a firm can train knowledgeable sales people to advice on customers' need immediately. Sales people able to offered appropriate product information according to customer requirement. Therefore, knowledge service is playing an important role in its capability to provide customer loyalty because customers would feel comfortable to deal with knowledgeable sales people than otherwise. Ball, Coelho & Manuel [1] claim that better customer service, could lead to higher levels of customer satisfaction, which could also lower price sensitivity..

Hypothesis 1: Good knowledge of service will have a positive influence on business competitiveness.

Commitment

Commitment can be defined as an important variable that enables businesses to grow. According to Fullerton [11], high commitment from a firm will have a negative impact on customers' willingness or intentions to switch, which could enhance the relationship with customers. Caceres & Paparoidamis [5] also points out that relationship commitment has a positive impact on customer loyalty. Effective sales persons are very important for a firm to establish a strong position on the commitment given to customer. This is because poor commitment may result in negative impacts on customers' dissatisfaction, which could also affect the loyalty to the firm. Furthermore, achieving effective commitment not only relies on front line personnel, but it also depends on the top management to ensure that the required structures and framework are in place to support the processes. Firms must be highly committed to their staff in order to enhance employees' job satisfaction, and therefore the employees' commitment towards customers.

Nowadays, the perception of customer on commitment can be considered as an assurance and responsible provided by the firm. For example, customer would feel comfortable to have transaction with those company will compensate discounted voucher during late delivery happen. Customer willing to purchase goods or services with those companies can provide extended warranty or 24hours service response and part replacement service. The higher level commitment provided will highly influence on customer loyalty and lower customer comparison on pricing as mentioned earlier on previous researcher. In contrast, it is important that how firm can deliver commitment to customer and the commitment might influence on the customer repurchase decision. Therefore, commitment is one of the important factors to influence the firm business competitiveness. Hence, the

Hypothesis 2: High level of commitment will have a positive influence on business competitiveness.

Responsiveness

Responsiveness can be considered as a customer care instrument to show that the firm values its customers. Usually customers expect fast response on any request from suppliers and this could include response to complaints, problem solving matters, inquiries etc. One of the previous research found that the effectiveness of service recovery strategies will result in higher customer satisfaction Jayachandran, Hewett, & Kaufman [14]. In addition, responsiveness serve as a tool to minimize customers' complaint and enhance customer satisfaction. Especially in this economic crisis year, fast responses to custmers' issues would provide a strong advantage for a firm to build upon in developing capabilities for business competitiveness.

In the current market circumstances, customers are able to find alternative sources of products and services they may need through the Internet and this will create avenue for possible multiple suppliers from all around the globe. It is important for firms to maintain a strong relationship with custmers by being more responsiveness to theur needs. Disatisfied customers may find it easier to wsitch to competitors' product than otherwise, and some cases, may provide competitors some privileaged information about a firm. Meanwhile, firms

frequently seek customers' feedback on how the employees handle customers' complaint and inquiries. And majority of firms have begun to implement The Internet system to serve customers better and faster, and providing customers with enhance service quality. Brown [4] points out that greather speed in responding to customers' complaints will enhance the ability of the firm to maintain a steady market share and possibility improve the overall business position in the marketplace.

Hypothesis 3: Responsiveness will have a positive influence on business competitiveness.

Marketing management (MM)

Marketing management serves as a new market development weapon and business growth instrument among firms. Gok [13] mentioned that marketing is the key factor for the company to sustain its competitive adcvantage. Propoer marketing management planning will enable a firm to create outstanding performance compared to their competittors. As a result, outstanding performance will lead the firm to create customer awareness and effectively explore the new markets for new business opportunity. Firms are able to attract new customers by attracting more market share, and hence the firms will sustain their business competitiveness. This article identified three marketing dimensions that could be used to create business competitiveness in the firm: Promotion, Differentiation, and Diversification.

Promotion

Promotion is an activity to create customer awareness on a firms' product, service and brand name. According to the previous research, advertising relates positively with a firm's sales revenue (Kim, Wilcox & Drumwright) [15]. In other words, promotion serves as an important variable to develop business stability and growth, which could translate into bigger sales in the market. Meanwhile, promotion also acts as a new market development tool because promotion such as discounted price, new product demonstration and mobile marketing would help a firm to attract new customer. In addition, promotion activities work hand in hand with marketing strategies in response to market competition in order to expand market share.

New global business enforced promotion transit from conventional paper broacher marketing to telephone/internet marketing. Telemarketing is one of the important elements in sales and marketing strategies because telephone account management is able to cover wider areas of customer (Oetting, Rudy, Gantman & Geri) [20]. Firms can adapt telemarketing strategies on their promotion and this could result in more customers covered compared to face to face visit. Firm can email promotion materials to targeted customers after telemarketing activity. As a result, this method seems to be cost effective and efficient than traditional promotion methods. More over, firms can effectively identify new potential opportunities after telemarketing screening process. Firms can also minimize business travelling cost by using telephone/internet marketing. Bravo, Mugica, & Sanz [3] claim that promoting products will increase brand awareness and loyalty, which could in turn improve the firm's competitive advantage.

Hypothesis 4: Effective promotion activity will have a positive influence on business competitiveness.

Differentiation

Differentiation can be considered as an offensive weapon to build more market power and economies of scope. Customers will be attracted to the uniqueness of a product and this could increase the firm's ability to increase the number of customers who are insensitive to price, wich in trn may enable the firm to earn more revenue (Tan, Kwan & Eze) [22]. Usually, industry new entrants must act differently or produce some special products to be able to maintain a stake in any industry, especially in this competitive business era. This is because the existing players in the industry will concentrate their efforts on protecting their own market base with well established customer relationship. Customers would feel reluctant to switch over to other firms that provide similar/homogeneous product and services. Therefore, new firms should perform outstanding works and formulate specific strategies strong enough to create a good impression in a market. The differentiate solution will effectively minimize an unnecessary competition with existing firm.

Firms may select differentiation in pricing, product features, service quality and sales people knowledge for their marketing strategies. For pricing and product features, differentiation can be classified as tangible differentiation, while, service quality and employees' knowledge can be classified as intangible differentiation. Tangible differentiation could be easy and the fastest to approach to implement a firm's short term strategy. However, price and product features are easier for competitors to imitate. Intangible differentiation would require longer time to establish but it is difficult to imitate by competitors. Therefore, firms would use tangible differentiation as short term market penetration and intangible differentiation would be a long term solution to sustain the firm's competitive position in the market place. For example, firms offer cheaper price range product to enter new market for business opportunity. A firm can also build up customer relationship with differentiated service and quality after the firm's successful entrance into the market. According to Fisher & Robert [10], firms can sustain superior competitive position when durable differentiation is achieved. Dumovic [9] also claims that product driven differentiation will sustain the competitive advantage. Consequently, differentiation acts as an important offensive weapon to develop new markets and also defend existing customer base.

Hypothesis 5: Differentiation initiatives will have a positive influence on business competitiveness.

Diversification

Diversification plays an important role on business expansion and enhances business competitiveness. According to Bobillo, Iturriaga & Gaite [2], firms internal and external advantages have certain correlation with the international market diversification. Tan, Kwan & Eze [23] mentioned that the comprehensive range of product offered will enhance the customer loyalty. Diversification can be through market or product diversification. Both business diversifications would also increase the firms' revenue and business competitiveness. Therefore, diversification would facilitate the firm to move towards higher levels and could enhance the firm's capabilities. In other words, the enhancement of the firm's capabilities will enable the firm to deal with the existing competition in the

marketplace, and hence the possibility for the firm to achieve a competitive position in the industry.

In this economic crisis, most of the firms find it difficult to grow or even maintain existing market position because of global demand contraction. In this case, diversification becomes crucial for the firm to survive in this economic down turn. Firms can use diversification strategy to improve sales, which could also help to overcome this crisis. The diversification strategies can be applied in two ways. For example, well established firms may implement product diversification to improve in flattening sales situation, while medium and small scale businesses can implement market diversification method to overcome sales contraction in existing customer base. Alternatively, firms can also mix strategies of market and product diversification to improve firm revenue. As a result, diversification strategies would be useful for firm's expansion and also diversify the firm's risk to achieve business competitiveness.

Hypothesis 6: Business diversification will have a positive influence on business competitiveness.

Knowledge management (KM)

Knowledge management plays an important role in building a firm's capabilities. Moustaghfir [18] indicates that effective knowledge asset management would have a positive impact on the firm performance. In other words, knowledge management system (KMS) can act as a supporting tool for the firm quality management and marketing management process. Effective knowledge management will enable firm to speed up the employee knowledge learning process and firm capabilities building process. In addition, KMS could assist firms manage customers' information, which could enable better customer understanding. KMS would also help firms to publish comprehensive product information according to specific requirements by consumers. In this paper, we identified three knowledge management dimensions that could be used to create business competitiveness in the firms and they are Interactive data base, Knowledge sharing, and Web services.

Interactive data base

Interactive data base is one of the interfacing instruments involve in buyer and seller. Excellent customer interaction will enhanced customer knowledge and these will lead to higher customer relationship (Cardwell) [6]. A two-way communication is important to the firm because effective communication will enable firm to aware on customer needs and behaviour. Furthermore, data base will reserved all customer information for firm to develop appropriate strategies on customer loyalty program. While, the interactive activities can effectively build up the customer relationship. To improve customer relationship and increase customer loyalty is depend on firm managing interaction with customer (Calhoun) [7].

The interactive data base would be online interaction and the feedback of sales people. Online interaction would be the faster way to acknowledge the customer voice. Unfortunately, there is some missing screening on mute customer are feel reluctant to feedback their needs via internet. Therefore, personal visit and phone call will be effective in this situation, face to face and phone call can well mange on those "mute customer" and

search out their expectation and needs. This is because the customer information is the key information for the firm to address customer properly. There will be an advantage if the firm have extra information than their competitors. Firm are able to develop appropriate marketing strategies to have outstanding performance than competitors. Consequently, interactive data base act as an important tools to enhance company competitive advantage.

Hypothesis 7: Effective interactive system will have a positive influence on business competitiveness.

Knowledge Sharing

Knowledge sharing is internal knowledge transfer of information among the staff. Knowledge sharing will enable firms to improve their capabilities and business competitiveness by maximizing the firms' ability to satisfy customers' needs and generate solutions to increase the firm's efficiency (Reid) [21]. Proper knowledge management involves manipulating explicit and implicit knowledge to improve efficiency and this will help a firm to achieve competitive advantage (Nunes, Annansingh & Eaglestone) [19]. Knowledge sharing plays an important role to improve employee's knowledge; this would improve the firms' capabilities. Especially in the hypercompetitive business era, intangible capabilities are not easy to imitate by competitors and the firm will sustain competitive advantage. Therefore, knowledge sharing is becoming an important process to develop employees; knowledge capabilities. And these would improve communication frequency among the staff for better team work in the firm.

The knowledge shared among the employees could include customer knowledge, successful selling method and the most sellable products to specific industries. Firms currently are trying to optimise efficiency in order to compete effectively. Knowledge sharing would assist firms to effectively adopt strategies through knowledge sharing processes. Further more, knowledge sharing also helps to support the firm's knowledge service quality and differentiation initiatives. For example, sales personnel could be able to share their customer, industries, and product knowledge through the knowledge sharing process. They can also apply specific knowledge sharing ability to similar circumstances outside the current market. This would increase the firm's business opportunities and it would result in better business competitive position.

Hypothesis 8: Effective knowledge sharing will have a positive influence on business competitiveness.

Web Service

Web service can be defined as convenience service or fast response service to the customer. According to Yang & Lieh [25], web services enable firms to simplify the process of business transaction and hence improve the business efficiency. The electronic service may minimize customer complaint and hence the faster feedback will result higher level of customer satisfaction (Goetzinger, Park & Widdows) [12]. Web service will speed up the service process and the fast response will improve the service quality. Customer would highly satisfy with the immediate response service; the fastest service will become a value added service to

customer. Web service will delivered convenience value customer or reduce the customer waiting time, customer can login to the web page and search for assistant like user guide line or provide comprehensive product information. Or customers can speak to service officer through online conference web page and the conference will offer customer "close to you" perception.

Web service could be designed in question and answer format, online video conference, online order, e-payment service, and email complaint service product information data base such as user guide line. All these services will assist a firm to improve responsiveness. In addition, web service also offers convenience value to customers, and this would enhance the customer's interest in the firm, which could also influence the sales potentials. Trabold, Heim & Field [24] claim that electronic services are significant in most of the service industries and it would positively influence the firm's performance. As a result, web service will assist firms to satisfy customers and achieve optimum service quality, which could translate into enhanced business competitiveness.

Hypothesis 9: Effective web service will have a positive influence on business competitiveness.

RESEARCH METHODOLOGY

This paper focuses on the key determinants for business competitiveness. The research questions for this paper will be designed around the three management-focused constructs introduced earlier, which inlcude quality management, marketing management and knowledge management. These questions will also be designed to achieve the specific objectives in line with the hypotheses discussed above. Two types of data will be collected which are primary and secondary data. Primary data will be collected using survey questionnaire, while secondary data will be drived from printed resources such as journal articles, magazines, newspapers etc. Participants in this for this research will be selected through cluster sampling method. We have selected four key states in Malaysia for this research and they inlcude Malacca, Kuala Lumpur, Johor and Penang. We chose these four states because of their standing in application of new developments in technology, the location of key business operations, and economic contributions to Malaysia. Furthermore, face-to-face interviews will be considered as an additional data collection method both before and after main data collection. This is to make provision for complemetary materials that may be useful in the final discussion.

Basically, the survey questionnaire will be divided into two sections. The first section will contain questions on the respondents' background (age, gender, job title, year of working experience, business field etc), while the second section will contain questions relating to the conceptual framework. We will use a 5-point Likert scale in designing questions relating to the framework. In the design, "1" will mean "strongly disagree" and "5" will represent "strongly agree."

DATA ANALYSIS AND FINADINGS

The details of the respondent demographic profile as shown in table 1. According to the demographic profile table shows that male respondent contribution to this survey is more than female respondent which is 82.4% of male respondent participated. While the status of marital for the respondents are equally contributed and the age for the respondent is fall in between 21 years old to 50 years old. In addition, Chinese respondent is the highest participants in this survey with 60.1%. Fifty two percent of degree qualification respondents and 46.2% respondents with managerial position are participate in this survey. Most of the participants is work in sales and marketing department with 71.5% and major participants of years working experience is fall in four to six years which is 44.6%. Electronic and electrical industries background participants will be the largest contribution group in this survey with 52.8%.

Table 1: Respondent Demographic Profile

	Frequency	Percent
Gender		
Female	34	17.6
Male	159	82.4
Marital Status		
Single	97	50.3
Married	96	49.7
Age		
Below 21	0	0
21 – 30	89	46.1
31 – 40	84	43.5
41 – 50	20	10.4
Above 50	0	0
Educational Level		
Secondary School graduate	12	6.2
Diploma/Advance Diploma graduate	80	41.5
Degree	101	52.3
Master	0	0
PHD	0	0
Position		
General Manager	20	10.4
Senior Manager	11	5.7
Manager	89	46.1
Executive	73	37.8
Department		
Sales and Marketing	138	71.5
Technical/Customer Service	28	14.5
Project/Engineering	27	14.0
Year Of Working Experience		
Less than 3 years	49	25.4
4 to 6 years	86	44.6
7 to 10 years	38	19.7
More than 10 years	20	10.4
Type of Industries		
Electronic and Electrical	102	52.8
Factory/Process Automation	23	11.9
Mechanical Engineering	39	20.2
Machine Equipment Engineering	14	7.3
IT & Networking	15	7.8

Table 2: Mean Analysis for Knowledge Service Value

Item ID	Item Description	Mean (n=100)	Std Dev
KS1	Sales people with good product knowledge will be able to offer better service.	6.3161	0.69866
KS2	Sales people with well acknowledge of customer needs will enhance the level of customer satisfaction.	6.2021	0.74694
KS3	Sales people with better understanding of customer requirement will enhance product/service quality.	5.9067	0.86699
KS4	Sales people with good product knowledge will significantly reduce problem-solving time.	5.7927	0.82824
KS5	Well customer knowledge management will enable firm to develop accurate business strategies.	5.8912	0.59824

Table 2 presents the mean and standard deviation for the responses on knowledge service value. In general, most of the respondents agreed that knowledge service value is important with average mean exceeding 4.00 for KS1, KS2, KS3, KS4, and KS5. The results further indicate that most respondents rated their knowledge service value is important in improving firm business competitiveness. In addition, results show that sales people with better product knowledge will be able to offer better service to customer as the mean value indicates (KS1 6.3161).

Table 3 presents the mean and standard deviation for the responses on commitment. From the result, the average mean for commitment is above 5.00 the results further indicate that most respondents rated their commitment to customer is important in improving firm business competitiveness. In addition, results show that high commitment towards customer will positively influence business competitiveness as the mean value indicates (CM1 5.7876).

Table 3: Mean Analysis for Commitment

Item ID	Item Description	Mean (n=100)	Std Dev
CM1	High commitment towards customer will positively influence business competitiveness.	5.7876	0.55099
CM2	Continuance commitment delivered to customer will minimize customer switching intention to the competitors.	5.7098	0.65252
CM3	Customers are willing to recommend highly committed company to others and hence improved firm reputation.	5.6839	0.76961
CM4	Customer may consider firm is highly committed if firm can provide ac-hoc responds.	5.7047	0.67764
CM5	The firm commitment provided to the customer is solely dependent on front line personnel performance.	5.3990	0.68572

Table 4 presents the mean and standard deviation for the responses on Responsiveness to customer. From the result, the average mean for responsiveness is above 5.0000 (RE1, RE2, RE3, RE4, and RE5). The respondents highly agreed that the commitment is important in building firm business competitiveness (RE3 = 5.8808), followed by immediate response to corrective action (RE1 = 5.8187), shorter time for problem solving (RE5 = 5.6839), proactive response factor (RE4 = 5.6218) and faster response to customer factor (RE2 = 5.4041). Thus, responsiveness would play an important role in business compositeness.

Table 4: Mean Analysis for Responsiveness

Item ID	Item Description	Mean (n=100)	Std Dev
RE1	Customer will be highly satisfied if firm can provide immediate response to customer needs.	5.8187	0.73120
RE2	Fast responses to customer request will positive influence customers' purchase intention.	5.4041	0.83690
RE3	A firm must take corrective actions immediately when the firm observes customers are feeling unhappy with the appropriateness of the product/services.	5.8808	0.78481
RE4	A firm should be proactive to shape market demand than being reactive.	5.6218	0.98792
RE5	Shorter time of problem solving is considered as one of the good quality services.	5.6839	0.86518

Table 5 presents the mean and standard deviation for the responses on promotion. From the result, respondents feel more important in promotion activities because promotion will help firm to enhance business competitiveness. (PR1 = 5.7979). This followed by free trial sample promotion to retain existing customer (PR4 = 5.3472), telemarketing promotion (PR3 = 5.1295), free trial sample to win new business (PR5 = 5.1192), and price promotion (PR2 = 4.7772).

Table 5: Mean Analysis for Promotion

Item ID	Item Description	Mean (n=100)	Std Dev
PR1	Increased promotion activity will enhance brand awareness.	5.7979	0.89884
PR2	Price promotion activities will directly increase sales revenue.	4.7772	0.81464
PR3	Telemarketing promotion activity is one of the cost effective methods to increase brand awareness.	5.1295	0.91219
PR4	Free trail sample for new product promotion will help to retain existing customer.	5.3472	0.98885
PR5	Free trial sample for new product promotion will enable firm to win new business.	5.1192	0.97430

Table 6 presents the mean and standard deviation for the responses on knowledge service value. In general, most of the respondents agreed that knowledge service value is important with average mean exceeding 5.00 for DF1, DF2, DF3, DF4, and DF5. The results further indicate that most respondents rated differentiation is important in improving firm business competitiveness. In addition, results show that differentiated product/services will create value added for firm customers as the mean value indicates (KS1 6.3161).

Table 6: Mean Analysis for Differentiation

Item ID	Item Description	Mean (n=100)	Std Dev
DF1	Differentiated product/service will create value added for a firm' customers.	5.7617	0.55451
DF2	A differentiation strategy is considered a proactive motive to improve business competitiveness.	5.6062	0.69997
DF3	Innovative product will win new business opportunities.	5.4456	0.62782
DF4	Product/services differentiation would increase company reputation compared to its competitors.	5.5492	0.79642
DF5	Product/services differentiation would minimize customer sensitivity towards pricing.	5.4560	0.49935

Table 7 presents the mean and standard deviation for the responses on diversification. From the result, respondents believed that diversification will help firm to gain superior business competitiveness. (DV1 = 5.4301). This followed by globalization and market diversification (DV2 = 5.3316, and DV3 = 5.3264) and Product/services & business diversification (DV4 = 5.2746, DV5 = 5.1969).

Table 7: Mean Analysis for Diversification

Item ID	Item Description	Mean (n=100)	Std Dev
DV1	Globalization of business will enable a firm to increase its market share.	5.4301	0.80138
DV2	Globalization of business will lower the cost by offering standardized product.	5.3316	0.67228
DV3	Market diversification will enable firm to have large economic scale advantage compared to its competitors.	5.3264	0.83677
DV4	Geographic diversification will improve a firm's competitive performance by minimizing risk.	5.2746	0.74458
DV5	Business diversification motive would sustain firm business competitiveness.	5.1969	0.73072

Table 8 presents the mean and standard deviation for the responses on interactive database. From the result, most respondents agree that interactive database will positively influence business competitiveness. They believe that key customer information is important to them (ID2 = 5.5130), key customer information database (ID4 = 5.5026), interactive activity (ID3 = 5.3886) and address customer needs (ID1 = 5.2435). However, most respondent was neutral that the communication or active-interaction will enhance communication with customer (ID5 = 4.32).

Table 8: Mean Analysis for Interactive Database

Item ID	Item Description	Mean (n=100)	Std Dev
ID1	Interactive activities will enable a firm to be aware of its customer needs.	5.2435	0.68296
ID2	Interactive database would help firm to address customer inquiry and needs properly.	5.5130	0.63005
ID3	Interactive activities will encourage customer to provide feedback to a firm for the purchased product/services.	5.3886	0.67644
ID4	Interactive database will effectively support a firm to develop key customer information.	5.5026	0.80444
ID5	An interactive database will enhance communication with customer.	4.3200	0.61759

Table 9 presents the mean and standard deviation for the responses on knowledge management. In general, most of the respondents strongly agreed that transaction processing

is important with average mean exceeded 5.00 (KM1, KM2, KM3, KM4 and KM5). The results further indicate that most respondents rated knowledge management will improve firm competitive advantage. Furthermore, successful knowledge sharing will enhance employee capabilities (KM3 = 5.7047).

Table 9: Mean Analysis for Knowledge management

Item ID	Item Description	Mean (n=100)	Std Dev
KM1	Internal staff knowledge exchange will improve firm capabilities to achieve competitive advantage.	5.6010	0.67035
KM2	Knowledge sharing among employees will shorten the customer/product knowledge learning process of employees.	5.6373	0.58901
KM3	Successful knowledge sharing experience will enhance employee problem solving skills.	5.7047	0.90762
KM4	Successful sales experience sharing would improve firm sales people's capabilities.	5.1658	0.88003
KM5	Effective knowledge sharing program will help a firm to improve team member cooperation.	5.5907	0.49299

Table 10 presents the mean and standard deviation for the responses on knowledge management. In general, most of the respondents strongly agreed that transaction processing is important with average mean exceeded 5.00 (WS1, WS2, WS3, WS4 and WS5). The results further indicate that most respondents rated knowledge management will improve firm competitive advantage. Furthermore, online business will enable firm to gain superior competitive advantage (WS3 = 5.4508).

Table 10: Mean Analysis for Web Service

Item ID	Item Description	Mean (n=100)	Std Dev
WS1	Web services will help firms to deliver convenience value to the customer.	5.4093	0.83748
WS2	Web services can navigate customer to download desired product information and hence increase customer purchase intention.	5.2487	0.82305
WS3	Online business activities will enable firm to respond efficiently to customer inquiry/complaint.	5.4508	0.91794
WS4	Online tracking of shipment will increase customer interest to do business with the firm.	5.3368	0.83886
WS5	Web service would enhance business competitiveness by simplify business transactions.	5.3316	0.99681

Table 11 presents the mean and standard deviation for the responses on knowledge management. In general, most of the respondents strongly agreed that transaction processing is important with average mean exceeded 5.00 (BC1, BC2, BC3, BC4, BC5, BC6, BC7, BC8 and BC9). The results further indicate that most respondents rated knowledge service, commitment, responsiveness, promotion, differentiation, diversification, interactive database, knowledge management and web services will improve firm competitive advantage.

Table 11: Mean for Business Competitiveness

Item ID	Item Description	Mean (n=100)	Std Dev
BC1	Knowledge service will enable firm to improve competitive advantage.	4.5400	.59323
BC2	High commitment will have a positive influence on business competitiveness.	4.4500	.57516
BC3	Fast responsiveness will improve firm competitive advantage.	4.1700	.65219
BC4	Effective promotion activity will have a positive influence on business competitiveness.	4.4000	.72474
BC5	Differentiation initiatives will enable firm to enhance business competitiveness.	4.3200	.61759
BC6	Business diversification will have a positive influence on business competitiveness.	4.4500	.57516
BC7	Effective interactive system will have a positive influence on business competitiveness.	4.1700	.65219
BC8	Effective knowledge sharing will improve firm competitive advantage.	4.4000	.72474
BC9	Effective web service will have a positive influence on business competitiveness.	4.3200	.61759

Table 12: Reliability Test Result

Item ID	Cronbach's Alpha
KS	0.826
CM	0.677
RE	0.796
PR	0.581
DF	0.810
DV	0.782
ID	0.824
KM	0.757
WS	0.830
BC	0.886

Table 12 result shows that all variables cronbach alpha value is above 0.50. Therefore, all the data collected are reliable and all these data can be used for further analysis. Business

competitiveness shows high reliability which is 0.886; follow by web services (0.830), knowledge service (0.826), interactive database (0.824), differentiation (0.810), responsiveness (0.796), diversification (0.782), knowledge management (0.757), commitment (0.677), and promotion (0.581).

Table 13 shows the correlation matrix of all the variables in this research paper. This table would focus on the relationship between each and every independent variable with the dependent variable. From the table results shows that all the independent variables show significantly positive relationship correlation with the dependent variable (business competitiveness) and all the correlations do not exceed 0.90. This mean the data collected is no colinearity problems.

Table 13: Correlation Matrix
Inter-Item Correlation Matrix

	xKS	xCM	xRE	xPR	xDF	xDV	xID	xKM	xWS	xBC
xKS	1.000									
xCM	.806	1.000								
xRE	.749	.763	1.000							
xPR	.579	.608	.514	1.000						
xDF	.720	.614	.564	.797	1.000					
xDV	.663	.622	.582	.554	.783	1.000				
xID	.866	.796	.882	.740	.724	.634	1.000			
xKM	.710	.797	.660	.831	.654	.598	.825	1.000		
xWS	.609	.662	.703	.708	.650	.698	.759	.753	1.000	.
xBC	.877	.817	.844	.785	.830	.807	.922	.836	.870	1.000

CONCLUSION

Business competitiveness is considered as an important factor in the business world. Based on the findings in this paper, the respective firms in Malaysia would able to identify the critical factor to achieve business competitiveness, and may be able to sustain their competitive advantage from the internal capabilities improvement. A good quality management system will enable a firm to provide excelent service quality to satisfy customers' needs. This may enhance customer satisfaction, and the highest customer satisfaction will help to reduce customers swtiching capabilities and intentions. Usually, excelent quality service is considered an intangible capability, which is, more often than not, diffucult to imitate by competitors. In addition, knowledge management would effectively enhance a firm's internal capabilities through knowledge sharing process among staff, interactive data base by catering to customers' information needs. Web services will enable a firm to improve service effeciency and potentially enhance customer satisfaction. In addition,, knowledge management would also enable firms to develop solid marketing strategies to improve a firm's competitive position in the marketplace. As a result, a firm would be able to retain its customers through good quality management and appropriate marketing strategies, which could help attract greater market share, and possibily sustain a firm's business competitiveness. Finally, this research may benefi firms to based on the three

construct mentioned in this paper as the firm strategies to serving their existing and potential customer. We hope that firm can, based on our finding, improve their competitiveness by effectively managing and delivering effiency services to customers.

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THE EFFECTS OF THE HRM DEPARTMANT'S ROLE ON ORGANIZATION COMPETITIVE

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ABSTRACT

Globalization dominates the competitive horizon and an HRD deal is at the heart of organizational success. HRD should create new models and processes for attaining global agility, effectiveness, and competitiveness. This study recognizes the roles of HRD from the viewpoint of role theory and discusses its influence on organizational performance within four HRD characters: strategic partner, administrative expert, employee champion, and change agent. We conducted a survey of 112 companies in Taiwan, the results of which demonstrate that the role of HRD influences corporate performance, particularly the performances of an employee champion and change agent. Although HRD has eliminated the role of a transitional affair worker, being a strategy partner requires greater effort.

Keywords: role theory, HRD's role, performance, Ulrich's multiple role model

INTRODUCTION

Role theory has been used effectively by researchers in the fields of psychology, social psychology, sociology, organization behavior, and human resource management since the early 1930s (Welbourne, Johnson & Erez, 1998). Role theory is based on a dramaturgical metaphor (Solomon, 1985) that explains how people send and adopt specific roles. Recently, this theory was used to analyze various forms of social systems. Biddle (1986) states that role theory comprises one of the most important characteristics of social behavior—the fact that human beings behave in ways that are different and predictable, depending on their respective social identities and the situation (Biddle, 1986). Drawing on a behavioral perspective, role theory is attractive and useful in ameliorating human problems.

Multiple researchers from various fields have concluded that roles are important in social structure (Mead, 1934; Turner, 1978; Welbourne, Johnson & Erez, 1998), and roles have been recognized as central to understanding employee behavior in organizations (Katz & Kahn, 1987; Welbourne, Johnson & Erez, 1998). Additionally, role theory has also been proposed to explain teamwork. Belbins' role theory (1981), Benne & Sheats (1948), and Heap (1977) indicate the functionality of member roles that affect group performance (Chen, et al., 2002). Chen et al. (2002) provide experimental results demonstrating that role theory is effective in predicting group performance.

According to role theory, employee performance is a function of both the individual and the organization. Welbourne, Johnson, and Erez (1998) support that this theory represents a milestone in explaining performance since it combines the psychological (individual contributions) and sociological (organizational framework) perspectives. Consequently, this study recognizes the roles of HRD and discusses its influence on organizational performance within four HRD characters: strategic partner, administrative expert, employee champion, and change agent.

ROLE OF HRD

The phrase "HR professional" has long remained an oxymoron. If HR practices are to be leveraged by the HR function, HR professionals must begin to act professionally. Therefore, the new competitive reality is a new agenda for HR, that is championing competitiveness. As champions of competitiveness, HR professionals must focus more on the deliverables of their work than on doing their work better. Ulrich (1997) supports the argument that HR should define their roles in terms of value created, and develop HR mechanisms that will allow for prompt business results. They must also learn to measure results in terms of business profitability and to lead cultural transformation.

HR professionals must fulfill four key roles in order to make their business partnership a reality (Figure 1). Ulrich (1997) devises this framework over the course of his work with dozens of companies and hundreds of HR professionals; many companies have since used it as a way to describe the deliverables of their HR work.

Insert Figure 1 about here

In Figure 1, the two axes represent the HR professional's focus and activities. In fact, these two axes delineate four principal HR roles: (1) management of strategic human resources, (2) management of firm infrastructure, (3) management of employee contribution, and (4) management of transformation and change (Ulrich, 1997). Table 1 summarizes these issues for each of the roles identified in Figure 1.

Insert Table 1 about here

Management of Strategic Human Resources

The primary actions of the strategic HR manager translate business strategies into HR priorities. In fulfilling this role, HR professionals increase the capacity of a business to execute its strategies. The management of strategic human resources is based on strategy execution. In fact, HR practices help accomplish business objectives.

Management of Firm Infrastructure

Creating an organizational infrastructure is a traditional HR function; successfully achieving it continues to add value to a business. HR professionals—caretakers of the corporate infrastructure—ensure that these organizational processes are designed and implemented efficiently. The infrastructure role is based on administrative efficiency. In fact, HR professionals acting as administrative experts ferret out unnecessary costs, improve efficiency, and continuously find new ways to do things better.

Management of Employee Contribution

Intellectual capital is a critical source of the firm's value; HR professionals should be active and aggressive in developing this form of capital. The management of employee contribution leads to increased employee commitment and competence. Overall employee contribution increases when HR is able to understand the employees' needs and ensure that these needs are met.

Management of Transformation and Change

As change agents, HR professionals face a paradox inherent in any organizational change. HR serves as a business partner by helping employees to relinquish the old culture and adapt to a new one as the firm undergoes transformation. HR helps an organization to identify a process for managing change.

PERFORMANCE

Organizational performance is also a kind of competitive ability in which to estimate a firm's value (Yang, Wang & Niu, 2007). Quinn and Rohrbaugh (1983) divide their performance evaluation index into three dimensions: focus (e.g., productivity, profit, job satisfaction, and growth), structure (e.g., expressed in terms of control and flexibility), and advantage (e.g., information flow and management, and employee training and development). Ford and Schellenberg (1982) provide three dimensions to evaluating performance: goal, system, and process indicate the employees' learning and resolution behaviors.

Yang et al. (2007) mention that given the potential competitive implications of revealing such information, it is not surprising that many respondents are hesitant to report information pertaining to indicators such as profitability and return on investment (ROI). Profit rate, comparative market position, sales volume, and market share can be used to evaluate performance effectively (Woo & Willard, 1983; Venkatraman & Ramanujam, 1986; Miler, 1990).

More recently, researchers have been considering both financial and work aspects to be important when evaluating a firm's performance. High performance is a kind of resource that depends upon, among other factors, both financial content and work factors (Dyer & Reeves, 1995; Lumpkin & Dess, 1996; Delaney & Huselid, 1996; Yang et al., 2007).

METHODOLOGY

Participants

The names of firms belonging to various industries were selected from a publicly available list compiled by the Taiwan Stock Exchange Corp. Convenience sampling was utilized in this study where a total of 300 prospective respondents were contacted by telephone to solicit

their agreement to participate. Approximately 57% of the subjects contacted agreed to participate in the study.

Questionnaires were administered via mail along with a self-addressed stamped envelope. After one reminder by telephone, 112 completed questionnaires were received—a response rate of 66%. The profile of the sample is shown in Table 2. Of particular interest are the following three categories: gender distribution, age, and education.

Insert Table 2 about here

Measures

All variables were measured using multi-item Likert-type scales. The scale items and measures used in the present study are given below.

The Role of HR Professionals

We use Ulrich's definition (2001), according to which the roles undertaken by HR professionals are, in reality, multiple, not single. In fact, HR professionals must fulfill both operational and strategic roles, must function as both the police and partners, and must assume responsibility for both qualitative and quantitative goals over the short and long terms. Five concepts were used to assess the extent to which HR roles are functional. Participants indicated their agreement with each item using a five-point Likert scale ranging from "strongly disagree" to "strongly agree." Higher scores reflect higher levels of role identification. The alpha coefficients of the four concepts were 0.90, 0.96, 0.93, 0.97 (see Table 3).

Organizational Performance

As mentioned earlier, organizational performance was measured in terms of financial and work performance. Similar to the case of HR professionals' roles, five-point Likert scales were also used to measure the dimensions of organizational performance. With regard to financial performance, a four-item measuring tool was used, which included sales growth, profitability, market share, and ROI. The scale was adapted from Tippins and Sohi (2003). A four-item measurement tool was used to measure work performance; its three dimensions—

efficiency, effectiveness, and satisfaction and timeliness—were adapted from Henderson & Lee (1992) and Janz & Prasarnphanich (2003). The alpha coefficient of the scale for this study was 0.91 (see Table 2).

Insert Table 3 about here

RESULTS

Descriptive Statistics and Correlation

Table 2 presents the means, standard deviations, Cronbach's α, and correlations for the variables investigated in this study. From the participants' perspective, four roles of HR do not act strongly, particularly the role of strategic partner, which is extremely low (M = 1.54). The other roles score fairly well in this survey (M = 2.05 ~ 2.60).

An analysis of the correlations reveals that, as expected, the roles of HR acting significantly positive correlated to organizational performance.

Regression

Regression analyses were conducted to detect the relationship between HR roles and organizational performance. In the direct model, the relationship between HR professionals' roles and organizational performance was proven by Equation 1 as a significant positive relationship ($p < 0.05$). Consequently, considering the evidence, we can deduce that performance can be explained by HR professionals' roles. However, this result is partly supported by the more detailed analysis of the partial model. Only the HR roles of employee champion and change agent explain organizational performance ($p < 0.05$).

$$P1\ (Performance) = 1 + \beta 11 * OL1 + \beta 12 * OL2 + \beta 13 * OL3 + \beta 14 * OL4 + e1\ Bij = slop,$$

$ei = error$ <equation 1>

Insert Table 4 about here

DISCUSSION AND CONCLUSION

Globalization dominates the competitive horizon. This concept is not new, but the intensity of the challenge to get ahead is. If organization capability has become a source of competitiveness and HR professionals are to be the champions of organization capability (Walker & Reif, 1999), then a new agenda for both HR practices and HR professionals must emerge. This entails shifting the focus from things that can be done easily to challenging traditional beliefs and assumptions about HRD. In delivering value, HR professionals must become partners, players, and pioneers (Guest & King, 2004).

From the perspective of the value chain theory, firms are more likely to succeed when HR practices are aligned with the needs of internal and external customers. Ulrich (1997) defines the roles and activities of HR professionals' into four principal characters: strategic partner, administrative expert, employee champion, and change agent. Indeed, in this case, this research also supports the principal roles of the employee champion and the change agent.

The deliverable results of HR professionals are currently in use. However, the roles of the strategic partner and administrative expert are not apparent. On one hand, in practice, approximately 85% of the ownership of strategy formulation belongs to the general manager or line manager (Ulrich, 1997, p.33). Sometimes, HRD is carried out by an assistant or staff department, actually act as a strategy bulletined not a formulator. On the other hand, the information system has transformed the traditional paperwork system through the use of the intranet. As is often the case, most HR competencies involving process improvement and information technology are shifted to the information department. While developing e-learning, HRD focuses on content, rather than building up the learning system.

Even so, HRD cannot be a participant in major strategy formulation. In light of the shifting environment, HR professionals can still enhance the roles of administrative experts by playing the role of organizational diagnostician. In addition, HR professionals can follow the organizational diagnostic process to become a strategic partner.

This study has several limitations. First, the sample is not representative of the general population. Due to time and financial constraints, the researcher has selected a convenient sample of companies within Hsing Chu Science Park. Thus, the results must be interpreted with considerable caution. Second, this study is based on cross-sectional data; thus, no causal relationship should be inferred. More longitudinal studies across organizations are required.

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A FUZZY QUALITY FUNCTION DEPLOYMENT CONSTRUCTING MODEL FOR PRODUCT PLANNING

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ABSTRACT

Quality function deployment (QFD) is an important and useful tool in processing new product design planning in order to maximum customer satisfaction. Product planning is the first deploying process in QFD activities for a new product development (NPD). Recognizing and ranking the importance levels of customer requirements (CRs) are vital issues due to the explicit and implicit voices of the customer leading the determinations of design requirements (DRs) and the relationship between CRs and DRs in the QFD activities for product planning. Unlike the existing researches, this study considers three different perspectives, including customer perspective, competition perspective and value perspective, to evaluate the importance levels of CRs. To cope with the vague and uncertainty nature in product planning stage, fuzzy approaches are adopted in the proposed methods which including the modified fuzzy Delphi, entropy and value analysis methods with the concept of α-cut. Besides, dissimilar to prior studies which ignored the interactive influences between CRs themselves, this paper not only consider the relationship between DRs themselves but also take the relationship between CRs themselves into account to determine the relationship between CRs and DRs. From an illustrative example, the proposed methods indicate that the total degree of customer satisfaction achieved is greater than the previous methods.

Keywords**:** quality function deployment (QFD), fuzzy set theory, product planning, customer requirements

1. INTRODUCTION

Quality function deployment (QFD) is a useful customer-driven tool for new product development (NPD), devoted to translating customer requirements (CRs) into well communication to leading better efficiency in the downstream processes of NPD for maximizing customer satisfaction [5, 6]. A general QFD process consists of four phases which is start with CRs to product design requirements (DRs) and then translating DRs into critical part characteristics (PCs) (or sub-system), engineering process parameters (PPs), and establishing production requirements (PRs) in ending process for a NPD. House of quality (HOQ) is consists of relevant information on CRs, DRs, the relationships between CRs themselves, the relationships between DR themselves, and the relationship between CRs and DRs. Based on the relevant outcomes above, the importance ratings of DRs can be determined. Furthermore, QFD team can figure out the fulfillment level to each DR to achieve the maximum customer satisfaction. Chan and Wu [7] and Carnevalli and Miguel [5] argued that interpreting and analyzing the customer voice is one of the major difficulties in

QFD application. This study attempts developing methods to elaborate the understanding of CRs for enhancing customer satisfaction.

To this purpose, this study considers three different perspectives to interpreting and analyzing the CRs including the customer perspective, the competition perspective and the value perspective, respectively, to determine the importance levels of CRs. In the customer perspective, a modified fuzzy Delphi method is proposed to determine the importance level to each CR based on the current and potential customers' response and feedback. In regard to the competition perspective, the relative performance between firm and its competitors are analyzed to determine the sales point of each CR using the concept of information entropy with fuzzy means. As for the value perspective, the worth and the cost of CRs are considered to establish the value level for each CR to reflect firm position. Finally, combining three different perspective considerations above, the importance scores of CRs can be determined.

In general, the relationship degree in HOQ is expressed on a scale or point system such as 1-3-9 or 1-5-9, representing linguistic statements such as "weak", "moderate", and "strong", respectively [15]. But, QFD members usually experienced the predicament to accumulate experiment, information and knowledge about the influence of DRs because the lack of information or language hedge from the CRs during product planning stage [8, 9]. These considerations have led to the application of fuzzy approaches which are essential in addressing the diversity and imprecision issues in determining the relationships in HOQ [8-14, 19]. Dissimilar to existing studies which only focused the interactive influences of the relationship between DRs themselves to determine the relationship between CRs and DRs, this paper not only considers the relationship between DRs themselves but also take the relationship between CRs themselves into account to determine the relationship between CRs and DRs to obtain a more adequate and realistic relationship levels between CRs and DRs.

Based on the outcomes of importance levels of CRs and relationship levels between CRs and DRs, the fulfillment level of the each DR to maximize customer satisfaction can be achieved. In the following section, the CRs analyzing approaches with three different perspectives are introduced to determine the importance score of each CR. In Section 3, a fuzzy HOQ construction model is developed to determine the performance levels of DRs that will be produced maximum customer satisfaction. An example of a semiconductor packing case is given to demonstrate the proposed approaches in Section 4. Finally, the concluding remarks are summarized in Section 5.

2. THE CUSTOMER REQUIREMENTS ANALYZING APPROACHES

As mentioned previous, the determination of importance score of each CR is an important issue for enhancing customer satisfaction. In the existing literature, Kano's model [18] is considered to classify customer demand attributes due to some customer requirements more important to the customer than others [25, 29, 30]. Karsak [19] and Chen and Ko [10, 11] applied the fuzzy Delphi method to determine the fuzzy importance scores of CRs. Büyüközkan and Feyzioğlu [3] and Büyüközkan et al. [4] considered multiple preference ways and fused different expressions into a uniform group decision approach to reflect CRs assessment with fuzzy set theory in the collaborative circumstance. In addition, the importance ranking of CRs is argued as multi-criteria decision making issue, some

researchers applied analytic hierarchy process (AHP), or fuzzy AHP to determine the importance ranking of CRs in QFD application [1, 22, 23]. However, the existing literature above only focuses on unique perspective, i.e., importance to customer to determine the importance scores of CRs. Lai et al. [24] emphasized the competition perspective besides the importance to customer perspective to ranking CRs importance levels.

To elaborate the understanding of CRs for enhancing customer satisfaction, this study considers three different perspectives to determine CRs' importance scores, including the customer perspective, the competition perspective and the value perspective, respectively. To cope with the vague nature of customer requirements evaluation processes, fuzzy approaches are used to each evaluation way. The relevant decision-making approaches in the each perspective are discussed as follows.

2.1 Customer perspective

Customer perspective is a common sense for determining the importance levels of CRs. In this point of view, the consideration focused on each CR how important to customer. In this study, the current customers and potential customer are regarded as the experts who assess the importance degree to each CR. To aggregate experts' assessment, the fuzzy Delphi method [20] is applied to determine the importance levels of CRs. In original rule, the assessment from each expert is assigned with the same weight in fuzzy Delphi processes [19]. This study proposes the modified fuzzy Delphi method to deal with the different weighting consideration to determine importance scores of CRs. The relevant steps are described as follows.

Step 1. Each expert provides the assessment of importance scores of CRs. Suppose that a triangular fuzzy number is assigned to the format of assessment as:

$$\tilde{k}_{i,e} = \left[\left(k_{i,e}\right)^{\mathrm{L}^*}, \left(k_{i,e}\right)^{\mathrm{M}^*}, \left(k_{i,e}\right)^{\mathrm{H}^*} \right], e = 1, 2, \ldots, \mathrm{E}; i = 1, 2, \ldots, I, \quad (1)$$

where $\tilde{k}_{i,e}$ is described by linguistic terms and defined as the fuzzy subsets of [0, 1] and denoted the importance score of CR_i by the expert e; the indexes "L*", "M*", "H*" represent the lowest, the most likely and the highest level of $\tilde{k}_{i,e}$.

Step 2. Computing the weighted-average of all $\tilde{k}_{i,e}$, the formulation is expressed as

$$\tilde{\bar{k}}_i = \left[\left(\bar{k}_i\right)^{\mathrm{L}^*}, \left(\bar{k}_i\right)^{\mathrm{M}^*}, \left(\bar{k}_i\right)^{\mathrm{H}^*} \right] = \left[\frac{\sum_{e=1}^{\mathrm{E}} w_e \left(k_{i,e}\right)^{\mathrm{L}^*}}{\sum_{e=1}^{\mathrm{E}} w_e}, \frac{\sum_{e=1}^{\mathrm{E}} w_e \left(k_{i,e}\right)^{\mathrm{M}^*}}{\sum_{e=1}^{\mathrm{E}} w_e}, \frac{\sum_{e=1}^{\mathrm{E}} w_e \left(k_{i,e}\right)^{\mathrm{H}^*}}{\sum_{e=1}^{\mathrm{E}} w_e} \right], \quad (2)$$

where $i = 1, 2, \ldots, I$; w_e represents the importance weight of current or potential customer e. Calculating the differences between $\tilde{k}_{i,e}$ and $\tilde{\bar{k}}_i$, and then, return to each expert for the next re-evaluation run.

Step 3. Taking the differences in the prior step as a reference base, each expert provides a

revised linguistic variable (if necessary) of the importance scores as

$$\tilde{k}'_{i,e} = \left[\left(k'_{i,e}\right)^{\mathrm{L}^*}, \left(k'_{i,e}\right)^{\mathrm{M}^*}, \left(k'_{i,e}\right)^{\mathrm{H}^*} \right], e = 1, 2, \ldots, \mathrm{E}; i = 1, 2, \ldots, I. \quad (3)$$

The weighted-average $\tilde{\bar{k}}'_i$ can also be determined using (2). The difference between $\tilde{\bar{k}}'_i$ and $\tilde{\bar{k}}_i$ can be calculated using a distance measure as below [2]:

$$d\left(\tilde{\bar{k}}_i, \tilde{\bar{k}}'_i\right) = 0.5\left\{\max\left[\left|\left(\bar{k}_i\right)^{\mathrm{L}^*} - \left(\bar{k}'_i\right)^{\mathrm{L}^*}\right|, \left|\left(\bar{k}_i\right)^{\mathrm{H}^*} - \left(\bar{k}'_i\right)^{\mathrm{H}^*}\right|\right] + \left|\left(\bar{k}_i\right)^{\mathrm{M}^*} - \left(\bar{k}'_i\right)^{\mathrm{M}^*}\right|\right\} \quad (4)$$

Step 2 and *Step* 3 could be repeated until the distance measure becomes reasonably close to meet the consensus criteria. The consensus criteria is assumed to be a small distance, such as $d \le 0.2$.

Step 4. If there is any change or update information that may lead to start a new evaluation-round process from *Step* 1.

Finally, the assessment consequences of importance degree to CRs can be obtained and expressed as a triangular fuzzy number $\tilde{k}'_i = \left[\left(k'_i\right)^{\mathrm{L}^*}, \left(k'_i\right)^{\mathrm{M}^*}, \left(k'_i\right)^{\mathrm{H}^*} \right]$.

2.2 Competition perspective

Facing the short life-cycles and global dynamic competition environment, taking the competition perspective into account for improving the understanding of CRs is an essential and vital deliberation. Cohen [15] defined a sales point is the ability to sell the product or service, based on how well each customer requirement is satisfied.. In traditional practice, the sales point is set as a crisp value such as 1.5, 1.25 and 1 to reflect the strong, moderate and none sales point to competitors. In competition analysis, considering that a company has many customers and competitors in the competition market, the different customer will set various satisfaction weights to different suppliers based on how well the product or service is met its expectation. In this study, a sales point evaluation is based on a performance standpoint of customer satisfaction to each CR. Suppose that $\tilde{Y}_{\psi i,t}$ is a triangular fuzzy number represented the tth customer who evaluates the satisfaction performance of ψ th supplier on ith CR. Therefore, $\tilde{Y}_{\psi i,t}$ can be expressed as

$$\tilde{Y}_{\psi i,t} = \begin{bmatrix} \tilde{y}_{11,t} & \cdots & \tilde{y}_{1I,t} \\ \vdots & \tilde{y}_{\psi i,t} & \vdots \\ \tilde{y}_{\Psi 1,t} & \cdots & \tilde{y}_{\Psi I,t} \end{bmatrix} = \begin{bmatrix} (y_{11}^{\mathrm{L}^*}, y_{11}^{\mathrm{M}^*}, y_{11}^{\mathrm{H}^*})_t & \cdots & (y_{1I}^{\mathrm{L}^*}, y_{1I}^{\mathrm{M}^*}, y_{1I}^{\mathrm{H}^*})_t \\ \vdots & (y_{\psi i}^{\mathrm{L}^*}, y_{\psi i}^{\mathrm{M}^*}, y_{\psi i}^{\mathrm{H}^*})_t & \vdots \\ (y_{\Psi 1}^{\mathrm{L}^*}, y_{\Psi 1}^{\mathrm{M}^*}, y_{\Psi 1}^{\mathrm{H}^*})_t & \cdots & (y_{\Psi I}^{\mathrm{L}^*}, y_{\Psi I}^{\mathrm{M}^*}, y_{\Psi I}^{\mathrm{H}^*})_t \end{bmatrix}, \quad \text{and} \quad (5)$$

$$\left(y_{\psi i}^{\mathrm{L}^*}, y_{\psi i}^{\mathrm{M}^*}, y_{\psi i}^{\mathrm{H}^*}\right)_t = \left(y_{\psi i}^{\mathrm{L}^*} = \frac{\sum_{t=1}^{T} v_{\psi,t} \cdot \left(y_{\psi i}^{\mathrm{L}^*}\right)_t}{\sum_t v_{\psi,t}}, y_{\psi i}^{\mathrm{M}^*} = \frac{\sum_{t=1}^{T} v_{\psi,t} \cdot \left(y_{\psi i}^{\mathrm{M}^*}\right)_t}{\sum_t v_{\psi,t}}, y_{\psi i}^{\mathrm{H}^*} = \frac{\sum_{t=1}^{T} v_{\psi,t} \cdot \left(y_{\psi i}^{\mathrm{H}^*}\right)_t}{\sum_t v_{\psi,t}} \right) \quad (6)$$

where $\psi = 1,...,\Psi$, $t = 1,...,T$, and $v_{\psi,t}$ represents the weights of performance satisfaction of tth customer to ψth supplier; $v_{\psi,t} \in [0,1]$. The assessment of customer satisfaction performance $\tilde{y}_{\psi i,t}$ is described by linguistic terms and defined as the fuzzy subsets of [0, 1] and surveyed from each customer who concerned the product development.

Once the customer satisfaction performance is collected and treated using (5) and (6), the sales point of a firm can be determined by (7).

$$\begin{aligned} SP_i &= \left[SP_i^{\mathrm{L}^*}, SP_i^{\mathrm{M}^*}, SP_i^{\mathrm{H}^*}\right] \\ &= \left[\sum_{\psi=1}^{\Psi} y_{\psi i}^{\mathrm{L}^*} \cdot \log\left(\frac{1}{y_{\psi i}^{\mathrm{H}^*}}\right), \sum_{\psi=1}^{\Psi} y_{\psi i}^{\mathrm{M}^*} \cdot \log\left(\frac{1}{y_{\psi i}^{\mathrm{M}^*}}\right), \sum_{\psi=1}^{\Psi} y_{\psi i}^{\mathrm{H}^*} \cdot \log\left(\frac{1}{y_{\psi i}^{\mathrm{L}^*}}\right)\right]. \end{aligned} \quad (7)$$

Eq. (7) is considered the concept of entropy in information theory [28].

2.3 Value perspective

Understanding what customer values within CRs is the third perspective for determining the importance score of CRs. DeSarbo et al. [16] noted that performing customer value analysis to articulate the "voice of customer" is applied in more and more firms. This study concerned the economics value which is defined by Elias [17] and expressed as worth w_i divided by cost C_i^* of the each CR.

$$V_i = \frac{w_i}{C_i^*},\ i=1,\ldots,I. \quad (8)$$

where w_i represents each current and potential customer's perception on CR$_i$; C_i^* is the initial cost evaluated by QFD team to CR$_i$ for the new product planning. Same as the customer perspective stage, to address the fuzzy nature in worth and initial cost evaluation to each CR, the modified fuzzy Delphi method is employed to determine the worth $\tilde{w}_{i,e}$ of CR$_i$. $\tilde{w}_{i,e}$ is described by linguistic terms and defined as the fuzzy subsets of [0, 1] and provided by the expert (customer) e. Assuming the assessments of the worth and the initial cost to CR$_i$ are $\left[\left(\overline{w}_{i,}'\right)^{\mathrm{L}^*}, \left(\overline{w}_i'\right)^{\mathrm{M}^*}, \left(\overline{w}_i'\right)^{\mathrm{H}^*}\right]$ and $\left[\left(C_i^*\right)^{\mathrm{L}^*}, \left(C_i^*\right)^{\mathrm{M}^*}, \left(C_i^*\right)^{\mathrm{H}^*}\right]$, respectively, then eq.(8) can be modified as

$$\tilde{V} = \left(V_i^{\mathrm{L}^*}, V_i^{\mathrm{M}^*}, V_i^{\mathrm{H}^*}\right) = \left[\frac{\left(\overline{w}_i'\right)^{\mathrm{L}^*}}{\left(C_i^*\right)^{\mathrm{H}^*}}, \frac{\left(\overline{w}_i'\right)^{\mathrm{M}^*}}{\left(C_i^*\right)^{\mathrm{M}^*}}, \frac{\left(\overline{w}_i'\right)^{\mathrm{H}^*}}{\left(C_i^*\right)^{\mathrm{L}^*}}\right] \quad i=1,\ldots,I. \tag{9}$$

Once the assessments of customer perspective, competition perspective and value perspective are determined, the fuzzy importance score of CR_i can be expressed as

$$\tilde{K}_i = \tilde{k}_i' \otimes \tilde{SP}_i \otimes \tilde{V}_i \quad i=1,\ldots,I. \tag{10}$$

where the symbol $\otimes$ represents the fuzzy multiplication operator. To treat fuzzy multiplication, a fuzzy set can fully and uniquely be represented by its α-cuts [21]. For example, the α-cut of the fuzzy set $\tilde{V}_i$ at the level, $\alpha \in [0,1]$, can be expressed by its lower and upper bounds as $[(V_i)_\alpha^L, (V_i)_\alpha^U]$, which is defined as:

$$\left(V_i\right)_\alpha^L = \inf_{x\in[0,1]}\left\{x \middle| \mu_{\tilde{V}_i}(x) \geq \alpha\right\}, \text{ and} \tag{11a}$$

$$\left(V_i\right)_\alpha^U = \sup_{x\in[0,1]}\left\{x \middle| \mu_{\tilde{V}_i}(x) \geq \alpha\right\} \tag{11b}$$

where $\mu_{\tilde{V}_i}(x)$ is the membership degree of x belonging to $\tilde{V}_i$; the indexes "L", "U" represent the lower and upper bound of $\tilde{V}_i$ at α level, respectively. According to α-cuts and the extension principle in fuzzy set theory [32, 33], the membership function of the fuzzy importance score $\tilde{K}_i$ can be defined by the lower and upper bounds of each α-cut of $\tilde{k}_i'$, $\tilde{SP}_i$, and $\tilde{V}_i$ as well as formulated as:

$$\left(K_i\right)_\alpha^L = \left(k_i'\right)_\alpha^L \cdot \left(SP_i\right)_\alpha^L \cdot \left(V_i\right)_\alpha^L \text{ and} \tag{12a}$$

$$\left(K_i\right)_\alpha^U = \left(k_i'\right)_\alpha^U \cdot \left(SP_i\right)_\alpha^U \cdot \left(V_i\right)_\alpha^U \tag{12b}$$

For simplification of QFD application, the fuzzy importance score can be defuzzified so as to combine with the modified fuzzy normalized relationship in determining the fuzzy technical importance ratings. The fuzzy mean (FM) method [26] is employed to carry out the defuzzification of $\tilde{K}_i$ due to consider its simplicity and efficiency. The FM method is expressed as

$$D = \frac{\sum_{i=1}^{I} \alpha_i x_i}{\sum_{i=1}^{I} \alpha_i}, \tag{13}$$

where α_i and x_i denote the membership degree and the representative (pre-calculated) numerical value of the ith output, respectively; D is the defuzzification value of interval

values [x_i^L , x_i^U], i.e., the *i*th α-cut of fuzzy number. Based on Mabuchi's idea [27], the representative value of the *i*th output is defined as the average of lower and upper bounds of the interval by $x_i = \frac{1}{2}\left(x_i^L + x_i^U\right)$. Therefore, the average value of the α-cut of $\tilde{K}_i$ at the α_i level, i.e., $\left(K_i\right)_{\alpha_i} = \frac{1}{2}\left[\left(K_i\right)_{\alpha_i}^L + \left(K_i\right)_{\alpha_i}^U\right]$ is used as the representative value in this study. According to the FM method, the $\tilde{K}_i$ can be defuzzified as

$$K_i' = \frac{\sum_i \alpha_i \cdot \left(K_i\right)_{\alpha_i}}{\sum_i \alpha_i}, \; i = 1, \ldots, I. \tag{14}$$

3. A FUZZY HOQ CONSTRUCTION MODEL

In product planning, a QFD team collects a set of CRs, assesses and treats their importance scores as described in prior section afterward a number of appropriated DRs that affect the CRs are identified. Based on CRs and DRs, the relevant relationship matrixes will be assessed in HOQ construction. A HOQ is shown in Figure 1. In Figure 1, R_{ij} denotes the relation level in terms of score between the CR_i and DR_j, L_{iI} is the correlation score between CR_i and CR_I; T_{jJ} is the correlation score between DR_j and DR_J, and W_j represents the importance rating of DR_j which is then applied to determine the fulfillment level of the each DR to maximize customer satisfaction.

Considering the imprecise nature of the relationships evaluation, Chen and Weng [8] proposed the fuzzified formulation as (15a) and (15b) based on Wasserman's idea [31] which considered the relationships between the DRs themselves to determine the normalized fuzzy relationship value between CRs and DRs.

$$\left(R_{ij}'\right)_\alpha^L = \frac{\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)_\alpha^L\left(T_{\zeta j}\right)_\alpha^L}{\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)_\alpha^L\left(T_{\zeta j}\right)_\alpha^L + \sum_{\substack{\phi=1 \\ \phi\neq j}}^{J}\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)_\alpha^U\left(T_{\zeta\phi}\right)_\alpha^U}, \text{ and} \tag{15a}$$

$$\left(R_{ij}'\right)_\alpha^U = \frac{\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)_\alpha^U\left(T_{\zeta j}\right)_\alpha^U}{\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)_\alpha^U\left(T_{\zeta j}\right)_\alpha^U + \sum_{\substack{\phi=1 \\ \phi\neq j}}^{J}\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)_\alpha^L\left(T_{\zeta\phi}\right)_\alpha^L}, \tag{15b}$$

where $\left(R_{i\zeta}\right)_\alpha^L / \left(R_{i\zeta}\right)_\alpha^U$ denoted the lower/upper bound of the fuzzy relationship $\tilde{R}_{i\zeta}$ at α level for CR_i to DR_ζ, $\left(T_{\zeta j}\right)_\alpha^L / \left(T_{\zeta j}\right)_\alpha^U$ denoted the lower/upper bound of the fuzzy correlation score $\tilde{T}_{\zeta j}$ at α level for DR_ζ to DR_j. In (15a) or (15b), if

$\sum_{\substack{\phi=1\\ \phi\neq j}}^{J}\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)_{\alpha}^{U}\left(T_{\zeta\phi}\right)_{\alpha}^{U}=0$ or $\sum_{\substack{\phi=1\\ \phi\neq j}}^{J}\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)_{\alpha}^{L}\left(T_{\zeta\phi}\right)_{\alpha}^{L}=0$, then $\left(R'_{ij}\right)_{\alpha}^{L}=1$ or $\left(R'_{ij}\right)_{\alpha}^{U}=1$. Obviously, the situation above is not reasonable while the original relationship $\tilde{R}'_{ij}=\left[R_{ij}^{L},R_{ij}^{U}\right]$ is evaluated with low or moderate linguistic level. The situation of $\sum_{\substack{\phi=1\\ \phi\neq j}}^{J}\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)_{\alpha}^{U}\left(T_{\zeta\phi}\right)_{\alpha}^{U}=0$ or $\sum_{\substack{\phi=1\\ \phi\neq j}}^{J}\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)_{\alpha}^{L}\left(T_{\zeta\phi}\right)_{\alpha}^{L}=0$ will be found while only one DR impact to one CR and no any other DRs correlated with this DR. To improve this critical issue, (15a)

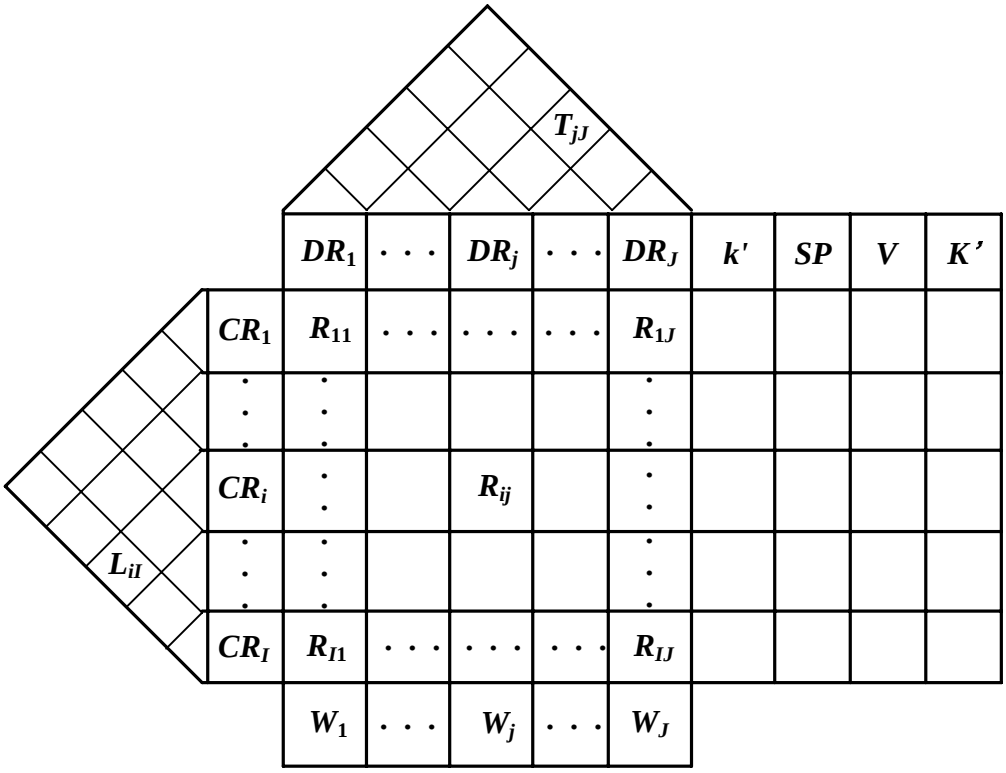

Figure 1. House of Quality

and (15b) should be modified as

$$\left(R'_{ij}\right)_{\alpha}^{L}=\begin{cases}\dfrac{\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)_{\alpha}^{L}\left(T_{\zeta j}\right)_{\alpha}^{L}}{\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)_{\alpha}^{L}\left(T_{\zeta j}\right)_{\alpha}^{L}+\sum_{\substack{\phi=1\\ \phi\neq j}}^{J}\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)_{\alpha}^{U}\left(T_{\zeta\phi}\right)_{\alpha}^{U}}, \text{ and} \\ R_{ij}^{L}, \text{ if } \sum_{\substack{\phi=1\\ \phi\neq j}}^{J}\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)_{\alpha}^{U}\left(T_{\zeta\phi}\right)_{\alpha}^{U}=0\end{cases} \tag{16a}$$

$$\left(R'_{ij}\right)^U_\alpha = \begin{cases} \dfrac{\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)^U_\alpha\left(T_{\zeta j}\right)^U_\alpha}{\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)^U_\alpha\left(T_{\zeta j}\right)^U_\alpha + \sum_{\substack{\phi=1\\ \phi\neq j}}^{J}\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)^L_\alpha\left(T_{\zeta\phi}\right)^L_\alpha}, \\ R^U_{ij}, \text{ if } \sum_{\substack{\phi=1\\ \phi\neq j}}^{J}\sum_{\zeta=1}^{J}\left(R_{i\zeta}\right)^L_\alpha\left(T_{\zeta\phi}\right)^L_\alpha = 0 \end{cases} \quad (16b)$$

Besides, considering the influence of the relationships between the CRs themselves $\tilde{L}_{i\zeta}$ to (16a) and (16b), the normalized fuzzy relationship value between CRs and DRs can be further upgraded as

$$\left(R''_{ij}\right)^L_\alpha = \begin{cases} \dfrac{\sum_{\zeta=1}^{I}\left(L_{i\zeta}\right)^L_\alpha\left(R'_{\zeta j}\right)^L_\alpha}{\sum_{\zeta=1}^{I}\left(L_{i\zeta}\right)^L_\alpha\left(R'_{\zeta j}\right)^L_\alpha + \sum_{\substack{\phi=1\\ \phi\neq i}}^{I}\sum_{\zeta=1}^{I}\left(L_{\phi\zeta}\right)^U_\alpha\left(R'_{\zeta j}\right)^U_\alpha}, \\ \left(R'_{ij}\right)^L_\alpha, \text{if } \sum_{\substack{\phi=1\\ \phi\neq i}}^{I}\sum_{\zeta=1}^{I}\left(L_{\phi\zeta}\right)^U_\alpha\left(R'_{\zeta j}\right)^U_\alpha = 0, \end{cases} \quad (17a)$$

$$\left(R''_{ij}\right)^U_\alpha = \begin{cases} \dfrac{\sum_{\zeta=1}^{I}\left(L_{i\zeta}\right)^U_\alpha\left(R'_{\zeta j}\right)^U_\alpha}{\sum_{\zeta=1}^{I}\left(L_{i\zeta}\right)^U_\alpha\left(R'_{\zeta j}\right)^U_\alpha + \sum_{\substack{\phi=1\\ \phi\neq i}}^{I}\sum_{\zeta=1}^{I}\left(L_{\phi\zeta}\right)^L_\alpha\left(R'_{\zeta j}\right)^L_\alpha}, \\ \left(R'_{ij}\right)^U_\alpha, \text{if } \sum_{\substack{\phi=1\\ \phi\neq i}}^{I}\sum_{\zeta=1}^{I}\left(L_{\phi\zeta}\right)^L_\alpha\left(R'_{\zeta j}\right)^L_\alpha = 0 \end{cases} \quad (17b)$$

where $\left(L_{i\zeta}\right)^L_\alpha / \left(L_{i\zeta}\right)^U_\alpha$ denoted the lower/upper bound of the fuzzy correlation score $\tilde{L}_{i\zeta}$ at α level for CR_i to CR_ζ. Once the lower and upper bounds of α-cuts of the fuzzy normalized relationship are obtained, the fuzzy technical importance ratings $\tilde{W}_j$ can be simplified and expressed as:

$$\left(\tilde{W}_j\right)_\alpha = \left[\left(W_j\right)^L_\alpha, \left(W_j\right)^U_\alpha\right] = \left[\frac{\sum_{i=1}^{I} K'_i \cdot \left(R''_{ij}\right)^L_\alpha}{\sum_{i=1}^{I} K'_i}, \frac{\sum_{i=1}^{I} K'_i \cdot \left(R''_{ij}\right)^U_\alpha}{\sum_{i=1}^{I} K'_i}\right]. \quad (18)$$

The results from (18) can be employed to find the fulfillment level of the each DR to maximize the overall customer satisfaction.

4. AN ILLUSTRATIVE EXAMPLE

A semiconductor packing case of the turbo thermal ball grid array (T^2-BGA) package is introduced to exemplify the applicability of the proposed methods.

4.1. CRs' importance scores

According to product characteristics and performance specifications of T^2-BGA, a QFD team surveyed and collected the opinions of customers during the product planning stage. Suppose that the CRs are determined as "package profile" (CR_1), "thermal performance" (CR_2), "electrical performance" (CR_3), "reliability" (CR_4), and "co-planarity" (CR_5). Considering the above CRs, three different perspectives are applied to determine the importance scores of CRs.

4.1.1. Customer perspective

In customer perspective, the fuzzy Delphi method is applied to determine the importance levels of CRs. Suppose that a QFD team forwards a questionnaire with linguistic evaluation levels, "very low (VL)", "low (L)", "medium (M)", "high (H)" or "very high (VH)", to eight current and potential customers in order to obtain the importance level of five CRs. The relevant computational procedures are described as follows:

Step 1. The first assessing outcomes are listed in Table 1. The QFD team member has to translate linguistic terms i.e., VL, L, M, H, and VH into the triangular fuzzy numbers as the lowest, the most likely and the highest level set, namely (0, 0, 0.2), (0, 0.2, 0.4), (0.3, 0.5, 0.7), (0.6, 0.8, 1), and (0.8, 1, 1), respectively. For example, in Table 1, the importance levels of the first CR evaluated by the second customer is expressed as $\tilde{k}_{1,2} = (0, .2, .4)$.

Step 2. Computing the weighted-average of all $\tilde{k}_{i,e}$ by (2), assuming the importance weight set to eight current and potential customers is assigned as {1, 0.9, 0.9, 0.5, 0.5, 0.2, 0.2, 0.1} based on their real or potential contribution in business. The producing results of $\tilde{\tilde{k}}_i$ to each CR are (0.049, 0.202, 0.402), (0.293, 0.493, 0.693), (0.091, 0.244, 0.444), (0.512, 0.712, 0.888), and (0.035, 0.147, 0.347), respectively. Then, the differences between $\tilde{k}_{i,e}$ and $\tilde{\tilde{k}}_i$ are calculated and return to each customer for re-evaluation procedure.

Step 3. Same to *Step* 1, each customer provides the revised assessment outcomes which are listed in Table 1. The weighted-average of $\tilde{k}'_{i,e}$ can also be obtained by (2), and then the $\tilde{\tilde{k}}'_i$ of each CR is obtained as (0.014, 0.214, 0.414), (0.265, 0.465, 0.665), (0.091, 0.291, 0.491), (0.547, 0.747, 0.923), and (0, 0.181, 0.381), respectively. The difference between $\tilde{\tilde{k}}'_i$ and $\tilde{\tilde{k}}_i$ is calculated by (4) as 0.023, 0.028, 0.047, 0.035, and 0.035, respectively. The differences between two adjacent averages are all less than to 0.2,

therefore, the consensus condition is achieved.

Step 4. If the consensus condition was not obtained, the re-evaluation process would be performed in the next assessment cycle till the consensus condition is achieved.

Table 1. The first/ second round assessment of importance levels of CRs

Customer	CR_1	CR_2	CR_3	CR_4	CR_5
$Cust_1$	L/ L	M/ M	L/ L	H/ H	VL/ L
$Cust_2$	L/ L	M/ M	VL/ L	H/ H	L/ L
$Cust_3$	VL/ L	H/ M	M/ M	M/ M	L/ L
$Cust_4$	M/ L	L/ L	L/ L	H/ H	M/ L
$Cust_5$	L/ L	L/ M	L/ L	VH/ VH	VL/ L
$Cust_6$	L/ L	M/ M	H/ M	M/ H	VL/ VL
$Cust_7$	M/ M	M/ M	L/ L	L/ M	VL/ VL
$Cust_8$	VL/ L	M/ M	VL/ L	M/ H	L/ L

In this case, the fuzzy results $\tilde{\tilde{k}}_i'$ of importance level of CR_i, i=1,…,5, will be used to determine the fuzzy importance scores.

4.1.2. Competition perspective

Suppose that there are three major suppliers and four customers dedicate to T^2BGA development in the competition market. In competition analysis, a company (supplier) survey and asks it's four customers to evaluate the performance levels of each CR for T^2BGA product planning with linguistic evaluation level set {VL, L, M, H, VH} to three major suppliers. Furthermore, inviting customers to provide the corresponding performance satisfaction weights to different suppliers based on how well the product or service is met its expectation. Assuming the performance satisfaction weights are defined as 1.8, 1.5, 1.2, and 1 in this case. Table 2 is listed the outcomes of performance assessment of CRs from customers for T^2BGA product planning. Based on the assessment outcomes in Table 3, the fuzzy sales points of each CR can be determined by (6) and (7) as (0, 0.018, 0.314), (0.087, 0.452, 1.255), (0.087, 0.452, 1.255), (0.031, 0.299, 0.798) and (0.011, 0.120, 0.465). The fuzzy sales point of each supplier is listed in Table 3. In Table 3, the each competitor has the same results of fuzzy sales point at CR_2 and CR_3, that represent there is a good opportunity to be distinguished in the current competition situation by CR_2 and CR_3. Moreover, the third supplier possesses better competition situation at CR_1 and CR_5, while supplier 2 at CR_4 holds the better competition advantage.

4.1.3. Value perspective

To understanding the economic value of CRs, the worth and cost of each CR has to determined. According to the procedures of fuzzy Delphi method, the first round assessment

Table 2. The performance assessing outcomes of CRs

	Customer 1						Customer 2					
supplier	**CR_1**	**CR_2**	**CR_3**	**CR_4**	**CR_5**	**weight**	**CR_1**	**CR_2**	**CR_3**	**CR_4**	**CR_5**	**weight**
$comp_1$	**VH**	**M**	**M**	**H**	**VH**	**1.5**	**VH**	**M**	**M**	**H**	**VH**	**1.5**
$comp_2$	**VH**	**M**	**M**	**H**	**H**	**1.2**	**VH**	**M**	**M**	**M**	**H**	**1.5**
$comp_3$	**VH**	**M**	**M**	**H**	**H**	**1**	**H**	**M**	**M**	**M**	**M**	**1**
	Customer 3						**Customer 4**					
supplier	**CR_1**	**CR_2**	**CR_3**	**CR_4**	**CR_5**	**weight**	**CR_1**	**CR_2**	**CR_3**	**CR_4**	**CR_5**	**weight**
$comp_1$	**VH**	**M**	**M**	**H**	**VH**	**1.2**	**VH**	**M**	**M**	**H**	**VH**	**1.5**
$comp_2$	**VH**	**M**	**M**	**M**	**VH**	**1**	**VH**	**M**	**M**	**H**	**VH**	**1**
$comp_3$	**VH**	**M**	**M**	**H**	**VH**	**1.8**	**VH**	**M**	**M**	**H**	**H**	**1**

Table 3. The outcomes of sales point

supplier	SP_1^{L*}	SP_1^{M*}	SP_1^{H*}	SP_2^{L*}	SP_2^{M*}	SP_2^{H*}	SP_3^{L*}	SP_3^{M*}	SP_3^{H*}	SP_4^{L*}	SP_4^{M*}	SP_4^{H*}	SP_5^{L*}	SP_5^{M*}	SP_5^{H*}
$comp_1$	**0.001**	**0**	**0.097**	**0.029**	**0.151**	**0.418**	**0.029**	**0.151**	**0.418**	**0**	**0.078**	**0.222**	**0**	**0**	**0.097**
$comp_2$	**0**	**0**	**0.097**	**0.029**	**0.151**	**0.418**	**0.029**	**0.151**	**0.418**	**0.022**	**0.124**	**0.318**	**0**	**0.047**	**0.164**
$comp_3$	**0**	**0.018**	**0.12**	**0.029**	**0.151**	**0.418**	**0.029**	**0.151**	**0.418**	**0.01**	**0.098**	**0.258**	**0.011**	**0.073**	**0.204**
$\tilde{SP}_i$	**0**	**0.018**	**0.314**	**0.087**	**0.452**	**1.255**	**0.087**	**0.452**	**1.255**	**0.031**	**0.299**	**0.798**	**0.011**	**0.12**	**0.465**

outcomes are listed in Table 4. Assuming the worth weight set is same to importance weight set to eight current and potential customers based on their real or potential contribution in business. The weighted-average of all $\tilde{w}_{i,e}$ can be obtained by (2), producing results of $\tilde{\tilde{w}}_i$ to each CR are (0.398, 0.598, 0.798), (0.647, 0.847, 1), (0.647, 0.847, 1), (0.481, 0.681, 0.881), and (0.453, 0.653, 0.853), respectively. The calculation result has to send to each participant for second round evaluation. Following the performing step 3 of fuzzy Delphi method, each customer provides the revised assessment outcomes which are listed in Table 4. And then, the weighted-average results of $\tilde{\tilde{w}}_i'$ to each CR are calculated by (2) as (0.349, 0.549, 0.749), (0.712, 0.912, 1), (0.74, 0.94, 1), (0.412, 0.612, 0.812), and (0.398, 0.598, 0.798). Furthermore, the difference between $\tilde{\tilde{w}}_i'$ and $\tilde{\tilde{w}}_i$, i=1,…,5, are calculated by (4) as 0.184, 0.065, 0.033, 0.07, and 0.056, respectively. Obviously, the differences between two adjacent averages are all less than the consensus condition. Consequently, the outcomes of $\tilde{\tilde{w}}_i'$, i=1,…,5, are the final worth results of CRs. Assuming the lowest, the most likely and the highest initial fuzzy cost of CR_i, i=1,…,5, are (0.1, 0.2, 0.3), (0.3, 0.5, 0.7), (0.3, 0.5, 0.7),

Table 4. The first/ second round assessment of the worth of CRs

Customer	CR_1	CR_2	CR_3	CR_4	CR_5
$Cust_1$	M/ M	H/ H	VH/ VH	H/ H	H/ M
$Cust_2$	M/ M	VH/ VH	H/ H	H/ M	M/ M
$Cust_3$	H/ M	H/ VH	H/ VH	M/ M	H/ H
$Cust_4$	M/ M	H/ H	H/ VH	H/ H	M/ M
$Cust_5$	H/ H	H/ VH	VH/ VH	M/ M	M/ M
$Cust_6$	M/ H	H/ H	H/ H	M/ M	M/ H
$Cust_7$	M/ M	H/ H	H/ H	H/ M	H/ H
$Cust_8$	M/ M	VH/ VH	VH/ VH	M/ H	H/ M

(0.15, 0.3, 0.45), and (0.1, 0.3, 0.5), respectively, which assessed by QFD team. In the fuzzy sense, the value of CRs then can be determined using (9) which are (1.163, 2.745, 7.49), (1.017, 1.824, 3.333), (1.057, 1.88, 3.333), (0.916, 2.04, 5.413), and (0.796, 1.993, 7.98).

4. 2. DRs' importance rating and total customer satisfaction

Once the importance level, the sales points, and value of CR_i are obtained, all of this outcomes could be transferred into the α-cut expression of the fuzzy sets $\tilde{k}_i'$, $\tilde{SP}_i$, and $\tilde{V}_i$ by (11). For example, $[(V_2)_\alpha^L, (V_2)_\alpha^U] = [1.017 + 0.807\alpha,\ 3.333 - 1.509\alpha]$. Without any biases, the α levels in this paper are evenly distributed in [0, 1]. Let α_ξ denote the ξth level, and $\alpha_\xi = \xi / \lambda$, $\xi \in \{0,1,\cdots,\lambda\}$, thus the distance between each two adjacent levels is equal, i.e. $\alpha_\xi - \alpha_{\xi-1} = \lambda^{-1}$, $\xi \geq 1$. Based on the transformation above, the lower and upper bounds of the fuzzy technical importance score $\tilde{K}_i$, i=1,…,5, at each α level, can be determined by (12). And then, the final results of importance scores of each CR can be defuzzified by (14) as 0.043, 0.305, 0.206, 0.377, and 0.069, respectively.

To responding CRs for customer satisfaction, QFD team determines the corresponding design requirements (DRs) by design feasibility studies. Five DRs are proposed, including "heat slug exposed area" (DR_1), "heat slug attached material" (DR_2), "height of heat slug" (DR_3), "copper pattern" (DR_4), and "molding flow" (DR_5). The relationship between CR_i and CR_j, the relationship between CRs themselves, and the relationship between DRs themselves are evaluated by QFD team with the same linguistic evaluation levels set {VL, L, M, H, VH}. The initial HOQ is set and illustrated in Figure 2. According to the linguistic relationships in Figure 2, the fuzzy normalized relationship at each α-cut can be calculated using (16) and (17). An then, considering the importance scores of each CR, the lower and upper bounds of the fuzzy technical importance ratings $(\tilde{W}_j)_\alpha$, j = 1, 2, …, J, at each α level, can be obtained by (18) for determining the importance priority of each DR. The lower and upper bounds of $(\tilde{W}_j)_\alpha$ at various α levels are listed in Table 5. The results of fuzzy technical importance ratings of DRs can be applied to Chen and Weng's model [8] to determine the performance

level of each DR for maximizing customer satisfaction. The fulfillment level of each DR and the total customer satisfaction degree (the objective function value) are calculated and shown in Table 6. Figure 3 indicates the membership functions of the total customer satisfaction degree of the QFD processes as levels in the feasible regions using originally unique perspective and three perspectives for CRs ranking. Obviously, the membership function of the total customer satisfaction degree from proposed method is better than the unique perspective one, i.e., importance to customer requirements perspective, although all of them meet the requirement in new product planning.

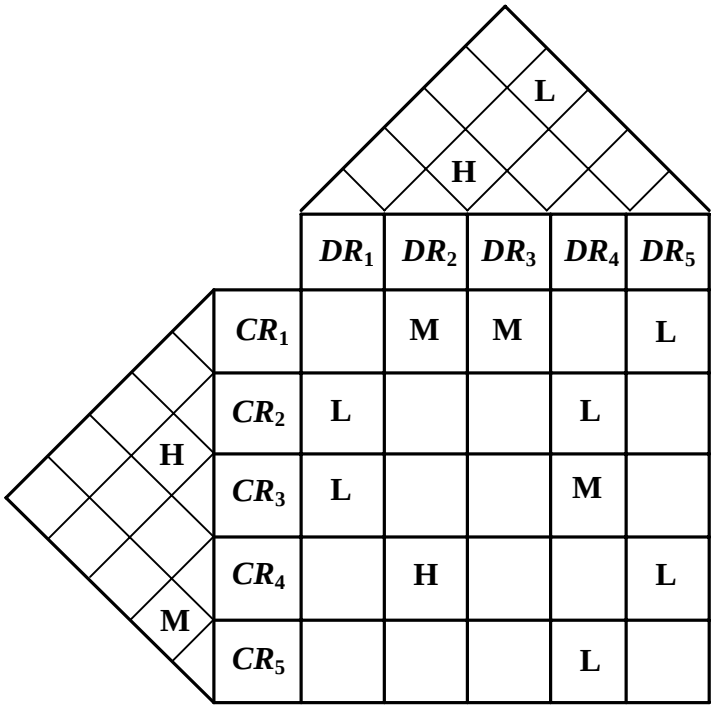

Figure 2. The HOQ for a T^{2}BGA product planning

Table 5. The lower and upper bounds of $\tilde{W}_j$ at different α levels

α	W_1^L	W_1^U	W_2^L	W_2^U	W_3^L	W_3^U	W_4^L	W_4^U	W_5^L	W_5^U
1	**0.257**	**0.257**	**0.17**	**0.17**	**0.018**	**0.018**	**0.229**	**0.229**	**0.184**	**0.184**
0.8	**0.2**	**0.313**	**0.143**	**0.198**	**0.016**	**0.021**	**0.189**	**0.273**	**0.13**	**0.241**
0.6	**0.145**	**0.368**	**0.12**	**0.228**	**0.013**	**0.023**	**0.15**	**0.318**	**0.084**	**0.298**
0.4	**0.093**	**0.42**	**0.099**	**0.257**	**0.011**	**0.026**	**0.115**	**0.364**	**0.047**	**0.348**
0.2	**0.044**	**0.468**	**0.081**	**0.285**	**0.009**	**0.029**	**0.084**	**0.411**	**0.02**	**0.389**
0	**0**	**0.511**	**0.066**	**0.311**	**0.008**	**0.032**	**0.055**	**0.459**	**0**	**0.42**

Table 6. Outcomes of the total customer satisfaction degree and fulfillment level of DRs

α	Z_1^L	Z_1^U	$x_1^{(L)}$	$x_1^{(U)}$	$x_2^{(L)}$	$x_2^{(U)}$	$x_3^{(L)}$	$x_3^{(U)}$	$x_4^{(L)}$	$x_4^{(U)}$	$x_5^{(L)}$	$x_5^{(U)}$
1	**0.656**	**0.656**	**0.881**	**0.881**	**0.1**	**0.1**	**0.1**	**0.1**	**0.989**	**0.989**	**1**	**1**
0.9	**0.552**	**0.764**	**0.733**	**1**	**0.112**	**0.1**	**0.1**	**0.1**	**1**	**0.979**	**1**	**1**
0.8	**0.459**	**0.854**	**0.604**	**1**	**0.125**	**0.127**	**0.1**	**0.1**	**1**	**1**	**1**	**1**
0.7	**0.38**	**0.943**	**0.496**	**1**	**0.133**	**0.164**	**0.1**	**0.1**	**1**	**1**	**1**	**1**
0.6	**0.311**	**1.032**	**0.408**	**1**	**0.136**	**0.202**	**0.1**	**0.1**	**1**	**1**	**1**	**1**
0.5	**0.252**	**1.121**	**0.334**	**1**	**0.135**	**0.241**	**0.1**	**0.1**	**1**	**1**	**1**	**1**

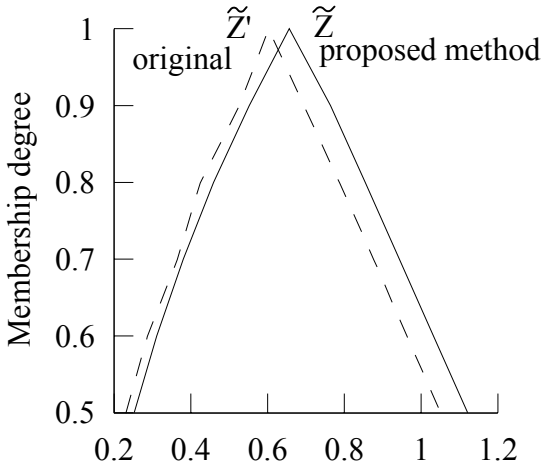

Figure 3. The membership functions of customer satisfaction with different approaches

5. CONCLUDING REMARKS

Determining the performance levels of DRs is an important decision problem in QFD applications, but recognizing and ranking the importance levels of customer requirements is more important issue for product planning. To improve the understanding of customer voice to obtain the better customer satisfaction, this study proposed a new method to aggregate the various assessment perspectives including, importance to customers, competition and value three perspectives to determine the importance scores of CRs. Moreover, determining the relationship between CRs and DRs and calculating the importance rating of DRs are further steps for a HOQ construction. This paper not only considered both relationship between DRs themselves but also take the relationship between CRs themselves into account to determine the relationship between CRs and DRs. A modified model is proposed to determine the relationship between CRs and DRs to improve the reasonability of the existing normalization model. Through the modification of the importance score of CRs and the the relationship between CRs and DRs, the importance rating DRs can be determine. The illustration of the proposed methods with a numerical example indicates that the total customer satisfaction degree is greater than that from the existing perspective of CRs evaluation while using the same fuzzy linear model. To enhance the customer satisfaction, the other considerations, such as the concept of theory of constraints or the group decision-making approaches could be modeled to improve the understanding of the voice of customer in the future study.

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FIRM SIZE, CORE COMPETENCES, FIRMS INTERNATIONALIZATION AND PERFORMANCE: AN EMPIRICAL STUDY

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ABSTRACT

Core competences from either source could contribute to the business operations in the international markets. Firm-specific knowledge has been traditionally regarded as the important determinant of competitive advantage in the international market place. Drawing on previous research, this study verifies hypotheses with empirical data collected and explores the internationalization in Taiwan financial industry. Study findings of the research find support for the theoretical base that competence factors and firm size do have a significant impact on firms internationalization. Further, this study reveals that firms internationalization relates positively to the firms performance.

Keywords: resource, competence, firm size, market knowledge, internationalization

INTRODUCTION

When any market is crowded with competitors, the best strategic approach is differentiation, establishing a niche that builds a competitive advantage against competitors in the short term that can be leveraged against the major players in the long-term. But in many cases, even entering into the niche market game is difficult, and small firms often lose the competitive struggle, going out of business or being swallowed. Hence, firm size is defined as the determinant of firms competence [1] and internationalization [44]. In this study, the literature pertinent to competence, firm size and their effects on internationalization is reviewed. At present, a number of different measures of the degree of internationalization (DOI) of a given firm are used by scholars. Therefore, in addition to financial indicators, we use the proxy of individual attributes for an organization's international attitudes. The study reviews approaches to measurement of DOI, and then defines, measures, and discusses the degree of internationalization of Taiwan financial companies. Finally, the effect of internationalization on a firm's performance is also verified by the research.

The objective of this study is to investigate and evaluate the business competences and firm size and, then, examine their importance in allowing Taiwan financial firms to develop a competitive position in the international marketplace. This study will contribute to the

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literature on internationalization by focusing on financial firms with international operations within the context of developing markets and emerging countries. The findings have the potential to offer significant implications for theory and practice. This paper is organized as follows. Section 2 gives a review and construct of the literature in the areas of competences, firm sizes, and internationalization and outcomes. Section 3 presents data and methods. Section 4 gives the findings of the study. Finally, section 5 provides the discussion and managerial implication. The conceptual framework is illustrated in Figure 1.

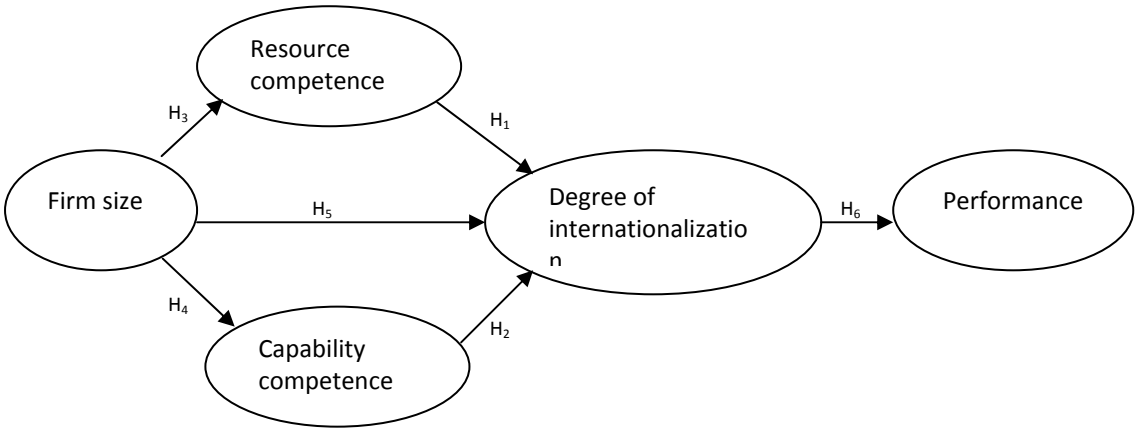

Figure 1. Concept framework

LITERATURE REVIEW

This section discusses the early contributions of the authors and the research that has stimulated others to study these issues.

Core competence: Retrospect and prospect

The concepts of competence and competitive advantage are not synonymous. Core competences make it possible for firms to build a framework that addresses the key dimensions of strategic management and competition [39]. Core competences or distinctive capabilities, are combinations of resources and capabilities, which are both unique to a specific organization and responsible for generating its competitive advantage [14]. For example, managerial competences help open up relationships, the capability to take action with insufficient information, and tolerance for behavioral flexibility [45]. Hence, competences can be manipulated by firms to generate competitive advantage and high performance. If a firm's strategy is inconsistent with its competences, its performance will be lower than that of other firms executing a similar strategy but enjoying better coherence with competences [36].

In academia, numerous researchers have attempted to integrate or review this vast array of literature and differentiate two sources of competitive advantages: unique resources and distinctive skills [34]. For service industries, three different types of competence are defined by scholars, including disciplinary knowledge and understanding of realities, competence in handling information, and communicative competence [21]. O'Farrell, Hitchens, and

Moffat (1993) consider the competitive advantages in the service industry include flexible pricing policies, network effects, competitive scope, proprietary technology, service differentiation, and reputation [36]. Bharadwaj, Varadarajan and Fahy (1993) suggest a conceptual model for sustainable competitive advantage in service industries [3]. Key factors considered in their model as major sources of competitive advantages include resources (e.g. cost and demand synergies, managerial innovation, brand equity, relationships contracts, etc.) and skills (e.g. customer service, functional and implementation skills, etc.). After assessing the insights of scholars and the attributes of financial industry, we choose resources competence (product and managerial innovation; branding and information technology) and capabilities competences (innovation and customer service skills; implementation skills and international market knowledge) to be the factors discussed in our model, and explored their importance in internationalization.

Resource competence

Product and managerial innovation. For the financial industry, product and managerial innovation are helpful for companies to creat diffenentiable and distinguished service quality identifed by consumer. Innovative products designed for customers bring new business. Successful enterprise analysis has clearly shown that business performance derives primarily from innovation oriented managerial and organizational processes [7]. It is is important that managers have a knowledgeable understanding of the processes and activities required for the successful integration of their management (e.g. [3]; [17]).
Branding. The difficulty in achieving sustainable form of product differentiation for most financial products means that branding is a critical issue for the companies concerned (e.g. [3]; [19]; [42]). Homogeneity of markets and services' distinct characteristics have made branding as a means of competitive advantage of financial companies. While international and even national brand owners may be more concerned with tailoring their brands for local markets, they aggressively expand in the international markets [31]. Hence, all financial services need to understand more about how individual brands are positioned and advertised as well as what portfolios are optimal [19].
Information technology. While firms' internatonalization, transnational integration implies dependence of subsidiaries on the multinational system for information, technology, management, funds, and products [27]. Reduced barriers to international trade and investment coupled with the advances in information technology have accorded opportunities for firms [40]. Hence, technology has been a significant variable in explaining the internationalization of a firm, as seen in international business literature [13]. Advancements in information technology and improvements in communication infrastructure have resulted in opportunities for financial firms to participate in global markets [46]. Therefore, to competing with global financial companies and be an international firm, product and management innovation, branding and information technology are key factors in the operating and internationalization decisions of financial firms

Capability competences

Innovation and customer service skills and implementational skills. Skills are important and can be fostered via training and learning in the firms' educational processes. Creative skills are quite flexible as they apply to different outputs and environments and this makes them

especially useful in a changing, uncertain environment [47]. For financial companies, whose financial products are largely similar, innovation and customer services skills are important to increase firms' image identification and satisfaction by customers and then strengthen customer loyalty. Effective and efficience implementaion skills of employees are helpful to the business operations [3].

International market knowledge. The internationalization process model developed by Johanson and Vahlne (1977) is based on an analysis of the firm's market knowledge, market commitment, commitment decision and activities [23]. Internationalization behavior is often decided by a combination of learning through the experience and incorporation of members that have international knowledge [26]. Firm-specific knowledge has been traditionally regarded as the important determinant of competitive advantage in the international market place. The lag between start up and internationalization is necessary to gain the requisite market knowledge in order to culturally adapt service offerings and marketing strategies for foreign consumers (e.g. [16]; [29]). In sum, we consider skills and international market knowledge as important factors in firm capability during operation and internationalization process.

The positive relationship of competence to a firm's internationalization

For international firms, core competences and firm-specific resources may be transferred from the parent company to the subsidiaries. Firm-specific sources of competitive advantage are significant predictors of why firms go abroad [28]. The resource-based theory developed by numerous scholars is used to explain resource relationship to internationalization (e.g. [5]; [13]). Xia, Qiu and Zafar (2007) indicate that the factors influence on a firm's internatinalization can be largely explained by the dimensions of firm competences: technological resources; owner/top manager's managerial skills and capabilities; employee's Guanxi skills and professional/technical knowledge; the firm's internal and external relationships [47].

Cuervo-Cazurra, Maloney, and Manrakhan (2007) build on the resource-based theory to argue that the successful in internationalization include: advantage provided by resources transferred abroad, and complementary resources required operating abroad [11]. The competences of firms across different phases of the internationalization process are based on the resources and capabilities used by industries in their development and growth [4]. Therefore firms possessing strong distinct competences are likely to be more successful in international markets. Accordingly, we propose the following two hypotheses.
H_1: Perceived or actual firm resource competences are significant determinants of the degree of internationalization of a firm.
H_2: Perceived or actual firm capability competences are significant determinants of the degree of internationalization of a firm.

The effect of firm size on competences and internationalization

Firm size is assumed to be a proxy of firm resources and capabilities [1]. Hitt & Ireland (1984) indicate that the firm size has moderating effects on the relationships of firms' specific distinctive competencies [20]. Katsikeas (1994) suggests that the existence of significant

differences in perceived export competitive advantage between different exporter groups may be related to company size [24]. Moen (1999) identifies differences in export motivation and competitive advantage between firms of different size [33]. Onyeiwu (2003) uses the binary-logit model to explore the determinants of core competencies, and identifies firm size as one of significant determinants of core competencies [37]. Based on the above reviews, the positive effect of firm size to internatoinalization is explored.

Given the nature of service industry, scholars have argued that number of employees is more appropriate than financial capital as a measure of firm size (e.g. [5]; [22]). Xia, Qiu and Zafar (2007) measure firm size using the two most commonly used indicators: annual sales and number of employees [47]. In the study, we choose three items, including assets, annual sales, and the number of employees to measure the firm size. Based on the above reviews and samples, we conclude that firm size is the leading factor in firm competence, and formulate our third and fourth hypoetheses:
H_3: Firm size of a firm relates positively to the perceived or actual firm resource competences.
H_4: Firm size of a firm relates positively to the perceived or actual firm capability competences.

One stream of research has suggested a positive correlation between a firm size and international activities [44]. Dass (2000) find that firm size, international market diversification and product diversity have linear effects [12]. Whilst a positive impact has been found by many scholars [8], scholars have also reported a non-significant impact on relationship [5] or mixed results (e.g. [1]; [2]). The relationship between size and internationalization activity remains vague when firm size is measured differently [1]. For example, positive effects on performance are found when size is measured by total firm sales, while some negative effects are found when it is measured by number of employees ([1]; [25]). In the study, we use factor analysis method to produce the factor of firm size in term of three items (sales, number of employee and asset). To verify the relationship of firms size to firm internationalization for Taiwan financial companies, Hypothesis 5 is derived.
H_5: Firm size of a firm relate positively to the degree of internationalization of a firm.

Degree of Internationalization and performance

There are many ways to measure the degree of internationalization, but none of them leads to a completely satisfactory outcome [15]. Sullivan (1994) chooses five out of nine possible variables including foreign sales as to a percentage of total sales (FSTS), overseas subsidiaries as a percentage of total subsidiaries, foreign assets as a percentage of total assets (FATA), psychic (cultural) dispersion of international operations, and top managers' international experience, to measure internationalization [43]. Further, management problems caused by cultural heterogeneity in an MNE may not be neglected [15], for example, geographic dispersion and a straightforward count of the number of countries in which a firm operates [6]. The greater the number of countries of operation, the greater the cultural complexity. Based on the foregoing discussion, the study uses two items, attitudinal (managers' recognition plus number of countries invested) and financial (foreign assets as a percentage of the total assets: FATA) indicators, as the measures of the degree of internationalization.

The relationship between DOI and performance has been the subject of much research. Dhanaraj and Beamish (2003) study the degree of internationalization and its effect on the overall firm performance, using firm-level performance measures [13]. Chang (2007) indicates that firm performance will become negative if MNEs heavily expand their product range and geographic scope [9]. The performance gap between related and unrelated foreign investments diminishes in the more advanced stages of internationalization [18]. Companies operating at extreme (very high) degrees of internationalization face lower average performance and higher average performance variation [41].

Scholars have used a variety of indicators to measure performance, including ROE, ROA, IPO, and financial ratios (e.g. [10]; [32]). Financial measures of performance can be classified as sales-related, profit-related, and market share-related. Non-financial measures include those that are market-related or product-related, or are attitudes, such as managers' satisfaction or experiences [30]. Hence, to grasp the effect of the degree of internationalization on firms' performance, this research defines the measures of performance (EPS, ROE and income) and constructs Hypothesis 6.
H_6: Firms degree of internationalization relates positively to the financial performance of a firm.

DATA AND METHOD

Research methods used in the study include industrial analysis, manager surveys, and data analysis. Secondary data are collected through reliable databases (Market observation post system and company websites) (http://newmops.tse.com.tw/ accessed March 2008). Through secondary data, the study introduces the industry background and summarizes the current situation and internationalization of the Taiwan financial market. The sample population consists of both domestic and foreign firms in the Taiwan financial market, including banking, insurance, and securities firms. Over 280 questionnaires are sent out. The 102 returned questionnaires are used for this analysis. Fifty-five percent of the respondents are managers, while the remainders are senior and professional employees involved with the firm's internationalization. Telephone interviews, face-to-face interviews, and incentive gifts are used to find potential respondents and to increase the response rate. Results of the study are presented on the basis of a frequency distribution, ANOVA analysis, factor and reliability analysis, and regression models using SPSS [35].

Based on the returned questionnaires, data used in our study includes 9 foreign firms (one securities firm, 7 insurers and one bank) and 93 local financial firms. Respondents are asked to compare their firms' competences with those of their competitors, using a five-point Likert scale (e.g., 1 = much worse than competitors' and 5 = much better than competitors'). Firm size and performance measurements are established based on th concepts presented by scholars. We use number of employee, annual sales and total assets as the measures of firm size, and EPS, ROE, and income as the measures of firm performance.

Degree of internationaliztion is measured by two items: financial (foreign assets as a percetage of total assets: FATA), and attitudinal (managers recognition plus number of countries invested). Respondents are asked to indicate their firms' DOI using a five-point Likert scale (e.g., 1 = much low and 5 = much high). Another explanation of the five point

scale is provided for the respondents to ensure that their responses reflected the practical internationalization situations of the targeted firms. The five explanations for the DOI item are: "Option 1: focus on domestic market;" "Option 2: international market information collection but have not invested;" "Option 3: in the initial stage of international allocation;" "Option 4: in the growth stage of international allocation, focusing on specific countries;" and "Option 5: worldwide allocation". Thus, the higher the number, the higher the DOI.

STUDY FINDINGS

Exploration of the competences differences by industries

In order to distinguish the differences within the financial industries and varied internationalization degree of firms in Taiwan, Table 1 lists the ANOVA analysis of mean values of items by industries and DOI. In Table 1, the study finds two statistically significant factors within Taiwan financial industries: "product and management innovation" and "branding". The current industrial situations through respondents' investigations and companies' information are summarized as follows.

Product and management innovation. Table 1 shows that the insurers and bankers have higher perception of product and management innovation than securities. Taiwan banks and insurance firms actively research and develop various products to support market development. Through the competitiveness of subsidiary cross selling and common marketing, Taiwan financial holding companies have developed extensive business sources and innovative management, provided overall financial services, and created cost and demand synergy (e.g. FuBon, Cathy and MEGA). Compared to banks and insurance firms, though given lower scores by respondents on product and management innovation item, Taiwan securities firms (e.g. Cathy, TopTrade securities, TISC) have gone beyond traditional services and focused on R & D in derivatives, trades of local and foreign securities and bonds, and risk management. In term of the property management and customization services, securities firms assist clients in maximizing their investment results.

Branding. Brands are regarded as significant and valuable intangible assets for building corporate wealth. A growing number of Taiwan financial companies have developed new brands and strengthened existing brands to win customer brand loyalty and market share. An imitative strategy by the financial companies is always valid if the brand images are strong and welcomed by consumers, enabling financial firms to enhance their performance. Taiwan securities firms emphasize a professional image, spatial convenience, trade fee discount or gifts, and seldom use animated brand emblems. Hence, the brand identification of securities firms seems less clear than that of banks and insurance firms.

Information technology. Different information technologies are used in Taiwan financial markets based on the firms' wealth and strategic plans. For instance, MasterLink securities corporation HongKong creates a trade system. The trade system provides stocks, fund, derivatives, options and foreign stocks and diversification and reliable financial services for customers (http://www.masterlink.com.tw/ accessed 25 May 2008). Through aggressive planning of data warehouse systems, large Taiwan financial firms now offer their clients higher quality value-added service. Financial holding companies such as FuBon and TaiShi

have created optimal value and customer satisfaction via utilization of CRM (customer relationship management) and database technologies such as data mining.

Capability. According to the respondents, there are no significant differences on the perception of innovation customer service skill, implementational skills of employees and international market knowledge of managers among three industries (Table 2). The mean analysis of Table 1 shows that most respondents give higher scores on capability competences. According to the respondents, capability competences are important, and most of the respondents are confident in their skills and abilities, and in the needed training provided by the firms. Through sustained education training, financial firms increase the professional service skills, product and international market knowledge of staff and employees.

Table 1. ANOVA analysis of mean values of question items by industries and DOI

	Industry				DOI
	Mean			F values	F values
	Security	Insurances	Banks		
Resource					
Product and managerial innovation	2.78	3.38	3.21	3.18*	2.10**
Brand equity	2.73	3.38	3.21	3.32*	2.41**
Information technology	3.33	3.25	3.27	0.10	1.88*
Capability					
Innovation, quality and customer service related skills	3.49	3.54	3.36	0.58	1.62*
Implementational skills	3.49	3.71	3.61	1.03	1.84*
International market knowledge	3.13	3.29	3.39	0.94	1.78*
Firm size					
Assets	2.77E+07	2.10E+08	7.19E+08	19.90**	7.85***
Employee	492.31	2835.38	4448.33	7.71**	4.59***
Sales	4.12E+06	7.90E+07	1.83E +07	6.06**	14.53**
DOI					
FATA	0.002	0.068	0.062	2.58	
Manager attitudes	2.07	3.33	2.82	9.44***	
Performances					
EPS	1.19	1.04	-0.05	1.66	0.97
ROE	0.057	-0.38	-0.11	2.86	0.12
Income	5.36E+05	1.22E+06	2.63E+06	2.00	6.85***

Note: Significance at the 95% confidence level. * if $p < 0.05$; ** if $p < 0.01$; *** if $p < 0.001$.

Competence, firm size and internationalization

To verify the hypotheses, we next perform factor analysis, reliability analysis, and linear regression analysis as discussed below. This entailed a two stage process. The first step is to reduce the data to a smaller number of underlying and theoretically plausible variables that could be entered into a linear regression analysis. Factor analysis is undertaken to identify underlying constructs from among sets of many interrelated items using the SPSS statistical package. The principal-component method is used for factor extraction, with factor interpretation carried out by variamax rotation. Five factors produced by factor analysis include "resource competence", "capability competence", "firm size", "DOI" and "performance. As shown in Table 2, all factor loadings of variables and Cronbach's α exceeded 0.6, while the α values of item to total correlation exceed 0.4. As a result, the five factors appear to be appropriate for the next step of regression analysis.

Table 2. Factor and reliability analysis of competence factors and decision factors

Factors and variables	Mean	std	Factor loadings	Eigenvalues	Item to Total correlation	Cronbach's α
*Resource competence (KMO: 0.64***)*				2.21		0.82
Process and managerial innovation	3.06	1.05	0.92		0.81	
Brand equity	3.04	1.12	0.88		0.72	
Information technology	3.29	0.79	0.77		0.55	
*Capability competence (KMO: 0.64***)*				1.87		0.67
Innovation, quality and customer service related skills	3.46	0.66	0.82		0.53	
Implementational skills	3.58	0.62	0.83		0.55	
International market knowledge	3.25	0.84	0.70		0.42	
*Firm size (KMO: 0.57***)*				2.40		0.87
Assets	2.95E+08	5.68E+08	0.89		0.73	
Employee	2323.51	4742.32	0.97		0.91	
Sales	2.64E+07	9.09E+07	0.83		0.65	
*DOI (KMO: 0.50***)*				1.44		0.61
Manager attitude	2.61	1.30	0.85		0.43	
FATA	4.54E-02	9.89E-02	0.85		0.43	
*Performance (KMO: 0.61***)*				1.85		0.69
EPS	0.75	3.11	0.86		0.61	
ROE	-9.99E-02	0.75	0.80		0.50	
Income	1.38E+06	4.64E+06	0.69		0.40	

See Table 1, all competence items exhibit a significant difference in the means under the varying degrees of internationalization. In Table 3, regression models are used to test the determinant effect of competence factors and firm size on firm internationalization, and the results of these models are presented. In the regression models, higher F statistics indicate better overall model fits [35]. The research omits the parameter intercept, hence, the value of constant is zero and does not appear in the regression models. Further, 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 3 shows that the value of the Durbin-Watson of the model 5 is near 2, which fits the requirement of the assumptions of regression analysis. R square, the Goodness-of-fit measure of a linear model,

varies between zero and one, with higher values indicating higher explanatory power, and good fit of the specified models [38]. Table 4 shows that the models 1, 2, and 3 are statistically significant in explaining the degree of firm internationalization. The test results suggest that resource competences and firm size are positively and significantly associated with a higher degree of internationalization of firms. Meanwhile, higher resource competence and size of firms are helpful in internationalization. Further, model 4 and 5 verify the effect of the leading factor of firm size determinants on the resource and capability competences of firms. In practice, in addition to multinational financial firms and financial holding companies, small Taiwan domestic financial firms primarily chose "focus on domestic market" or "in the preparation stage" for their attitudinal measures of DOI. Their competences (resource and capability) and firm size are apparently not as great as those of large financial firms, leading to unwillingness or inability to internationalize unless there is an intervening act of external force such as a merger or venture.

Table 3. Regression models for the degree of internationalization, competence and performance

Factors	Degree of internationalization			Resource	Capability	Performance
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	B	B	B	B	B	B
Resource	0.50***		0.31**			
	(0.000)		(0.002)			
Capability	0.05		0.06			
	(0.673)		(0.522)			
Firm size		0.63***	0.51***	0.37***	0.23*	
		(0.000)	(0.000)	(0.000)	(0.020)	
DOI						0.31**
						(0.002)
F values	19.99***	68.06***	33.86***	16.43***	5.56*	10.52**
R	0.53	0.63	0.71	0.37	0.23	0.31
R Square	0.29	0.40	0.51	0.14	0.05	0.09
Durbin-Watson	1.87	2.11	2.04	1.65	2.02	1.46

Internationalization and performance

In Table 1, except EPS and ROE, the income performance is significantly different among varied internationalization of firms. Further, in model 6 (Table 3), the degree of internationalization of firms appears to be linearly and positively related to firm performance. The results appear to show that firm internationalization has positive effects on profit. The results of our analysis for performance and DOI for Taiwan financial firms shows that firms possessing higher DOI can obtain good business performance (Table 3). However, beside income, the EPS and ROE of firms are not significantly different among firms' DOI (see Table 1). Apparently, compared to small and non-international firms, larger and international firms with high scales and sales can generate high income. However, according to EPS and ROE indicators, the operation performances of small firms are not absolutely lower than those of larger financial companies. Hence, while using varied financial ratios, the degree of internationalization of a firm can not be defined to have the absolute and positive relationship

to business performance. For instance, the business performance of small securities firms mainly depends on their trading activities in the stock market. If investors have optimistic expectations and are willing to enter the stock market, then the business performance of securities firms is strong. Therefore, the performance of firms is largely driven by the direction of business operations, strategies and management, not depending on the degree of internationalization. In sum, the results of models 1, 2, 3, and 4 suggest support for H_1 and H_3 but not H_2, and the findings of model 4, 5 and 6 suggest support of H_4, H_5 and H_6 ($p < 0.05$).

DISCUSSION AND CONCLUSION

Drawing on previous research, this study verifies hypotheses with empirical data collected and explores the internationalization in Taiwan financial industry. Study findings of the research find support for the theoretical base that some competence factors and firm size do have a significant impact on firms internationalization. Further, this study reveals that firms internationalization relates positively to the firms performance. We offer the following conclusions. First, competitive advantage derived from competence positively determine to the degree of firm internationalization. The results show that the resource competence has more significant impact than capability competence in a given firm's internationalization. This may be due to the fact that "capability" can be improved by firms through training and education, or that it is sometimes difficult for respondents to compare skills and market knowledge among firms. In our sample, most respondents are confident of their own skills and international market knowledge. Hence, capability competence display less significant differences across, or less significant positively relationships with, the degree of internationalization of firms. However, based on the high mean values, we conclude that "capability" is an important factor in the operations of firms.

Second, our results indicate that firm size significantly and positively relates to firm competences and internationalization. Hence, moves by the Taiwan government to guide financial institution mergers and enlarge their economic scale to foster one or more international financial holding companies represent sound public policy. Taiwan financial firms are starting to consolidate, since the global trend is toward fewer and bigger firms that offer professional services with an international vision. Taiwan financial firms cannot avoid the transformation from being local to acting global. Firm size, product and management innovation, branding, information technology, good skills and international market knowledge, and other distinct competences are required to support the internationalization process. Therefore, while companies possessing competitive advantages in a native market, the ambition of corporate internationalization could apply, transfer and reformulate adaptive competences to foreign countries, using abundant international experience and market knowledge. Then the probability of high profit could be obtained from the increase of overseas operation.

Because the targeted financial firms of the research vary in size, and most Taiwan financial firms treat overseas investment ratios as confidential information, and lack abundant financial data offered by the Taiwan government database, the study uses visible and limited secondary data, and the author's and respondents' subjective measurements for model development. A broader approach (e.g. multidimensional scale, structure equation model, etc.) would be valuable in analyzing the causal relationships among the factors. Another

limitation of this research is that it is based on only 102 respondents. However, respondents include managers or professional employees who are involved in the decision and execution processes of internationalization. Further, the competence levels among the firms, compared with competitors in the same industries, are sometimes difficult for respondents to measure. Hence, telephone interviews, face-to-face interviews, and confirmation of the actual industrial situation are all important for improving the quality of the responses. Future research could enlarge the sample, competence factors or choose other industries to verify the conceptual framework and generalize the model.

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WATER FOOTPRINT AN INDICATOR TO MANAGE WATER RESOURCE. A CASE OF ITALIAN OLIVE OIL

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ABSTRACT

It is long time since the efforts of researchers, politicians and decision makers are engaged, overall the world, to find the "recipe" to reach a sustainable economic growth. Even if significant steps are made, it is still far the final goal. In this contest, growing is the international interest towards Material Accounting and Material Indicators, useful tools to evaluate human activities impacts on natural system (air, water, ground, fauna, flora and climate). According to the common certainty that water scarcity will be one of the first limits to the future growth, the objective of this paper is to evaluate if a specific material indicator, the "Water footprint" (WF), represents a profitable tool to manage water natural resources. The aim is to underline pros and cons of this tool for private managers and public decision makers. In particular, WF has been applied to a specific product, the Italian extra virgin olive oil, with the aim to evaluate the effects of olive oil production chain on domestic water resource and to highlight suggestions for managers.

Keywords: water footprint, physical indicators, sustainability, environmental management system.

INTRODUCTION

Water scarcity is nowadays a fast growing sustainability problem across the world and needs innovative actions at regional, national and international levels. Agricultural, livestock and energy sectors consume over 80% of all renewable and accessible freshwater and considering the population growth rate expecting for the next decades and the effects of clime changes, water availability could turn its role from development factor into a constraint of growing [10]. For this reason it is necessary a deep change in water management passing from a demand-side to a supply-side approach like suggested into the European Environmental Agency last report [6]. The topic of water management requires a multidisciplinary approach, which affects in sustainable way the whole processes in water governance. A multidisciplinary approach has to overcome the classic engineering ones and, instead, to adopt new indicators, which combines material base of water use with information on the

efficiency, carrying capacity and resilience of natural basins. The choice of appropriate material indicators can become strategic for setting new targets and giving help in reformulating policies and programmes. The indicators can also be used both for benchmarking and encouraging better performance from, for instance, water service providers. It is not sufficient to know water or energy costs of products and services; it is necessary to recognize if the natural system is able to "sustain" that production chains. The goal of material indicators is to show if human appropriation of natural resources is above or below of natural system capacities and if natural capital is capable of providing material inputs of economic activities. Utilizing material indicators it should be possible to answer to questions like: What consumers and businesses can do to reduce their water consumptions?
In order to construct the material indicators, it is elemental topic to apply the material approach for analysing economic activities and for describing the quantity and quality of natural capital involved. The latter is also called "material basis" of an economic activities. The comparison between the material basis of economy and the available natural capital gives basal data for decision-making. In other words, based on the principle of conservation of matter and using as unit of account the weight rather than the value, the Material Account (MA), allowed to record quantitative information concerning the amount of natural resources used and the amount of waste produced by human system. An MA is therefore capable of quantifying the Total Material Requirement of an economic system. Apply an MA methodology, like a Material Flow Analysis (MFA), means to improve the integration of environmental and economic activities in a model of sustainability because it makes possible the identification of system potentialities and critic points. For instance, MFA shows the opportunity of by-product synergies reducing natural resources use or, quantifying, qualifying and highlighting the source of environmental impacts, an MFA gives the opportunity to business managers and to policymakers to operate in time to choose the best possible solution [4-5].

The aim of this note is to illustrate the material indicator capable of describing the state of art of sustainability of water resources: water footprint (WF). The concept of the "water footprint" has received attention from governments, non-governmental organizations, businesses and media as a useful indicator of water use. WF measures water volumes consumed (evaporated) and/or polluted at both direct and indirect water use. It is more than a figure for the total water volume used but it refers to the type of water use and where and when the water was used. It is a versatile indicator, which is possible to apply to a product, an individual, a business or a community in order to account both the negative externalities and the vulnerability of water systems. After the illustration of the methodology of this indicator, the authors have been analysed the Italian WF of extra virgin olive oil[1] production. This case study allows a discussion regarding the application of this indicator and the pros and cons for decision-making process.

The paper is split into different parts. First part analyzes the WF indicator; second one describes the WF application to Italian olive oil. On the basis of the results obtained, the authors illustrate the impacts of olive oil on domestic water resources. This analysis is useful for industry because it points out critic points and also for policy makers because it is the

1) All references to olive oil in this text refer to extra virgin olive oil.

base on which focusing new programs towards a sustainable economic growth. How much water it is necessary to produce olive oil, how much water goes out of the country through exportation and how much arrives through the importation, which are Italian olive oil industry critic points are some of the questions to which it will be possible to answer using WF indicator.

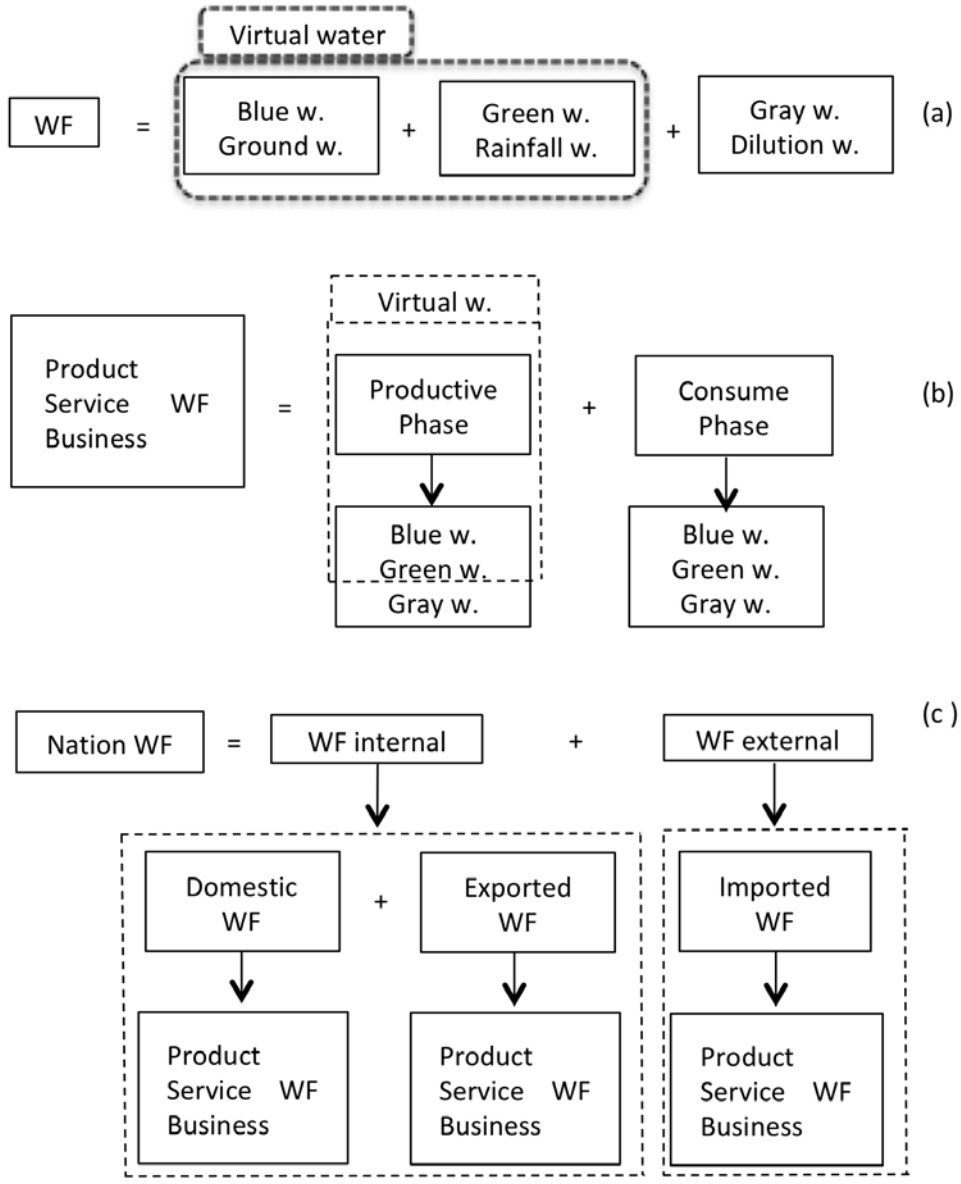
What distinguishes this paper is its focus on consideration of the full product life cycle from primary olives production to olive oil final use. Its advantage is to emphasized the details but it is much more laborious because it is necessary a data collection hard to find and to record. The choice of reporting a case of study is another peculiarity of this paper because against a variety of studies on MA methodologies or Material Indicator construction there is a lack of studies on material basis of productive chains and/or goods during all their life cycle from "economic" cradle to "environmental" grave. According to authors' idea, this work could contribute to enlarge product material basis knowledge testing, in the same time, the WF indicator.

BACKGROUND: WATER FOOTPRINT INDICATOR

The WF concept was first introduced in 2002 by Arjen Hoekstra, teacher of Multidisciplinary Water Management at Twente University (Holland) during the International Expert Meeting of Virtual Water Trade and received immediate international attention due to its efficacy to water resources sustainable management [7]. Like other material indicators, such as Ecological footprint, the WF aim is to translate human consumption into natural water resource use - generally expressed in cubic meter per year (m^3/y) - showing the hidden relations between human activities and freshwater appropriation and between global trade and freshwater resources management.

The term "water footprint" was choose first referring to the meaning of "footprint" in environmental science by which it indicates a measure of human appropriations of natural resources and also in analogy with Ecological footprint (EF) and Carbon footprint (CF) The first (EF) quantifies the use of bio-productive space (hectares), the second (CF), measuring CO_2 total emissions evaluates the use of energy (m^3/year) and the WF refers to the volume of fresh water use and/or polluted [8]. The idea of WF started from the intention to enlarge the utility of Virtual Water (VW) a concept introduced by Allan in the early 1990s [1-2]. The VW is older than the WF and it refers to the sum of water used during the different productive chain steps. The adjective "virtual" is justified by the fact that a large part of water used during the production chain is not contained in the product it-self. Obviously there is a big difference between real-water content and VW. One olive oil litre is water free but its estimated Italian VW is 5 – 11 m^3. Moreover, utilising VW it is possible to investigate if water imported by goods and services could be considered a sort of fresh water alternative source. WF differs from VW because it considers the amount of water used and polluted during productive and consumption phases, because it makes seeable the relations between fresh water local consumption and correlated global appropriation and because it quantifies the volume of water necessary to assimilate polluted water. For all these reasons WF is considered a contemporary geographically and temporally indicator.

Figure 1 – Water Footprint components and comparison between different typologies.



Source: personal elaboration by the authors.

WF is defined also a multi-dimensional indicator because contemporary focus on water volumes consumed and polluted respectively by source (rainwater and/or fresh surface or groundwater) and by type of pollution.

According to a common definition, and as mentioned before, WF refers to the total volume of water used and/or polluted to produces goods and services consumed by a person, a nation or a business activity. WF is constituted by three different components so-called: Green water, Blue water and Gray water (figure 1).

Green water refers to precipitations on land stored in the soil that does not run off or renew groundwater. The green water is the volume of rainwater used by crops to growth. Obviously it is mainly calculated for the agricultural products and indicates total rainwater consumed during crops vegetative period plus the amount of water incorporated into the same product.
Blue water refers to global surface and groundwater human appropriation to produce goods and services consumed by an individual, a community or economic activities. Compared to the total amount of available freshwater it measures the water consumed in the technosphere and the water available to sustain the ecosystem.

Gray water refers to the volume of water that is polluted during a production process. This component is quantified calculating volume of water necessary to dilute the pollutants discharged into natural water system in such measure that the final water quality remains constant compared with specific quality standard [9].

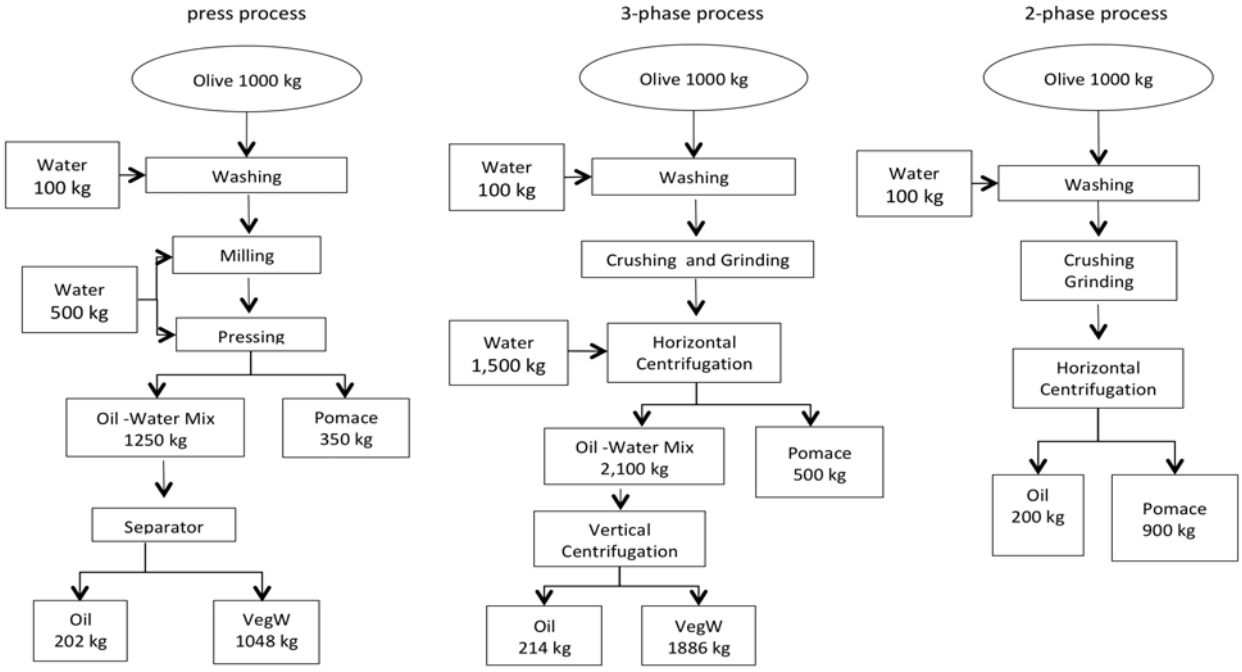
WF can be calculated for a person, a well-defined group of persons (a family, a city, a nation), for a specific service or commodity and also for a business. Figure 1 shows WF components, the relations between different WF typologies and between WF and VW.

Particularly a *product* WF is the volume of freshwater used during the entire production chain measured right at site. The WF of a product coincides with VW, but WF includes a temporal and spatial dimension, that it to say when and where water was used. To avoid WF underestimation it is usually calculated dividing raw material VW by the "fraction of product" (pf), intending with this expression the ratio between weight of final product and raw material used. For instance, if a primary crop is processed into a crop product (e.g. olive into olive oil) very often, there is a loss in weight, because only a part of the primary crop is used (180-200 kg of olive oil for 1000 kg of olive). In such a case, it is necessary to calculate the processed product VW by dividing the primary crop VW by the just mentioned "pf". This index denotes the weight of crop product (expressed in t) obtained per unit of primary crop (expressed in t) used. Obviously crop product VW (expressed in m^3/ton) is larger than the virtual water content of the primary crop [3].

CASE STUDY: ITALIAN OLIVE OIL WATER FOOTPRINT

The globalization market processes, which characterized the agro-food sector in the last decades, affect the olive oil market too. Olive oil is the principal flavouring produced and consumed in Mediterranean states even if its world market is increasing in a gradual but significant way chiefly due to the enlarging demand of quality and safety food products.
The first step of this analysis is the study of the diagram flows (figure 1) of olive oil chain. The result was a summary picture of different phases for growing olive tree, processing and delivering oil to family. Hence, a collection of data regarding the material and energy consumption has been carried out. In order to gather information, a review study of company reports, interviews with managers and visits to plants have been conducted. The data gathered has been compared with data from national and international literature. The analysis of energy, water, and waste flows and their external effects has allowed constructing environmental indicator, as water footprint, and making a representation of their environmental performance.

Figure 1 – Diagram flows of the production chain of olive oil.



In the final step of our analysis we discussed critical points of these chains and we focused on waste management issues and strategies to reduce environmental burdens.

Olive oil is a vegetable oil obtained from olive (Olea europaea) known throughout the world especially in the Mediterranean countries. In Mediterranean diet, it is considered the main vegetable fat source with a very good taste and several beneficial properties. In olive oil extraction industry, olive drupes are processed using solely mechanical or other physical equipments to obtain olive oil for food use and, as by-products, vegetative water (VegW) and crude olive cakes. Olive oil extraction process includes different steps. First of all, olives have to be clean to remove the stems, leaves, twigs, rocks, pesticides and dirt. Subsequently olives are crushing into a paste to facilitate oil release from the vacuoles. Crushing phase may be done with stone mills as well as with hammer mills. Usually obtained paste is malaxing in covered and jacketed holding tanks in which the paste is constantly agitated at controlled temperature. This is a very important phase by which good rates of antioxidants and flavour depends. Malaxing paste is then treated to separate oil from the other olive components (VegW and crude olive cakes) in presses or centrifuges. Until thirty years ago the press extraction process was almost the unique but, during the 1970s, a new process, the continuous 3-phase centrifugation was introduced with the aim to increase mills productivity. Its higher water consumption and the correlated larger amount of VegW produced compared to the press process represented the opportunity for developing a new technology, the 2-phase in which water is used only to wash olives to process and no more (figure 1). Obviously, water input influence quantity and quality of by-products obtained in each processes. As concerning the olive oil quality (referred to nutritional and organoleptic characteristics) the press process is still considered the best way to produce olive oil.

Materials and methods

The evaluation of Italian olive oil WF proposed is based on bottom-up approach by which, the authors try to evaluate its impact on domestic natural fresh water resources reflecting, in the same time, spatial, temporal and technological peculiarities of olive oil industry.

Domestic data collection mainly coming from ISMEA, the National Agricultural Institute, ISTAT, the Institute of Statistics and related specific reports and, as concerning Spanish and Greek ones, they have been gathered from national and international statistics, Eurostat and FaoStat and correlated reports.

This study considers a time course of 4 years from 2003 to 2006 and analyzes olive oil production, starting from olives production (agricultural phase) and ending with their industrial transformation. It is also considered that both of them happened on the same territory on which olives are produced and no industrial packaging phase was included in the analysis.

Climatic and crop growing parameters utilized to calculate agricultural phase refer to the local conditions and traditions of principal Italian, Spanish and Greek producer areas. In particular Puglia and Calabria for Italy, Andalusia for Spain and Crete for Greece. First of all crop water requirement (CWR expressed in m^3/t) of primary crop (olives) has been calculated. This allows calculating green (rainfall) and blue water (irrigation) contribution to olive cultivation. CWR has been obviously calculated for Italy, Spain and Greece and it has been obtained following the ratio of the methodology developed by FAO. As concerning grey water (pollution) estimation, directly linked to fertilizer and pesticide impacts on water sources, it has been used NO_3 impact indicator. The European Nitrates, Groundwater and Drinking Water Directives have referred it to permissible limit of nitrate in surface and groundwater as recommended for nitrate in water (equal to 50 mg nitrate-NO_3 per liter). The sum of the three components, green, blue and gray shows the total crop water requirement.

The evaluation of water industrial requirement (WIR expressed in m^3/t) takes into account the "fraction of product" (pf), intending with this expression the proportion between final product and raw material used (olive/oil) and the technology used. The average *pf*, apply for all the countries involved in the study is equal to 0.18. As concerning the technology, the analysis proposed, based on available data, splits olive production among the three different mill typologies in which they are really treated. For instance the 50% of Italian olive production is treated in traditionally press mills and the other part in 3-phase centrifuges. The 2-phase centrifuges technology is not applied in Italy. This distinction is important because direct linked to different water input and VegW production, principal cause of potential pollution problems. Almost in all olive oil producer countries the direct discharge of VegW into receiving natural water body is strictly forbidden, it is also no possible to treat them directly into public urban waste water treatment plants so, the most common practice is the illegal dispose on land or in aquatic body. Because of in Italy VegW are considered fertilizers whose use is controlled, in Spain olive oil industry is VegW free and in Greece VegW are uncontrolled spread on the land, in this analysis, no grey water related to VegW has been calculated.

Results and discussion

Based on the methodology and simplifications mentioned in the previous paragraphs, the total internal WF for annual Italian olive oil production has been evaluated in 3,250 – 7,400 Mm^3 (4.8 – 11 m^3/kg of oil generated). This value refers to the average production approximately equal to 670,000 t of olive oil during the period 2003-2006 of which approximately 71% produced in Apulia (37%) and Calabria (34%).

The large size of estimated WF range is due especially to the agricultural phase. Crop growing parameters and climatic factors justify and explain this result. As a matter of fact, the differentiation between the crop evapotraspiration, the disparity in the annual yield; the different extension of irrigated dedicated area and the difference in the water input for the two main olive producer regions are relevant. On the basis of the evaluation of crop primary production WF components, Calabrian production seems to be more efficient and more sustainable than Apulia.

As regard the industrial phase, based on just discuss methodology, the olive transformation happened into different mill typologies with a water input equally different. The analysis shows that olive oil industrial chain in Italy represents less than 0.1 % of total domestic olive oil WF (3,250 – 7,400 Mm^3) but, following the Spanish experience, the possibility to save water is still possible.

The domestic production of olive oil is not sufficient to satisfy local demand (approximately in 840,000 t) and in the same time, Italy is a great exporter of olive oil above all olive oil of high quality. The amount of olive oil exported from Italy is more than 200,000 t, so that 970 – 2,200 Mm^3 "leave" our country "virtually" enclosed into Italian olive oil. Assuming that the exportation are equally distributed between Apulia and Calabria and thank to the bottom-up approach it has been possible to note that the most relevant part of this water exported was Apulia water. This means that a region like Apulia, historically suffering water scarcity, is involved in VW olive oil exportation in the reason of 60% of WFe (equal to 4.8 – 9.6 Mm^3).
As concerning import, the only two Italian importer countries considered are Spain and Greece. For both of them WF has been calculated and it is respectively equal to 7,916 – 12,827 m^3/t and 6,081 -11,534 m^3/t. The Spanish olive oil WF shows the highest figure. Also in this case the crop primary production is the phase adsorbing the major part of water. Spain is penalized above all by the amount of fertilizer used (gray water increment) on the contrary Greek olive oil production suffers for climatic condition reflecting on intensive irrigation practice. The industrial phase undoubtedly advantage Spain because, as just mentioned before, it utilises 2-phase centrifuges where water input is lower than traditionally press mills and 3-phase centrifuges (respectively: 0.1 m^3/t of olives treated; 0.4-0.8 /t of olives treated and 1-1.5 /t of olives treated) [11].

CONCLUSION

The main objective of this paper is to describe WF indicator and to verify its utility to improve the management of water resources. The construction of Water Footprint needs a huge amount of data reflecting the different aspects of the same phenomena and the result is summarized in one figure. Furthermore, WF considers pollutions (grey water) in the sense

that it calculates the water needed to restore water initial quality. Unlike other more general indicators such as Ecological Footprint, WF gives a detailed illustration of human appropriation of water natural resources allowing to a specific planning policy. Considering that water resources scarcity in the near future will be the massive constraint of economical growing, decision makers have to use both indicators: the general one, as EF, and the analytic indicator, as WF. They differ from each other because EF gives an overview, summarized in a unique value (expressed in ha), of the total natural resource consumed, whereas WF focuses on water issues only.

According to the findings of this case study, WF is useful for companies in setting their strategic planning in order to improve the allocation of natural resources used during the production chain (agricultural and industrial phases). Our results confirm that the agricultural phase is the main responsible for water used and polluted during olive oil production. However Italian olive oil system has the possibility to become more efficient both in the agricultural phase than in industrial one.

As concerning the first phase olive cultivation could be better distributed on Italian territory in function of yield per hectare and annual average precipitations. It could be possible to limit the *Blue water* contribution or to improve irrigation system performances. Reducing irrigation not always means yields decreasing, above all in the case of olives. Also in the case of fertilizers the analysis focuses that their use is linked much to agricultural traditions than to an effective need by crop. Probably this is caused by farmers' lack of information about the related pollution problems. Minimal reductions in fertilizers use correspond to a substantial reduction in *Gray water* contribute, very often, without sensible reduction in yields.

For instance farmers could contribute to the reduction of blue and gray water by shifting to a different irrigation practice (different in efficiency and modality) or choosing another crop varieties more compatible with local conditions and apply less quantity of fertilizers or using them in a form able to decrease leaching. Reducing the blue and gray water footprint per ton of crop in one place means to realize a reduction of crop water footprint as a whole.

The industrial phase shows the larger possibilities of improvement and Spanish realty, based on 2-phase centrifuges, could represent a good model to follow.

Finally, companies and decision makers, together, could influence consumption patterns by addressing them toward those with a lower WF.

As already mentioned, WF supplies facts and figures of water resources and it illustrates if economy requires more water than ones available. We underline that WF should be introduced at legislative level for planning the economical regional development. For instance, it should be possible to approve new industrial activities after the result of water footprint benchmarking process capable of describing the effects on water resource, such as the decreasing of human appropriation of water or the mitigation of pollution.

An opportunity to apply this could come from European Union Commission that is working to the fourth edition of Common Agricultural Policy (CAP). During the debate, it is a common and clear idea that the new CAP has to be a guarantee for farmer incomes but the

subsidies have to be calculated based on farmer contribution to environmental sustainability. WF in this sense could play the role of planning tool because farmer by them-selves, knowing CAP new mechanism and basing on local pedo-climatic and water availability conditions will decide to plant the best environmental friendly crops.

In conclusion it should be introduced a non-stop efficiency revision of the whole production and supply chain, a costs reduction and a best satisfaction and involvement of stakeholders more and more interested to environmental performances. Hence managers of companies are claimed to introduce new management tools, as WF, for describing and managing the effects on environment caused by their activity.

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A STUDY OF INTER-ORGANIZATION INFORMATION SYSTEMS PERFORMANCE EVALUATION: BALANCE SCORECARD APPROACH

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ABSTRACT

Previous information systems of inner organizations mostly were constructed depending on the requirement of various function department, such as finance, production, and sales information systems etc. These information systems separately operated, do not integrate and connect each other, not communicate with external organizations. Now, under the dramatic change of business environment, organizations must break up the boundary of organization, share and transfer information with strategic alliance partners or customers more closely to promote collaboration each other in order to improve enterprises' competitiveness. Therefore, enterprises increasingly place more importance on Inter-Organizational Systems (IOS).Many studied indicate that introducing IOS would benefit enterprises.

The purpose of this study is to establish performance evaluation indicators for IOS using Balanced Scorecard (BSC) approach, and provide references for managers and future researches when measuring the performance of inter-organizational information systems.

The results demonstrated that the importance weights of all dimensions were ordered as follows: financial dimension, internal processes dimension, learning and growth dimension and customer dimension when managers measure inter-organizational information systems performance. Additionally, the importance weights of performance evaluation indicators were ordered as follows: increase inventory turnover rate, accelerate the process of dealing which suppliers and customers, reduce transaction cost, reduce the cost of information exchange cost and boost organization internal process elasticity.

Keywords: IOS, Balanced Scorecard, FAHP, Performance measure

INTRODUCTION

Previous information systems of inner organizations mostly were constructed depend on requirement of various function department, such as finance, production, and sales etc., information systems. These information systems separately operated, did not integrate and connect each other, did not communicate with external organizations. Now, under the

dramatic change of business environment, organizations must break up the boundary of organization, share and transfer information with strategic alliance partners or customers more closely to promote collaboration each other in order to improve enterprises' competitiveness. Therefore, enterprises increasing place more importance on Inter-Organizational Systems (IOS).

IOS cross the formal boundaries of organization and is utilized technologies to connect its partnership and customer by organization in order to promote connection, information integration and support transactions based information and communication technology (ICT). Numerous studies have demonstrated that enterprises can benefit from introducing IOS. For instance, Turban et al., (1999) posited that introducing IOS can improve organizational operating effectiveness, internal operating efficiency, and relations with customers and suppliers, while simultaneously helping achieve strategic goals and enhance enterprise competitiveness. Prasad et al. (1996) indicated that after introducing IOS, enterprises quickly respond to customer requirements, and reduce order processing and production times.

Introducing IOS is costly for enterprises. Thus the problem of whether organizations benefit from introducing IOS is extremely important. How to measure enterprise performance following the introduction of IOS is the key objective of this study. IOS is designed to handle internal organizational operations and communication between organizations. Organizations generally first organize internal organization via business process reengineering (BPR) and integration of inter-departmental information systems, then employ IOS to create external connections, for business introduction of IOS. Therefore, following its introduction, IOS is not the same as general information systems in terms of measuring enterprise performance. Measurement of enterprise performance following the introduction of IOS must consider both internal and external organizational perspectives.

Consequently, the study explored IOS performance from inner organization and outside organization view. The study utilized balanced scorecard approach to measure IOS performance. The result of the study offer organizations to understand the benefit of IOS.

Based above, this study conducts a literature review to collect performance evaluation indicators in order to construct the research model based BSC approach (Kaplan. and Norton, 1992; 2001) and designed a questionnaire, and sent out the managers from the high-tech information and electronics industries to fill out the questionnaire. Next, calculate the weights of all dimensions and indicators of the model using Fuzzy AHP (FAHP) method.

1. The study collected the performance evaluation indicators for IOS information systems through literature reviews.
2. The study researches applied BSC approach to design a feasible performance evaluation construct for IOS in order to measure the benefit of introducing IOS.

LITERATURE RIEVIEW

The definition of IOS

The concept of IOS stemmed from inter-organizational information sharing system which Barrett and Konsynski (1982) bring up. IOS is first formally defined by Cash and Konsynski

(1985), and Cash and Konsynski (1985) supposed that IOS mean two or two more companies mutually share the same automated information systems. Grover （1993） supposed that two more organizations employ automated information systems to achieve information sharing. Organizations can easily creative, store, transfer and communicate information based Information Technologies (IT) through IOS. Kumar and Dissel (1996) though that IOS promote inter-organization cooperation, collaboration connection grounded on Information and Communication Technologies (ICT). IOS could be viewed as planning and managing inter-organization cooperation mechanism. Soliman（2003）though that IOS which is automated information systems can cross organization obstacles through various technologies.

The benefit of IOS

Cash and Konsyns（1985）supposed that enterprises applying IOS could increase exit barrier and transfer cost, further prevent from other potential opponent entering the market. Malone et al. (1987) indicated that owing to introducing IOS, enterprises reduced communication cost, touched more suppliers through market mechanism, closely integrated upstream companies, and further form electronic market in order to tightly couple with other organizations. Johnston and Vitale (1988) supposed that IOS not only improve enterprise competitiveness, but also bring many resources to gain competitive advantage, and support new strategy and reduce costs.

1. The factors which effect organizational benefit from introducing IOS

Many factors influenced organizational benefit from introducing IOS. This study explored these factors from both internal and external organizational perspectives.

(1) internal organizational perspective

Back and Bell (1994) considered that integration of organizational inter-departmental information systems is an important factor for business introduction of IOS from internal organizational perspective. Sriram and **Banerjee** (1994) supposed that technology maturity effect business introduction of IOS. Crook and Kumar (1998) indicated that scale of organization, information technology capability, and senior executive support are all influences for business introduction of IOS. Vijayasarathy and Tyler (1997) supposed that internal organizational factors that influence business introduction of IOS include cost saving, strategic benefits, cooperative partner pressures, and improvement and management of channel relation. Premkumar et al. (1995) indicated internal requirement, senior executive support, originators, information infrastructure and organizational capability are internal factor for business introduction of IOS.

(2) external organizational perspective

The use of IOS involved in internal operation and message transmission of organizations. Inner operation standards, hardware facility integration and information system usage of organizations are factors which effect organizational benefit from introducing IOS. Suomi (1994) indicated that communication standards are common and technology-intensive. Information standards are industry specific and focus on user requirement. Saunders and Clark (1992) supposed that the power between organizations, recognized benefit, perceived cost and the trust between organizations are factors which influence benefit

from introducing IOS. Premkumar et al. (1995) indicated that external organizational factors which introducing IOS include dependency, power, transactions trend and competition pressure. Hart and Saunders (1997) supposed that main factor that effect introducing IOS is the trust between organizations. Vijayasarathy and Tyler (1997) supposed that industrial experience introducing IOS, the characteristics of suppliers and customers, are important factors that influence introducing IOS. Teo et al. (2003) supposed that the factors that enable the adoption intention of IOS comprise mimetic pressures, coercive pressures, and normative pressures from an institutional perspective. Sriram and Banerjee (1994) indicated that the impact of IOS is moderated by the volume of transactions using IOS.

RESEARCH METHOD

Step 1: Construct hierarchical framework of the BSC performance evaluation criteria

From the four BSC perspectives, the hierarchical framework of the BSC performance evaluation criteria is constructed.

Step 2: Using AHP method to calculate the weight

If get the weightmatrix W in pairwise comparison matrix A, standardize geometrical mean of row vectors, multiply element in every row, get geometrical mean and normalize it.

Step 3: Construct Positive Reciprocal Matrix

Every evaluation member use fuzzy AHP evaluation scale to express relative weight between each dimensions and criteria, and construct fuzzy Positive Reciprocal Matrix.

Step 4: Consistency Check

The check methods are as follows:

4.1 Consistency Index (C.I.)

According to Consistency Index (C.I.), C.I=0 indicate that evaluation has perfect consistency; C.I>0 indicate that evaluation has consistency; C.I. <0.1 indicate that evaluation has evaluation has tolerant bias.

4.2 Consistency Rate (C.R.)

Saaty (1980) supposed that Consistency Rate (C.R.) to evaluate the consistency of pairwise comparisons in a matrix among criterions. Under the condition of different rank of matrix, it produce different random index (R.I.). Under the condition of the same rank of matrix, the ratio of C.I. to R.I. is called C.R.. When C.R≤0.1, the consistency level is acceptable.

Step5: Calculate fuzzy weight value

Utilize the Lambda-Max method which Csutora and Buckley (2001) proposed, calculate the fuzzy weight of evaluation criterions. The steps of calculation are as follows:

5.1 When α=1, use α-cut to get median Positive Reciprocal Matrix. Then, calculate the weight use AHP method to get the weight matrix.

5.2 When α=0, use α-cut to get minimum positive reciprocal matrix and maximum positive reciprocal matrix. Then, calculate the weight use AHP method to obtain the weight matrix.

5.3 In order to make sure that calculated weight value is fuzzy number, therefore, adjusted the coefficient.

5.4 After obtained adjusted coefficient, calculate minimum positive reciprocal weight matrix and maximum positive reciprocal weight matrix of every measurement dimension.

5.5 Combing adjusted minimum, maximum and median values to get the fuzzy weight in kth evaluation member and kth measurement dimension.

5.6 Utilize average method to integrate the fuzzy weight of evaluation members and measurement dimensions.

RESULTS

Based on previous studies on applying the BSC approach to information systems, this study collected numerous indicators of information system performance, after screening, and used the remaining 17 indicators as performance evaluation indicators to construct the research model and develop the questionnaire items based the model. The 17 indicators are showed in and Table 1 and Figure 1.

Table 1 The indicators of IOS from the BSC approach

Dimension	Indicator		Cause
Financial Dimension	Reduce information exchange cost	Beamon(1998), Milis and Mercken (2004)	external organizational perspective (external connection)
	Increase inventory turnover rate	Clemons and Weber (1990), Beamon(1998), Mabert and Venkataramanan (2007)	external organizational perspective external connection)
	Reduce transaction cost		external organizational perspective (external connection)
	Reduce IT repetition investment expense		internal organizational perspective (internal integration)
Internal Processes Dimension	Boost organization internal process elasticity	Clemons and Weber (1990), Bhagwat and Sharma(2007), Mabert and Venkataramanan (2007)	internal organizational perspective (internal integration)
	Increase the information integration level of inner organizations	Bhagwat and Sharma(2007)	internal organizational perspective (internal integration)
	Increase the information share level between organizations		external organizational perspective (external connection)
	Decrease organization internal process lead time	Beamon(1998), Milis and Mercken (2004)	internal organizational perspective (internal integration)

Dimension	Indicator		Cause
Internal Processes Dimension	Accelerate the process speed of dealing which suppliers and customers	Beamon(1998), Milis and Mercken (2004), Bhagwat and Sharma(2007), Mabert and Venkataramanan (2007)	external organizational perspective (external connection)
Customer Dimension	Decrease the response time of customer requests	Milis and Mercken (2004), Bhagwat and Sharma (2007),	internal organizational perspective (internal integration)
	Increase the quality of consignment archives		external organizational perspective(external connection)
	Increase invoice transmitting effect	Bhagwat and Sharma (2007)	external organizational perspective(external connection)
	Improve the ability of handling emergent customer' demand		internal organizational perspective (internal integration)
Learning and Growth Dimension	Improve data quality	Beamon (1998), Milis and Mercken (2004)	external organizational perspective(external connection)
	Shorten information handling time	Clemons and Weber (1990), Beamon (1998), Milis and Mercken (2004)	external organizational perspective(external connection)
	Increase manager' decision-making ability	Beamon (1998)	internal organizational perspective (internal integration)
	Increase information exchange speed between organizations	Beamon(1998), Bhagwat and Sharma(2007)	external organizational perspective (external connection)

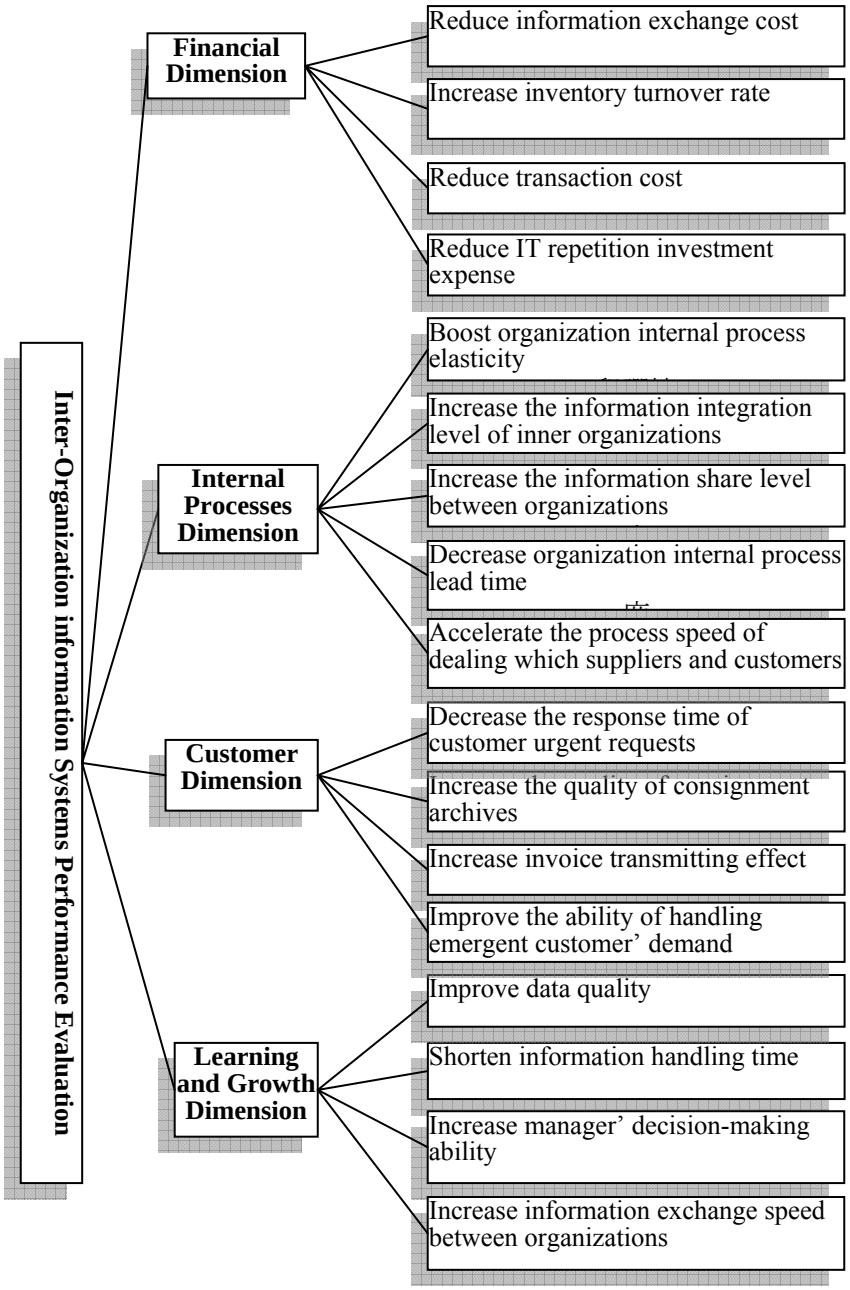

Figure 1 The hierarchical framework of the BSC performance evaluation criteria

Next, calculate the weights of all dimensions and indicators of the model using Fuzzy AHP method. The questionnaire was distributed among managers in the Taiwan' information and electronic industries, and a total of 20 valid questionnaires were returned from 20 different companies. The result of this study is showed in Figure 2.

The results demonstrated that the importance weights of all dimensions were ordered as follows: financial dimension, internal processes dimension, learning and growth dimension and customer dimension when managers measure inter-organizational information systems performance. Additionally, the importance weights of performance evaluation indicators

were ordered as follows: increase inventory turnover rate, accelerate the process of dealing which suppliers and customers, reduce transaction cost, reduce the cost of information exchange cost and boost organization internal process elasticity.

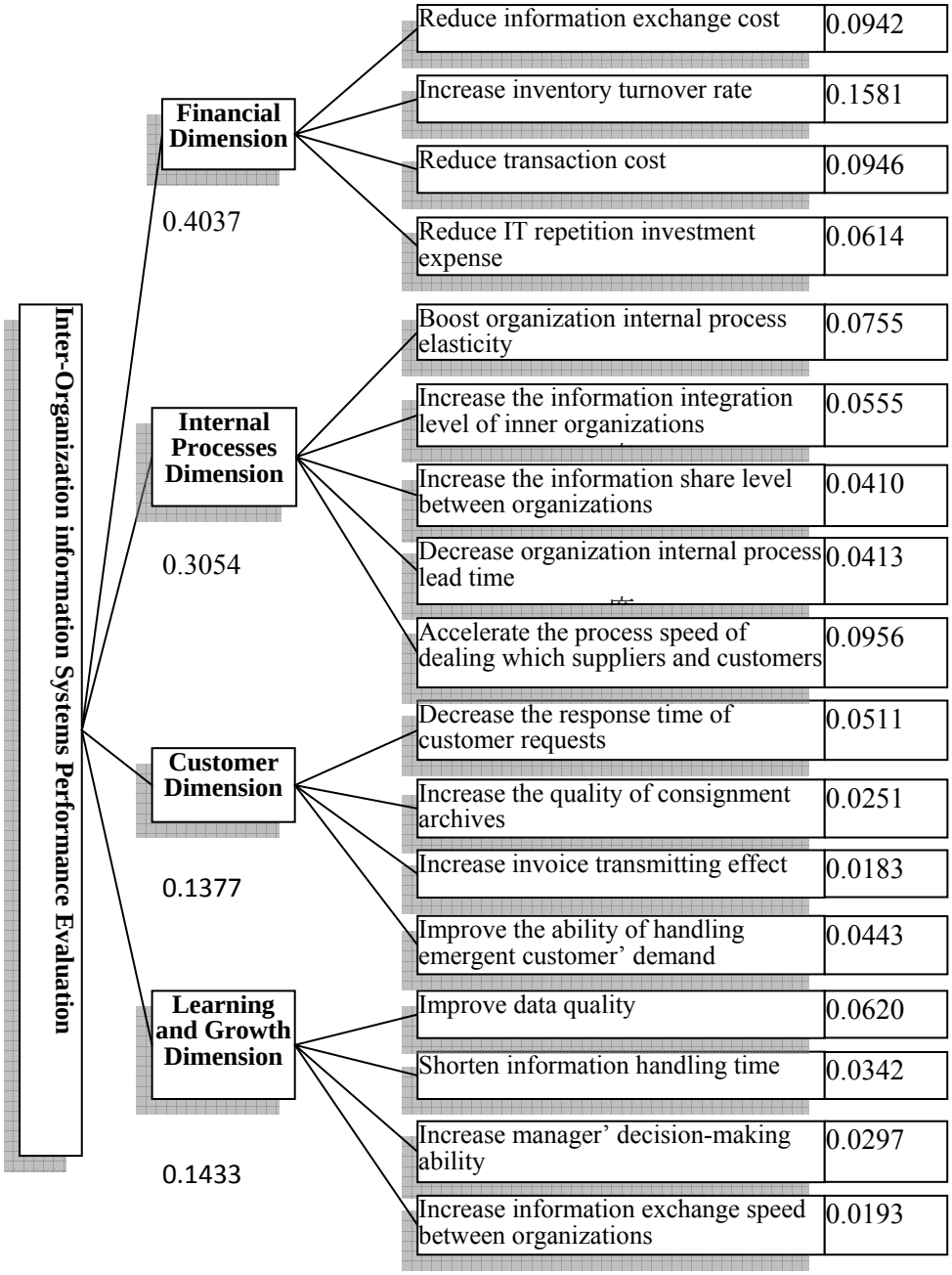

Figure 2 The result of this study

CONCLUSIONS

The result of the study could supply enterprises references for Taiwan' information and electronic industries when managers make related decisions on IOS.

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DOES GENDER EXPLAIN FINANCIAL PERFORMANCE? CASE OF WARSAW STOCK EXCHANGE LISTED COMPANIES

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ABSTRACT

131 Warsaw Stock Exchange listed companies were analyzed to examine correlation between the balance of men and women at management boards and companies financial performance (ROE) between 2001 and 2009. A multifactor regression model was estimated with women number and women parity in management board as factors explaining ROE changes. The analysis generally confirms that the number of board members changes when company size increases. Unfortunately the number of women as management board members decreases with the company growth, especially when large companies are considered. The size of the company has positive correlation with number of management board members and negative with number of women as management boards members although the dependence is not linear. The results show that increasing parity of women at management board increases ROE for small companies with ROE over 3,04% and all the large companies. Unfortunately ROE growth for all middle size and the least effective small companies (with ROE under 3,04%) depends on decreasing women parity at top management board. However, no matter the company size, women parity has stronger impact on ROE than other analyzed variables like company sales level or GDP growth.

Keywords: behavioral finance, gender, risk tolerance, financial effectiveness.

I. GENDER, RISK TOLERANCE AND GENDER (IN)EQUALITY

A success in business in most cases depends on risk taking and self-confidence. Healthy appetite for risk and self-confidence should be natural for all entrepreneurs, both men and women. In 2005 Cranfield School of Management conducted study examining 50 entrepreneurs to assess their willingness to take risk and their varying levels of confidence. The best combination that corresponded with the strongest sales and profit was a maximum of risk tolerance and a minimum of confidence. The second strongest combination, which led to slower sales but higher profits, was lower tolerance for risk and less confidence. The worst-case combination that ended with weak sales and/or poor profits were specific for those with low risk tolerance and lots of confidence. The Cranfield framework show that the collision of overconfidence and risk tolerance may lead to overexpanding, failing to respond to market signals, misjudging the strength of competitors, and failing to pursue one initiative to its conclusion before the next is launched (Hanft, 2005).

The combination of situational and individual approaches to risk propensity through consideration of individual responses to different risk domains is an interesting and promising

stream of research. The work of Weber and Milliman (1997), and subsequent work by Weber et al. (2002) represents an important development in this field. These authors found that while the degree of risk perceived in a situation can vary according to the characteristics of the situation, attitude to perceived risk (the degree to which people find perceived risk attractive) remained stable across situations for a significant portion of their sample. Work in this area (Fagley and Miller, 1997; Weber and Milliman, 1997) shows that it is possible to be risk seeking in some areas of one's life and risk averse in others while having a relatively consistent view of risk.

More and more studies, intensified recently as a natural consequence of behavioral finance, biological finance or neurofinance development, explain human risk taking behavior and processes of decision making. Many of them focus on differences in risk tolerance for men and women. Roszkowski and Grable (2005) examined a sample of 183 financial advisors and 290 advisory clients to determine the degree of correspondence between advisors' subjective clinical judgments about their clients' financial risk tolerance and the clients' actual financial risk tolerance. The correlation between the estimates and the actual measures was 0.41. It was further determined that advisors overestimated the risk tolerance of men and underestimated the risk tolerance of women. This distortion could not be attributed to income or wealth differences between the males and females.

Iqbal et al. (2006) provided additional evidence on this issue by examining the stock selling behavior of male and female executives in response to stock option awards. When corporate executives sell shares of their firm upon new stock option awards, it is an indication that they are attempting to reduce risk through diversification of their personal portfolio. More rigorous stock sales by female executives indicated that they were more risk averse than their male counterparts. However, male executives were more risk averse by engaging in higher diversification-related stock sales than the female executives.

Finally, in 2004 New York-based research group Catalyst published its study, called "The Bottom Line: Connecting Corporate Performance and Gender Diversity". The study was based on 353 Fortune 500 companies sampled between 1996 and 2000. They showed the existing link between largest US companies' financial performance and the percentage of women in senior management. It was proved that companies ranked in the upper quartile in terms of percentage of women in top management had ROE that were on average 35,1% higher and total shareholder returns that were 34% higher than those in the lowest quartile (No Gender…, 2004). The results may be surprising but remained unexplained by Catalyst. However similar findings have been noted by other researchers. A 1998 survey by the American Management Association found that a mixture of genders, ethnic backgrounds and ages in senior management teams consistently correlates to superior corporate performance. A comprehensive Finnish study of nearly 13 000 limited companies with more than ten employees found that firms with a female CEO were in practice around 10 percent more profitable than comparable firms with a male CEO. A similar effect was found for companies with gender balanced boards compared to those with all male boards (Kotiranta et al., 2007).

The researches mentioned suggest that proper balance of men and women managing companies or taking other parts in public activity leads to a better performance. The practice of business and economy as a whole should have noticed this fact and appreciate it as a

source of competitive advantage. Unfortunately, the economy does not confirm it. Although equality between women and men is a fundamental right and a common principle of the European Union and since the 1970s, the European Union has adopted an extensive body of equal treatment legislation, gender inequalities persist, predominantly to the disadvantage of women. If gender equality is to be fully realized further action is needed to eliminate gender stereotypes, close the gender pay gap, combat gender-based violence and increase the number of women in decision-making. According to the report on gender equalities by European Commission, Europeans believe that all sectors of society are impacted by gender inequality, and sexist stereotypes, primarily present in working life and advertising, reinforce the situation. One of the 'work-related stereotypes': the existence of 'female' or 'male' types of work is still present in European citizens' answers in 2009. It is also felt that women are under-represented in top positions not because they are less interested in positions of responsibility than men, but because of heavy family responsibilities (Gender equality…, 2010).

Table 1. Men and women as heads of businesses in the EU in 2009

EU Member State	Heads of businesses (1000s)			
	Women (N)	Men (N)	Women (%)	Men (%)
EU-27	2935	6083	33	67
Belgium	77	185	29	71
Bulgaria	47	104	31	69
Czech Republic	48	132	27	73
Denmark	21	68	24	76
Germany	285	642	31	69
Estonia	10	19	34	66
Ireland	32	133	19	81
Greece	118	297	28	72
Spain	421	778	35	65
France	307	461	40	60
Italy	564	1060	35	65
Cyprus	1	5	17	83
Latvia	18	33	35	65
Lithuania	23	50	32	68
Luxembourg	3	6	33	67
Hungary	32	80	29	71
Malta	1	4	20	80
The Netherlands	161	388	29	71
Austria	48	111	30	70
Poland	171	321	35	65
Portugal	79	172	31	69
Romania	42	114	27	73
Slovenia	11	34	24	76
Slovakia	19	45	30	70
Finland	20	72	22	78
Sweden	23	66	26	74
United Kingdom	353	703	33	67

Source: European Commission.

Across Europe in 2009, every central bank has a male governor and more than four out of every five members of key decision-making bodies are men. The central banks of Germany, Cyprus, Luxembourg, Austria and Slovenia do not have a single female representative on the main decision-making bodies and it is only in Hungary (33%), Sweden (41%) and Serbia (38%) where women account for at least one in three members. The situation is no different in the three main financial institutions of the EU (European Central Bank, European Investment Bank and European Investment Fund), which all have a man at the helm and an 89:11 male to female ratio amongst the combined members of their key decision-making bodies (More women…, 2010).

In the aftermath of the financial crisis, various commentators and even government ministers have suggested that the collapse of some of the major institutions might have been mitigated had there been more women on the boards to moderate the risk-taking culture. This view is given credence by an increasing number of research studies on the effect of gender on risk-taking, which tend to concur in showing that women are more risk averse than men as mentioned earlier. There is even evidence from the stock market to support this further. A study of companies from the French CAC40 suggests that those with the most women in management positions were also the ones that were affected least during the crisis (in terms of stock market value), though it must be said that from such a small sample this cannot conclusively be taken to be a cause and effect relationship.

The largest companies listed on the stock exchanges around Europe play a significant role in global business as well as contributing significantly to the national economies within which they operate. During the course of the recession, the decisions taken by these companies have had ramifications not only for their businesses and their employees but for the whole economy. In all but isolated cases these decisions are taken by a sizeable majority of men as women are still under-represented on company boards. In 2009, women account for an average of just 3% of the presidents of the largest companies in each of the EU Member States and less than 11% of board members (More women…, 2010). Fortunately, taking SME and self-employment into account, women lead about 33% of businesses (table 1).

II. GENDER PARITIES AT MANAGEMENT BOARDS OF WARSAW STOCK EXCHANGE LISTED COMPANIES

Behavioral finance proves that men are in general more risk tolerant than women, especially when financial issues are considered. The question is to what extend that differences explains financial performance of public companies in Poland. Regarding the current state of knowledge this kind of research was not provided yet for Polish companies so it seems to be relevant. The main purpose of the study is to examine the impact of men to women ratio at management boards of Polish companies on their financial performance.

The sample of organizational, financial and macroeconomic quarterly data for 131 Warsaw Stock Exchange (WSE) listed companies was collected for years from 2001 to 2009. The data was provided by WSE, Notoria Service and Polish Court of Registration (PCR). There were 372 companies listed at the main and parallel market of WSE in the end of 2009 so the sample provides data for 35,2% of public listed companies (excluding New/Connect WSE Alternative Trading System operating since August 31, 2007). The research period includes two subperiods of economic slowdown of the Polish economy, 2001-2002 and 2009 with global financial crisis influencing companies' operational and financial performance.

The sample of 131 Polish companies (foreign WSE listed companies were excluded) consisted of 3 main WSE indices companies:

1. 20 companies from WIG20 index of the 20 biggest and most liquid companies,
2. 37 companies from mWIG40 index of the 40 mid size companies,
3. 74 companies from sWIG80 index of the 80 small size companies.

A multifactor econometric model was estimated as the main analytical method. Men and women number and parity at management boards, company size and GDP growth were

assumed as factors explaining changes in ROE as the measure of financial effectiveness. Statistical measures for sample data are presented in table 2.

Table 2. Basic statistical measures for model variables

	$LSAL_T$	BM_T	WBM_T	WBR_T	GDP_T	ROE_T
Number of observations	3614	4031	4031	4031	4716	3278
Mean	5,4293	3,6735	0,3458	0,0968	3,8917	0,0722
Confidence interval (-95%)	5,3241	3,6150	0,3270	0,0911	3,8288	0,0633
Confidence interval (+95%)	5,5345	3,7320	0,3646	0,1025	3,9546	0,0810
Median	5,7585	3,0000	0,0000	0,0000	4,0000	0,0810
Minimal	-6,2150	1,0000	0,0000	0,0000	0,2000	-1,9940
Maximal	101,0000	16,0000	4,0000	1,0000	7,5000	1,9760
Lower quartile	4,4250	2,0000	0,0000	0,0000	2,0000	0,0170
Upper quartile	6,8510	5,0000	1,0000	0,1670	6,1000	0,1670
Standard deviation	3,2257	1,8939	0,6093	0,1844	2,2037	0,2576

Men and women parity at management boards. The data on number of management boards' members (BM_T) and women as their members (WBM_T) for all companies from 2001 to 2009 were collected. All active stock companies are obliged to inform PCR and Polish Financial Supervision Authority (PFSA) about changes in top management and supervisory boards so the data is dispersed but available to collect. For the research purpose it was assumed that new management board member can influence financial performance of a company no sooner than in the next quarter after the change took place. For example, if any change in management board takes place in Q1 the new board make-up is assumed as Q2 ROE explaining factor and so on. Woman to number of top management board members ratio was also calculated (WBR_T).

Company size. It was assumed that changes of the management board members number was related to company operating scale. Total sales for the last 4 quarters were taken as a measure of a company size. The larger the company the more duties and responsibility needs to be shared by managers and – to some limits – should lead to increase in number of positions in management board. The largest companies have more management board members than small companies so with the same number of women in management board their influence can be weaken. Due to wide range of sales for smallest and biggest companies natural logarithm of sales (in millions of PLN) was taken to narrow it ($LSAL_T$).

GDP growth. GDP annual growth providing better or worse economy conditions for most of companies operating in the country can be important factor influencing financial performance with no relation to management board members quantity and quality. GDP annual growth

provided quarterly by Polish Central Statistical Office (GUS) was included then to ROE explaining set of variables (GDP_T).

III. MODEL OF MANAGEMENT BOARD GENDER PARITY IMPACT ON COMPANY FINANCIAL PERFORMANCE

In the period from 2001 to 2009 mean for management board members number of all analyzed 131 Polish companies was 3,6735 and mean for number of women as management board members was only 0,3458. It means that the result for the sample is no significantly different than for all EU Member States largest companies with 9,68% mean of women parity at management boards in Poland. Nevertheless, the results vary when company size is considered. Table 3 presents details for WIG20 (largest), mWIG40 (middle size) and sWIG80 (small size) companies.

Table 3. Number of women as management board and company size

	Observations	BM_T		WBM_T		WBR_T, %	
	N	Mean	Std	Mean	Std	Mean	Std
largest	622	5,28	2,24	0,25	0,54	4,71	10,88
middle size	1154	3,90	1,84	0,35*	0,53	8,54	14,92
small size	2255	3,12	1,50	0,37*	0,66	11,64	21,22

* Statistical no difference (p=0,05).

The number of board members changes when company size increases with natural business constrains. All kind of companies differ in management board members number with the largest boards for the largest companies, as expected. Unfortunately number of women as top management board members decreases with a company growth especially when large companies are considered. It means that the size of the company has positive influence on number of management board members and negative on number of women as management boards members although the dependence is not linear. The polynomial functions of board members number depending on 4-quarters sales were estimated for all three groups of companies. Estimated parameters and functions graphs are presented below. Estimation results show that sales can explain about 22% of changes in management board size for small and middle companies and only 6,1% for largest companies.

Table 4. Estimated parameters of management board members number depending on last 4-quarters sale

$$BM_T = A_0 + A_1 \cdot (LSAL_T) + A_2 \cdot (LSAL_T)^2 + A_3 \cdot (LSAL_T)^3$$

	N	A_0	A_1	A_2	A_3	R	$LSAL_{min}$	$LSAL_{max}$
small	1868	1,8469	0,0897	0,0339	-0,0003	0,4658	-4,13	8,09
mid	1074	2,9128	0,0204	-0,0379	0,0100	0,4666	-2,60	8,44
large	528	-3,534	2,3340	-0,1532	0,0011	0,2472	3,05	10,97

Figure 1. Estimated number of management board members depending on last 4-quarters sale (smallest companies)

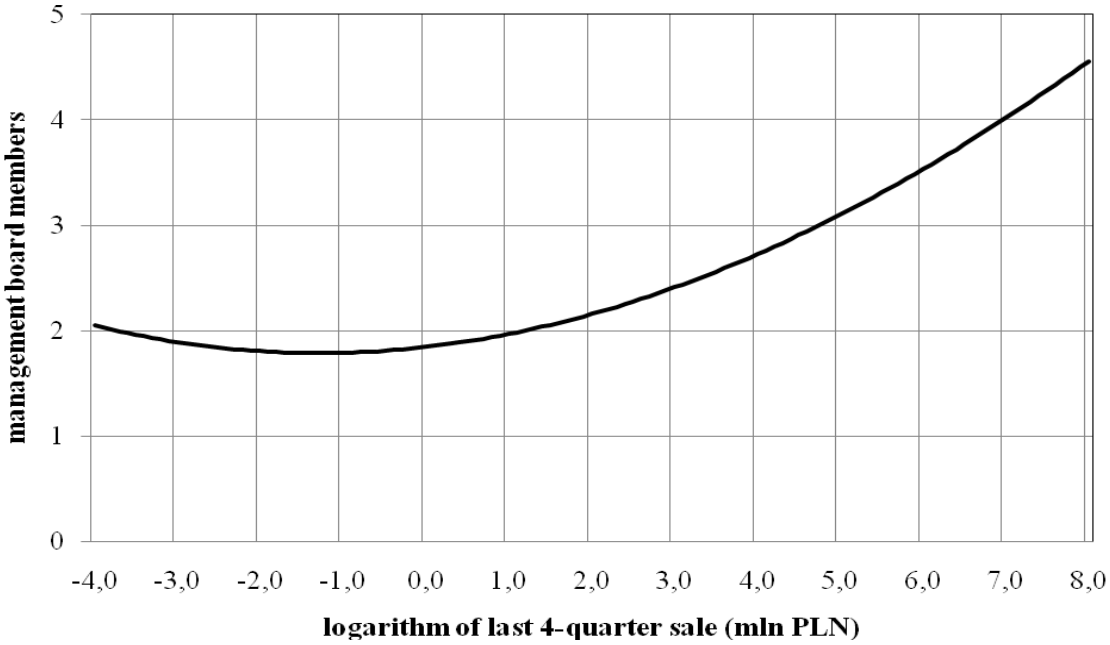


Figure 2. Estimated number of management board members depending on last 4-quarters sale (middle size companies)

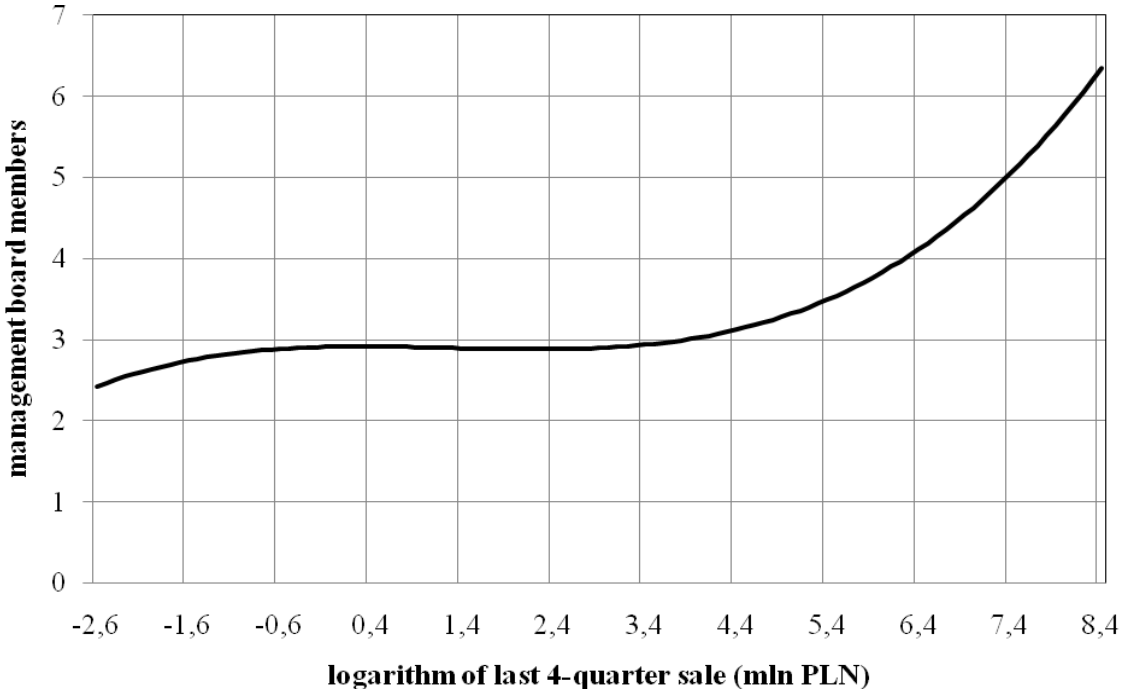
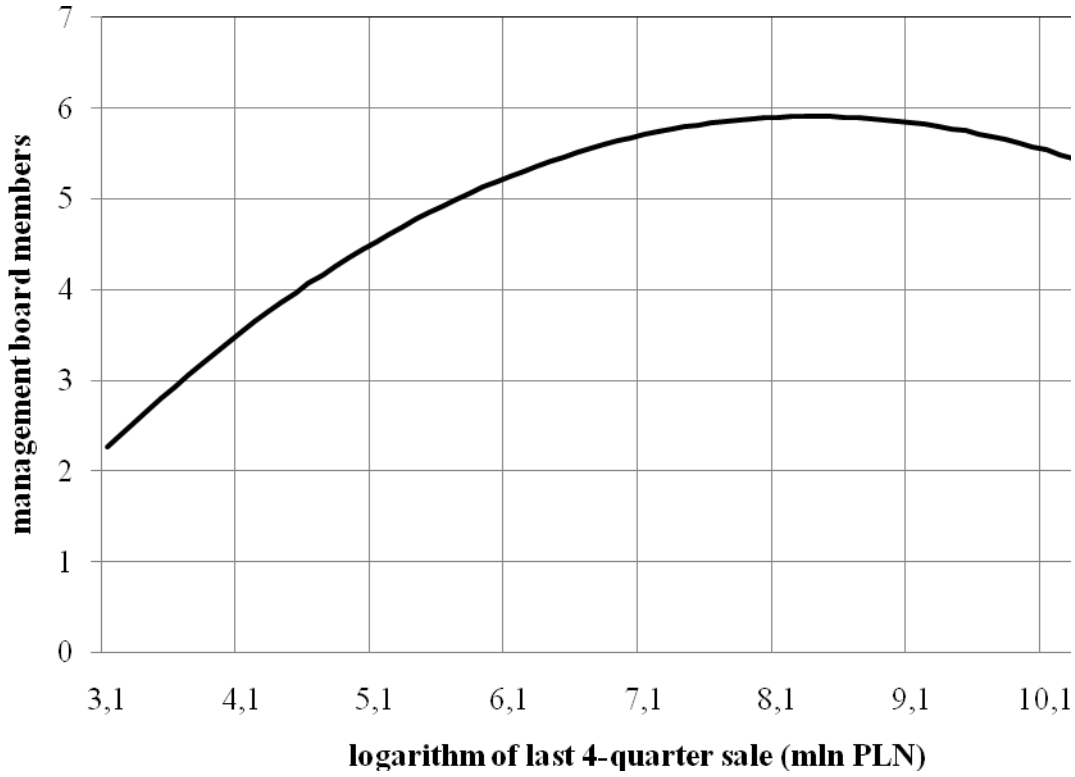


Figure 3. Estimated number of management board members depending on last 4-quarters sale (large size companies)



Finally, a simple linear model was proposed to estimate how ROE from 2001 to 2009 was influenced by women parity in top management boards and other factors. The model of linear regression with model-estimated breaking level of dependent variable is presented below as well as estimation results for all three classes of companies. Initial estimates proved that this kind of models better fitted than a single model with no breaking-points.

$$ROE_T = A_0 + A_1 \cdot LSAL_T + A_2 \cdot BM_T + A_3 \cdot WBM_T + A_4 \cdot WBR_T + A_5 \cdot GDP_T$$

Table 5. Estimation results for small companies (sWIG80)

ROE	**A_0**	**A_1**	**A_2**	**A_3**	**A_4**	**A_5**
under 3,04%	0,6064	-0,0311	-0,0894	0,2767	**-2,0658**	0,0121
over 3,04%	-0,0332	0,0020	0,0086	-0,0762	**0,5860**	0,0149
N = 425		R =0,7318		R^2 =53,55%		

Table 6. Estimation results for middle size companies (mWIG40)

ROE	**A_0**	**A_1**	**A_2**	**A_3**	**A_4**	**A_5**
under 10,77%	-0,2654	0,0308	-0,0166	0,1077	**-0,2025**	0,0249
over 10,77%	0,4551	-0,0309	-0,0038	-0,0269	**-0,2410**	0,0166
N = 312		R =0,6561		R^2 =43,04%		

Table 7. Estimation results for large companies (WIG20)

ROE	**A_0**	**A_1**	**A_2**	**A_3**	**A_4**	**A_5**
under 10,98%	-0,2405	0,0202	0,0079	-0,0115	**0,2318**	0,0054
over 10,98%	-0,0434	0,0036	0,0224	-0,0067	**0,1719**	0,0053
N = 101		R =0,8690		R^2 =75,17%		

The results are ambiguous and prove that number of women in management board may affect financial performance in both directions even within the same class of business size. The results show that increasing share of women in management board increases ROE for small companies with ROE over 3,04% and all the large companies. Unfortunately, the effect of ROE increase for middle and the least effective small companies (with ROE under 3,04%) have been obtained by decreasing share of women in top management. However, no matter

the company size, women parity in top management out of all variables had the strongest influence on ROE of analyzed companies.

Table 8. Decisions in management board structure towards ROE increase

Company	Number of women	Share of women	Suggested action
small company low ROE	increase	decrease	Increase number of board members, add more men than women
small company high ROE	decrease	increase	Decrease number of board members, reduce more men than women
mid company low ROE	increase	decrease	Increase number of board members, add more men than women
mid company high ROE	increase	increase	Increase number of board members, add more women than men
large company low ROE	decrease	increase	Decrease number of board members, reduce more men than women
large company high ROE	decrease	increase	Decrease number of board members, reduce more men than women

Desirable actions towards ROE increasing may consider above discoveries for business practice. For example, for middle size companies with relatively low ROE (up to 10,77 % in case of analyzed WSE listed companies) ROE enlarges if the number of women at the management board increase (A_3 = +0,1077) but enlargement of women part at the board reduces ROE simultaneously (A_4 = -0,2025). Decisions aiming to the enlargement of ROE through changes of the management board - if they are considered - should lead then to women number increase and simultaneously decrease of their participation. All other cases of decision depending on company size and financial performance are presented in table 8.

CONCLUSION

The above analysis leads to some general remarks on men and women impact on financial effectiveness measured by ROE. Suppose a company that is interested in increasing ROE. For all kind of companies men seem to be a force that leads to increase of financial effectiveness especially when it is relatively low. It is confirmed by positive influences of men participation at the board (e.g. negative influence of women participation) for small and middle companies with relatively low ROE. When ROE raises women participation should also rise (probably) to ensure some stability of financial situation. This kind of action should have strongest positive consequences for large companies and that confirms general results of researches provided in other countries.

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RESEARCH AND DEVELOPMENT AND MANUFACTURING TRADE

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ABSTRACT

This paper investigates the impact of research and development (R&D) on manufacturing trade using the panel adjusted gravity equation model for OECD countries during the period 1995-2003. We find that R&D is positively associated with manufacturing trade for exporting countries, while results are mixed for importing countries. The results reject the non-linear relationship between R&D and manufacturing exports. Estimations suggest that R&D may contribute to overcoming the effects of distance on manufacturing exports and may strengthen import specialization. R&D is found as the way to foster exports of manufacturing products from developing to developed OECD countries. Gross domestic product and gross domestic product per capita positively affect manufacturing trade. The distance influences negatively, while having a common border, common language, and regional free trade agreement membership positively enhances manufacturing trade between the eighteen analyzed OECD countries.

Keywords: manufacturing, R&D, distance, level of development, OECD countries, panel data analysis

INTRODUCTION

Theories in the literature explain various internal and external factors of technological sources, technology acquisition, R&D intensity and innovation at firm, industrial sector, and nation levels. The changing global competitiveness and trade patterns between the nations have generated a search for the determinants which are causing these changes. R&D intensity and innovation activities are seen as key factors in explaining the changes in technological gaps and in competitiveness in world trade (e.g. Freeman *et al.* 1991, Wakelin 1998). There is a growing literature on the determinants of trade performance, either for one country (e.g. Özçelik and Taymaz 2004), or for more or a group of countries (Roper and Love 2002), in order to assess and point to a role for R&D intensity and innovation activities as factors influencing the trade performance of developed

industrialized countries (Fagerberg 1988, Greenhalgh 1990) and developing countries (Montobbio and Rampa 2005).

This paper investigates the impact of R&D intensity on trade by analysing the determinants of the bilateral manufacturing trade flows between eighteen OECD countries. We employ adjusted gravity equations to identify the effects of R&D on bilateral manufacturing trade using a panel data analysis (Anderson and van Wincoop 2004). Our paper aims to contribute to the literature in four significant directions. First, the starting point of our investigation is the relationship between R&D and manufacturing trade performance in the OECD countries using a panel data analysis by applying the baseline adjusted gravity equation model. We integrate the Ghazalian and Furtan (2007) econometric approach in our estimation. So far there are scare similar studies in the literature. Second, we analyse whether the R&D intensities have mitigated the effect of distance on manufacturing trade, and therefore we check the rationale for long-distance on manufacturing trade. We employ the Freund and Weinhold (2002, 2004) and Bojnec and Fertő (2009, 2010) specification for the investigation of the effects of R&D on distance and long-distance into the adjusted gravity equation model. Third, we investigate for the impact of the level of economic development on manufacturing trade and check the sensitivity of the panel regression results to the choice of R&D by investigating the effects of R&D by the level of countries' economic development. Finally, the robustness test is conducted by years and for non-linearity.

The rest of the paper is organized as follows. The first section presents the literature review. In the next section after that we present the methodology and data used by focusing on the R&D intensity in the adjusted gravity regression analysis. After that, we present and discuss the regression results for alternative specifications of adjusted gravity models and for a robustness check. In the final section we summarise the main findings and give conclusions.

LITERATURE REVIEW

The literature provides a theoretical background for export and R&D relationship at both macroeconomic and microeconomic level. Since our study focuses on the macroeconomic level, we concentrate mainly on the former literature. The macroeconomic research offers two main theoretical perspectives to account for the relationship between R&D and exports. First, the neo-endowment models which concentrate on trade specialisation on the basis of factor endowments, such as materials, labour capital, knowledge and human capital (Wakelin 1998). Second, neo-technology models which predict innovative industries will be net exporters instead of importers. The latter type of models provides an extension of the conventional technology-based models such as the product life-cycle theory (Vernon 1966) and technology gap theory (Posner 1961).

In his seminal work, Krugman (1979) showed that countries and products can be ranked by technological level and that economies ahead on this scale specialize in the technological intensive goods. Increasing returns to scale and product innovations generate trade specialization and first mover advantages. But in equilibrium, imitation reduces technological gaps between countries, and the monopolistic power of leaders is temporary. In addition, he argued that the causal chain ran from R&D and innovation to international trade and not the other way round.

Grossman and Helpman (1995) argued that, in a framework of monopolistic competition, a country could shift its export demand curve outwards by increasing the quality of goods it produces; meanwhile, it could shift its import demand curve inwards by increasing the quality of goods produced for the domestic market. These demand-shift factors can possibly be proxied by factors that represent improvements in product quality, i.e. R&D and technological innovation.

A wealth of literature provides evidence at the macroeconomic level on the linkage between a country's export performance and its R&D pertained with creativity/innovation. Various empirical studies confirm the importance of R&D, technology and innovation as one of the major factors contributing to facilitating entry into global markets and thereafter maintaining competitiveness and boosting export performance (e.g. Fagerberg 1988, Greenhalgh 1990, Wakelin 1998, Montobbio 2003, Narula and Wakelin 1998, Leon-Ledesma 2005, DiPietro and Anoruo 2006).

The literature highlights three channels for R&D and innovation influencing the level of trade (Ghazalian and Furtan 2007). First, R&D and innovation may foster the product differentiation, allowing for more product variety choices and higher quality products for consumers. Second, R&D and innovation may reduce the production costs, making firms more competitive on the international markets. Third, R&D and innovation may reduce the transaction costs along the supply chain and between trading partners, making exports more competitive. For example, the literature on international trade emphasises the role of institutions and infrastructure in export growth (e.g. Anderson and Marcouiller 2002, Dollar and Kray 2002, de Groot *et al.* 2004, Francois and Manchin 2007, Depken and Sonora 2005, Levchenko 2007).

METHODOLOGY AND DATA USED

Traditional gravity trade theory indicates that bilateral trade is positively associated with their national incomes and negatively associated with their geographical distance (e.g. Frankel and Rose 2002, Baier and Bergstrand 2006). We apply adjusted gravity model variables including market size (real gross domestic product (GDP) of host *i* and destination *j* countries, geographical factors like the distance between capital cities (Distance) and common border (Contiguity), common cultural linkage (Language), and a dummy variable for Regional Free Trade Agreement (RFTA) membership as explanatory variables. First, we specify the following baseline adjusted gravity model:

$$\ln X_{ij,t}=\alpha_0+ \alpha_1 \ln GDP_{i,t}+\alpha_2 \ln GDP_{j,t}+\alpha_3 \ln GDPCAP_{i,t}+\alpha_4 \ln GDPCAP_{j,t}+\alpha_5 \ln Distance_{ij}+ \alpha_6 Contiguity_{ij}+\alpha_7 Language_{ij}+\alpha_8 RFTA_{ij}+u_1 \quad (1)$$

The trade data used is supplied by the OECD Bilateral Trade Database at the two-digit level of the ISIC in US dollars. We use data for the manufacturing exports (X_{ij}). The sample contains 18 OECD countries[1] between 1995 and 2003 resulting in 2,754 observations. GDP is a proxy for the market size, and GDPCAP is a general proxy for the level of economic development as an important demand factor for both exporter and importer countries. The source of data is the World Bank, World Development Indicators (WDI) database. The $Distance_{ij}$ variable measures the geographic distance between the countries' capitals *i* and *j*, whereas the other dummies reflect whether *i* and *j* share: a land border ($Contiguity_{ij}$), their primary language (Language), and membership in a RFTA. The source of these data is the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII): http://www.cepii.fr/anglaisgraph/bdd/distances.htm) database.

The literature argues that richer and larger exporters and importers trade more, as do countries linked by regional trade agreements, a land border, or a common language; and landlocked and physically large countries do less trade, while that trade falls with geographic distance (e.g. Leamer and Levinsohn 1995). Distance can have an influence on technology transfer (Eaton and Kortum 2002, Kneller 2005).

Second, we are interested in the role of R&D on manufacturing trade. The previous section provides some evidence on how R&D inputs/innovation-related variables are expected to directly raise export intensity. Thus, we employ an adjusted gravity model with R&D expenditure variables:

$$\ln X_{ij,t}=\beta_0+ \beta_1 \ln GDP_{i,t}+\beta_2 \ln GDP_{j,t}+\beta_3 \ln GDPCAP_{i,t}+\beta_4 \ln GDPCAP_{j,t}+\beta_5 \ln Distance_{ij}+ \beta_6 Contiguity_{ij}+\beta_7 Language_{ij}+\beta_8 RFTA_{ij}+\beta_9 R\&D_{it}+\beta_{10} R\&D_{jt}+u_1 \quad (2)$$

The variables of particular interest are the expenditures on R&D. The data for governmental R&D outlays are collected from the OECD STAN R&D dataset. The R&D intensity is measured as the OECD R&D expenditure for total manufacturing (in million constant US$ in 2000 purchasing power parity – PPP – prices). In the light of previous research, we would expect that the higher the R&D intensity, the higher would be the export activity performance.

We check the robustness of our results in two steps using different specifications. First, recent research emphasises the existence of a possible non-linear relationship between R&D and exports (Estrada *et al.* 2006), because the effect of R&D and thus improved technological innovation on trade could vary according to the technological achievement

[1] The list of countries included in the data sample: Australia, Belgium, Canada, the Czech Republic, Finland, France, Germany, Ireland, Italy, Japan, South Korea, the Netherlands, Norway, Poland, Spain, Sweden, the United Kingdom, and the United States of America.

in countries. To check for a possible a non-linear relationship between R&D and manufacturing exports, two additional terms are included in the model:

$$\ln X_{ij,t}=\beta_0+\beta_1 \ln GDP_{i,t}+\beta_2 \ln GDP_{j,t}+\beta_3 \ln GDPCAP_{i,t}+\beta_4 \ln GDPCAP_{j,t}+\beta_5 \ln Distance_{ij}+ {}_6Contiguity_{ij}+\beta_7 Language_{ij}+\beta_8 RFTA_{ij}+\beta_9 R\&D_{it}+\beta_{10} R\&D_{jt}+\beta_{11} R\&D2_{it}+\beta_{12} R\&D2_{jt}+u_1 \quad (3),$$

where the variables R&D2 describe the squared terms of innovation proxies.

Second, our panel regression specifications have been chosen to minimize the possibility of omitted variable bias and to capture some of the impact of the R&D on manufacturing trade. Cross-section estimation is more prone to these problems, as it is impossible to control for country-fixed effects while using country-specific variables. Nevertheless, cross-section estimation eliminates the possibility of co-trending variables over time and thus provides a useful robustness check of our results.

Finally, there are some issues that we have to address when we estimate such panel models (Ghazalian and Furtan 2007). First, heteroskedasticity may occur because trade between two smaller countries or between a smaller and larger country is probably more volatile than trade between two larger countries (Frankel 1997). The panel dataset is also subject to the existence of autocorrelation. Contemporaneous correlation across panels may occur because exporting to one country can take place as an alternative to exporting to another country. Similarly, adjacent exporter(s)'/importer(s)' time specific shocks result in larger correlated error terms of their trade with their partners. To deal with issues of contemporaneous correlation we apply the panel corrected standard error model (PCSE) which controls for heteroskedasticity and the AR(1) type of autocorrelation and contemporaneous correlation across panels (Beck and Katz 1995, 1996).

EMPIRICAL RESULTS

R&D expenditures

The impact of R&D on trade performance may vary by sectors in the economy which are either net users or net producers of R&D-based innovations. Some sectors in the economy might be characterized by high levels of R&D-based innovation, while some other sectors might be characterized by few R&D-based innovations. There might be also differences in production and use of R&D-based innovations by different sectors.

Table 1. The OECD research and development expenditure for total manufacturing (in million US$ in 2000 PPP)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	mean	Standard Deviation
Australia	1817	1717	1676	1552	1557	1717	1907	2176	2442	1840	296
Belgium	2331	2472	2658	2670	2882	3146	3586	3282	3222	2917	418
Canada	4048	4173	4751	5441	5764	6915	7573	6545	6364	5731	1233
Czech Republic	624	600	727	803	730	737	797	815	863	744	88
Finland	1235	1477	1729	2019	2290	2722	2845	2938	3042	2255	674
France	15339	15817	15885	16220	17233	17961	19230	20523	20663	17652	2060
Germany	24898	25765	26843	28310	30441	33082	33650	35003	36431	30491	4243
Ireland	517	569	607	626	637	631	620	634	654	610	43
Italy	5490	5724	5622	5276	5546	6068	6301	6298	6105	5825	376
Japan	51517	55609	59913	60874	61677	66584	69468	73434	75263	63816	7986
South Korea	8407	9460	10064	8400	9200	11398	13354	14267	15817	11152	2723
Netherlands	2863	2942	3115	3058	3503	3658	3887	3751	4061	3426	442
Norway	544	579	583	560	594	703	801	781	853	666	119
Poland	539	612	651	773	832	651	653	408	464	620	136
Spain	1891	2138	2204	2678	2756	2934	3026	3618	3843	2787	658
Sweden	4090	4467	4595	4679	5204	6271	7027	6893	6800	5558	1181
United Kingdom	11481	11580	12194	12842	13967	14583	15689	16621	16796	13973	2082
United States	10423 7	11695 3	12590 2	12544 7	12256 5	12959 4	12634 0	11745 3	12912 6	12195 7	8034

Source: OECD (2006). ANBERD database

Table 1 presents the R&D expenditure for total manufacturing by the analyzed OECD countries. Except for Poland, the analyzed OECD countries experience increasing R&D expenditures by manufacturing sectors. Particularly rapid increase is seen for Finland and South Korea.

Time-series properties of the variables in the panel

Table 2. Panel unit root test results

	intercept and trend		intercept	
ln Exports	Statistic	Prob.**	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-1.72707	0.0421	2.75432	0.9971
ADF-Fisher Chi-square	859.801	0.0000	660.428	0.0856
PP-Fisher Chi-square	850.296	0.0000	672.915	0.0441
Levin, Lin & Chu t*	-41.3195	0.0000	-5.79121	0.0000
ln GDP exporter				
Im, Pesaran and Shin W-stat	1.50362	0.9337	-8.94086	0.0000
ADF-Fisher Chi-square	603.409	0.5900	952.174	0.0000
PP - Fisher Chi-square	315.447	1.0000	805.242	0.0000
Levin, Lin & Chu t*	-41.3195	0.0000	-38.6387	0.0000
ln R&D exporter				
Im, Pesaran and Shin W-stat	-5.44310	0.0000	2.91297	0.9982
ADF-Fisher Chi-square	1079.56	0.0000	595.969	0.6712
PP-Fisher Chi-square	875.020	0.0000	967.296	0.0000
Levin, Lin & Chu t*	-55.4886	0.0000	-18.9092	0.0000
ln GDPCAP exporter				
Im, Pesaran and Shin W-stat	0.21571	0.5854	-4.89430	0.0000
ADF-Fisher Chi-square	750.099	0.0001	850.260	0.0000
PP-Fisher Chi-square	434.234	1.0000	1263.93	0.0000
Levin, Lin & Chu t*	-49.2143	0.0000	-32.5830	0.0000

Source: Own calculations. Lag length (1) was selected by Schwarz Bayesian Information Criteria.

Before estimating the panel regression models, the main model variables are pre-tested for unit root tests. A number of panel unit root tests are available. Considering the well known low power properties of unit root tests, in this paper we employ a battery of unit root tests: Levin, Lin and Chu (2002) method (common unit root process), Im, Pesharan and Shin (2003) method (assuming individual unit root processes), ADF-Chi square, PP-Chi square. Table 2 presents the results of four different panel unit root tests (Levin, Lin and Chu; Im, Pesaran and Shin; ADF-Fisher Chi square, PP-Fisher Chi square), with different deterministic specifications (with constant, and with constant and trend). Mixed results were obtained. The most important model variables such as the bilateral trade flows and R&D expenditures in countries i and j do not have unit roots, i.e. are stationary, with individual effects and individual trend specifications. The panel unit root null hypothesis is also rejected with constant only deterministic specification for Levin, Lin and Chu and PP-Fisher Chi square tests. Other variables such as GDP and GDPCAP are more ambiguous in terms of unit root in a panel context. We may conclude that with individual effects only specification both variables of the panel dataset are stationary, while the majority of test results accept the panel unit root null hypothesis.

To ensure that both variables are I(0) and not integrated of a higher order, we apply unit root tests on first differences of all variables. Table 3 presents unit root test results for the first differences with constant specification only (it is not likely that first differences are trended). All tests reject the unit root null hypothesis for the first differences. In sum, we may conclude that panel is likely stationary.

Table 3. Panel unit root test results in first differences

ln exports	intercept	
Null: Unit root (assumes individual unit root process)	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-16.1776	0.0000
ADF-Fisher Chi-square	1448.31	0.0000
PP-Fisher Chi-square	1587.28	0.0000
Levin, Lin & Chu t*	-40.9337	0.0000
ln GDP exporter		
Im, Pesaran and Shin W-stat	-8.94086	0.0000
ADF-Fisher Chi-square	952.174	0.0000
PP-Fisher Chi-square	805.242	0.0000
Levin, Lin & Chu t*	-38.6387	0.0000
ln R&D exporter		
Im, Pesaran and Shin W-stat	-16.8326	0.0000
ADF-Fisher Chi-square	1393.49	0.0000
PP-Fisher Chi-square	1283.29	0.0000
Levin, Lin & Chu t*	-55.9749	0.0000
ln GDPCAP exporter		
Im, Pesaran and Shin W-stat	-11.5627	0.0000
ADF-Fisher Chi-square	1132.94	0.0000
PP-Fisher Chi-square	935.235	0.0000
Levin, Lin & Chu t*	-43.5799	0.0000

Source: Own calculations. Lag length (1) was selected by Schwarz Bayesian Information Criteria.

The baseline adjusted gravity model estimations

We start to present our regression results based on the adjusted gravity model without R&D variables. The equation (1) in Table 4 shows our baseline adjusted gravity model estimations for manufacturing trade. The baseline adjusted gravity models indicate that the size of GDP has a positive and statistically significant impact on bilateral manufacturing trade for exporting and importing countries. The size of the economy and its growth over time encourages bilateral manufacturing trade between the OECD countries. The level of development measured by GDPCAP has also a positive and statistically significant impact on bilateral manufacturing trade for exporting and importing OECD countries. As expected, the Distance between the countries' capitals has a negative and statistically significant impact on bilateral manufacturing trade between

the OECD countries, indicating the importance of geographical proximity and trade costs in conducting international manufacturing trade business. The regression coefficients of the Contiguity, Language, and RFTA are positive and statistically significant, confirming the importance of geographical and cultural proximity as well as the importance of the bilateral and multilateral trade liberalisation for increases in bilateral manufacturing trade between the OECD countries.

Table 4. The effect of R&D on manufacturing trade

	(1)	(2)	(3)
ln GDP exporter	0.842***	0.351***	0.362***
ln GDP importer	0.806***	0.751***	0.775***
ln GDPCAP exporter	0.978***	0.636***	0.658***
ln GDPCAP importer	0.659***	0.465***	0.436***
ln Distance	-0.607***	-0.676***	-0.684***
Contiguity dummy	0.745***	0.617***	0.679***
Language dummy	0.204***	0.237***	0.191***
RFTA dummy	0.901***	0.786***	0.739***
ln R&D exporter		0.476***	0.759**
ln R&D importer		0.067*	0.290**
ln R&D2 exporter			-0.017
ln R&D2 importer			-0.014
Constant	-42.216***	-26.044***	-28.802***
N	2754	2754	2754
R^2	0.9937	0.9937	0.9935
Rho	0.753	0.835	0.822

Notes: * p<0.1; ** p<0.05; *** p<0.01. Parameters are estimated by the Prais-Winsten estimator. The common AR(1) parameter is denoted by rho. The z values are computed from standard errors that are corrected for heteroscedasticity and contemporaneous correlation of error terms across panels.

The effects of R&D on manufacturing trade

In the process of international expansion, R&D with innovation is a significant determinant for the development of competitive advantage (Krugman 1979). In general, a positive relation between a country's export performance and its R&D intensity /creativity/innovation has been confirmed by previous studies (e.g. Greenhalgh 1990, Verspagen and Wakelin 1997, DiPietro and Anoruo 2006).

In the equation (2) in Table 4 we extend the baseline adjusted gravity model specification with the R&D expenditure variables. The signs of the associations and statistical significance of the regression parameters have remained unchanged. Only the negative

association for the Distance variable has been strengthened, whereas the absolute size for the other regression coefficient has declined. A significant decline of the regression parameter is seen for the GDP exporter variable, which implies some correlation between the level of R&D expenditures and the level of GDP in exporting OECD countries. The regression coefficients that are pertaining to the R&D expenditure variables are positive and statistically significant at the higher degree for exporting than for importing countries. We do confirm the importance of R&D for competitiveness in manufacturing exports, but to a lesser degree also for the manufacturing import specializations.

Robustness test for non-linear relationship

The robustness test for non-linear relationship is included by the square of the R&D variable for exporter and importer countries. The regression (3) in Table 4 reinforces the findings that are consistent with the previous baseline adjusted gravity regression, whereas the regression parameters for the square of the R&D exporter and importer countries, respectively, are of a negative sign, but statistically not significant. This implies that we have not confirmed a non-linear relationship for the R&D variables.

Sensitivity check: cross-section estimations for the baseline model

We check for cross-section estimations stability for the baseline model by the analyzed years. As can be seen from Table 5, the regression coefficients that pertain to GDP exporter and importer countries, respectively, tend to increase, and after that are stabilized, and are statistically significant. These patterns confirm the importance of the economic size and economic growth of the exporting and importing OECD economies for manufacturing trade. There are diverging patterns in the importance that is seen for the GDPCAP for exporter OECD countries, which the regression parameters tend to decrease over time and vice versa for the GDPCAP for importer OECD countries, which the regression parameters tend to increase and after that stabilize. The importance of the Distance has increased over time. The importance of the Contiguity dummy and the RTFA dummy, respectively, on manufacturing exports between the OECD countries tends to decline, which is consistent with the ongoing process of manufacturing trade liberalization and advances in information and communication (Bojnec and Fertő, 2009). The importance of the Language dummy tends to increase slightly and after that stabilize. Our particular interest is in the R&D variables: the importance of the R&D variables for manufacturing exporters tends to decline slightly, but has remained statistically significant, while the importance of the R&D variables for manufacturing importers has become insignificant. These findings reinforce the importance of the R&D expenditures for exports to compete and sustain competitiveness in the exporting of manufacturing products, while it is becoming less important for manufacturing import specialization.

Table 5. Cross-section estimations for the baseline model

	1995	1996	1997	1998	1999	2000	2001	2002	2003
ln GDP exporter	0.062	0.074	0.100	0.101	0.145**	0.203***	0.318***	0.330***	0.306***
ln GDP importer	0.576***	0.563***	0.673***	0.834***	0.796***	0.794***	0.808***	0.802***	0.778***
ln GDPCAP exporter	0.755***	0.603***	0.573***	0.624***	0.668***	0.526***	0.583***	0.412**	0.290
ln GDPCAP importer	0.671***	0.534***	0.642***	0.943***	0.887***	0.815***	0.842***	0.867***	0.830***
ln Distance	-0.628***	-0.676***	-0.706***	-0.735***	-0.731***	-0.763***	-0.797***	-0.813***	-0.834***
Contiguity dummy	0.713***	0.618***	0.550***	0.528***	0.530***	0.487***	0.478***	0.483***	0.442***
Language dummy	0.277**	0.317***	0.324***	0.354***	0.326**	0.329**	0.358***	0.319**	0.342**
RFTA dummy	0.768***	0.639***	0.613***	0.606***	0.565***	0.481***	0.459***	0.408***	0.421***
ln R&D exporter	0.678***	0.635***	0.637***	0.631***	0.595***	0.557***	0.451***	0.427***	0.445***
ln R&D importer	0.209**	0.210***	0.116*	-0.032	0.017	0.057	0.048	0.054	0.064
Constant	-19.918***	-16.187***	-19.718***	-26.171***	-26.398***	-25.561***	-28.773***	-27.118***	-24.152***
R2	0.8428	0.8683	0.8705	0.8585	0.8616	0.8584	0.8595	0.8514	0.8449
N	306	306	306	306	306	306	306	306	306

Notes: * p<0.1; ** p<0.05; *** p<0.01.

The effects of R&D on distance

R&D with pertaining innovation may also reduce the transaction costs fostering the exports. Thus we check whether R&D intensity influences the distance effect between trading partners. Following Freund and Weinhold (2004) we re-estimated our model to check the effect of R&D intensity on distance:

$$\ln X_{ij,t}=\beta_0+ \beta_1 \ln GDP_{i,t}+\beta_2 \ln GDP_{j,t}+\beta_3 \ln GDPCAP_{i,t}+\beta_4 \ln GDPCAP_{j,t}+\beta_5 \ln Distance_{ij}+ \beta_6 Contiguity_{ij}+\beta_7 Language_{ij}+\beta_8 RFTA_{ij}+\beta_9 R\&D_{it}+\beta_{10} R\&D_{jt}+ \beta_{11} R\&D_{it}*Longdistance_{ij}+ \beta_{12} R\&D_{jt}*Longdistance_{ij}+u_1 \quad (4)$$

where $Longdistance_{ij}$ is a dummy variable, which equals one if the distance between countries *i* and *j* exceeds the average distance between all countries. The rationale for use of the interaction effect of R&D and Longdistance is that with more R&D intensity it would be possible to overcome the greater distance. If a particular R&D variable has reduced (increased) the effect of distance on manufacturing trade, then the regression coefficient on the interaction R&D*Longdistance term should be positive (negative).

Table 6. The effect of innovation on distance

	(4)
ln GDP exporter	0.327***
ln GDP importer	0.774***
ln GDPCAP exporter	0.693***
ln GDPCAP importer	0.408**
ln Distance	-0.654***
Contiguity dummy	0.698***
Language dummy	0.237***
RFTA dummy	0.700***
ln R&D exporter	0.454***
ln R&D importer	0.090***
ln R&D exporter * ln Longdistance	0.061***
ln R&D importer * ln Longdistance	-0.068**
Constant	-26.155***
N	2754
R^2	0.9936
Rho	0.826

Notes: * p<0.1; ** p<0.05; *** p<0.01. Parameters are estimated by the Prais-Winsten estimator. The common AR(1) parameter is denoted by rho. The z values are computed from standard errors that are corrected for heteroscedasticity and contemporaneous correlation of error terms across panels.

This model specification assumes, and empirical estimates in regression (4) in Table 6 confirm, that the regression coefficient pertaining to the Distance is negative. However, the regression coefficients have changed or decreased only slightly when the

(R&D*Longdistance) variables are included in the models. The regression coefficients on R&D variables remain positive and statistically significant. These results indicate that R&D intensity has strong impacts on the distance and manufacturing trade, particularly for encouraging manufacturing trade by exporting countries. This is further confirmed by the regression coefficients for the interaction R&D variables. There is a positive and statistically significant association for the exporting countries, and a negative and statistically significant association for the importing countries. These results imply that the R&D variable has reduced (increased) the effect of distance on bilateral manufacturing trade for exporting (importing) OECD countries. The OECD countries, which have invested more in R&D have also expanded and strengthened their manufacturing exports on longer distances, while the manufacturing import specialization by importing OECD countries has become weaker.

The effects of the level of economic development

Table 7. The effect of R&D and economic development on manufacturing trade

	(5)
ln GDP exporter	0.420***
ln GDP importer	0.717***
ln GDPCAP exporter	3.666***
ln GDPCAP importer	0.481***
ln Distance	-0.745***
Contiguity dummy	0.532***
Language dummy	0.316***
RFTA dummy	0.702***
ln R&D exporter	5.751***
ln R&D importer	-0.890*
ln R&D exporter * ln GDPCAP exporter	-0.528***
ln R&D importer * ln GDPCAP exporter	0.102**
Constant	-57.257***
N	2754
R^2	0.9942
Rho	0.845

Notes: * p<0.1; ** p<0.05; *** p<0.01. Parameters are estimated by the Prais-Winsten estimator. The common AR(1) parameter is denoted by rho. The z values are computed from standard errors that are corrected for heteroscedasticity and contemporaneous correlation of error terms across panels.

Barrios *et al.* (2003) argue that the effects of R&D do matter more for exports to technologically advanced countries, such as the European Union and other OECD countries where exporters have to improve technology in order to be able to compete on those markets successfully. Thus the effects of the R&D variables are empirically tested in association with the level of economic development:

$$\ln X_{ij,t}=\beta_0+ \beta_1\ln GDP_{i,t}+\beta_2\ln GDP_{j,t}+\beta_3\ln GDPCAP_{i,t}+\beta_4\ln GDPCAP_{j,t}+\beta_5\ln Distance_{ij}+ \beta_6 Contiguity_{ij}+\beta_7 Language_{ij}+\beta_8 RFTA_{ij}+\beta_9 R\&D_{it}+\beta_{10} R\&D_{jt}+ \beta_{11} R\&D_{it}*GDPCAP_{it}+ \beta_{12} R\&D_{jt}*GDPCAP_{jt}+u_1 \quad (5)$$

The rationale for use of the interaction effect of R&D and GDPCAP is that more economically developed countries with high higher GDPCAP invest more in R&D intensity and thus they can increase manufacturing exports through higher-valued product differentiation.

The effect of the level of economic development is included in the adjusted gravity regression model by the interaction effect of the R&D variables and GDPCAP variables, which is presented in regression (5) in Table 7. The negative absolute size of the Distance variable on bilateral manufacturing trade has increased, and particularly substantially has increased the impact of the R&D variable on manufacturing trade. This clearly confirms the important and statistically significant role of the R&D variables for increases of bilateral manufacturing trade in exporting OECD countries, and for import specialization by reduction in manufacturing trade in importing OECD countries. However, the regression coefficients that are pertaining to the interaction R&D*GDPCAP variables are negative and statistically significant for exporting countries and positive and statistically significant for importing countries, indicating the increasing importance of developing OECD countries in competitive manufacturing exports and successful import specialization in bilateral trade between the OECD countries.

IMPLICATIONS AND CONCLUSIONS

The paper provides empirical and policy insights into the effects of R&D on the bilateral manufactured goods trade between OECD countries in the panel data analysis. The emphasis is on whether R&D may help overcome the distance barriers among the countries and we find evidence in favour of this effect. We also test for possible non-linear effects of R&D on trade flows by including the square of the R&D variable. The adjusted gravity model allows the testing of a number of additional hypotheses, such as the role of economic development, the influence of common language, the effects of common borders, and the impact of a regional trading area. To be complete, various interaction effects between R&D investments and the other explanatory variables in the adjusted gravity model are tested. As a sensitivity test, the cross-section estimates by years are also provided. We find a catch-up effect in manufacturing trade, which is suggested by the interaction effect of R&D with GDPCAP.

Therefore, the contributions of the paper's results to the literature are both empirical and policy nature. The paper provides new empirical evidence on the relationship between R&D expenditure intensity and manufacturing trade between OECD countries using a large panel data sample. Our results show a positive relationship between R&D intensity and manufacturing exports. The R&D variable for exporting countries increases manufacturing exports, while the regression coefficients for the R&D variables for importing countries are mixed. The OECD countries, which invest more in R&D, have higher manufacturing export, but this varies for manufacturing imports. The greater R&D expenditure mitigates the importance of the distance for exporters by expanding their export opportunities, and reduces the distance for importers' countries.

The empirical novelty in this paper is the test for the interaction effect of the R&D with GDPCAP, and an important policy finding is that, with the R&D investments, the developing OECD countries are catching-up in manufacturing trade. This finding gives support for the importance of differences in R&D intensity and pertained innovation in influencing international manufacturing competitiveness, which is of importance to domestic government science, technology, and research and innovation policy with a positive impact on manufacturing trade performance. The R&D expenditures in the economically most developed OECD countries have not been sufficient to sustain a competitive position in manufacturing exports as well as in manufacturing import specialization, which has resulted in an increase of their manufacturing imports from developing OECD countries. The results imply structural changes that are caused by the R&D expenditure intensity with pertaining innovation in the developing OECD countries that improve their export competitiveness in more technological advanced manufacturing products, which are exported worldwide, particularly to the most developed OECD countries. Due to this, the results that are pertaining to the R&D variables and their interaction effects, particularly with the level of economic development (GDPCAP), in successful import specialization are mixed, but the R&D expenditures with successful innovations make domestic manufacturing more competitive particularly in technologically advanced developing OECD countries. As a result, some developing OECD countries, for example South Korea, have successfully entered in manufacturing trade between the OECD countries.

The results that are pertaining to the adjusted gravity equation variables are largely consistent with theoretical expectations. GDP and GDPCAP in exporter and importer countries, respectively, positively and statistically significantly affect manufacturing trade. The distance between the capital cities negatively affects manufacturing trade, implying that trade costs do matter for manufacturing trade, but can be mitigated by R&D intensity for transportation and communication costs. As expected, a common border, cultural linkage and common language, and regional free trade agreement membership positively affect manufacturing trade.

Among implications for research, we have conducted a cross-section sensitivity test and a test for a non-linear relationship by the square of the R&D for exporter and importer countries, respectively, but we have not confirmed a non-linear relationship for the R&D variables. However, we have confirmed that the R&D intensity fosters manufacturing exports between the OECD countries. The R&D intensity also has favourable impacts on the distance for both exporting and importing countries. These findings have important policy implications to consider concerning R&D and pertaining innovation activity on the importance of the R&D as a factor of export growth and for reduction of transaction costs, and thus for fostering manufacturing trade between countries.

Among the issues for future research are possible specifications adjustments of the tested hypotheses and models to include variables such as R&D sustained by foreign direct investment, global competitiveness indicators, innovation index, and creative climate indicators at the county level. To support the investigation of the sources of R&D funds that have been adopted from the public or private sectors or public-private partnership prevalent in R&D investment in some of the leading OECD countries is another challenging issue. The

data update and different other country data samples are also an additional issue for future research.

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THE USE OF GOVERNANCE MECHANISMS IN THE CONTEXT OF OPEN INNOVATION: A STUDY OF CONVENIENCE STORE INDUSTRY IN TAIWAN

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ABSTRUCT

This paper draws on a comparative case study design to investigate how Taiwanese convenience store chains use governance mechanisms to develop new services with partner firms. Using empirical evidence from case studies of the development of two e-commerce services (Online shopping with pick-up at store service and Multiple media kiosk service) developed by convenience store chains in Taiwan, this study found that the convenience store chains under study cooperate with their partners on the basis of informal governance mechanisms such as social ties created by previous collaboration experience, mutual benefits and interpersonal trust. Formal governance mechanisms are also used to manage the relationships with their partner firms such as shared ownership control and high switching costs arising from investment of valuable resources. Comparing the governance mechanisms used in the two selected service developments, the main difference was found in using informal governance mechanisms when convenience store chains cooperate with non-strategic partners (e-shops and service content companies). In online shopping with pick-up at store service development, the collaborations between convenience store chains and e-shops were based on their trust in partners' reputation and capability. Previous collaboration experience was considered essential in multiple media kiosk service development. Service content companies that have existing partnerships with convenience store chains in other services will be the prioritized partners in MMK service.

Keywords: Governance mechanism, Open innovation, Trust

INTRODUCTION

The context of open innovation emphasizes the importance of collaboration beyond company boundaries to share related resources for value creation. Chesbrough (2007) argued that compared with traditional business model, open business model can help a firm save development costs of innovation by tapping into external sources of knowledge and leveraging external knowledge in the firm's innovation process. Due to short product life cycle, firms are drawing more frequently upon external sources of knowledge, and that is what has allowed them to reduce dependence on internal R&D functions and to accelerate innovation (Bartlett *et al*., 2008). Partnering with other companies shortens the time to enter new business markets through leveraging partners' expertise and their channels. Although many advantages of open innovation have been identified, some fundamental questions are still unanswered and their relevance to open innovation has been overlooked. Open innovation model suggests that firms should share their valuable knowledge/resources with external companies for commercialization. But on the other hand, it may lead to leakage of business secrets or sensitive knowledge during innovation process. The choice of governance

mechanism has wide implications on the outcome of open innovation (Scarbrough and Amaeshi, 2009). It is reasonable to argue that formal and informal governance mechanisms are crucial coordination mechanism in the context of open innovation in order to lower transaction costs and facilitate inter-organizational knowledge sharing.

This paper aims to investigate how formal and informal governance mechanisms are employed by Taiwanese convenience store chains to manage and cooperate with their external actors in order to avoid the leakage of valuable knowledge and to acquire necessary resources for new service creation. The main research questions include: 1) What governance mechanism should be used to coordinate new service development activities with external actors and in which combinations? 2) Does the pattern of governance vary with the type of service innovation? Based on Dyer (1997), formal and informal safeguards can be employed to ensure equity among participating firms. Formal safeguards include financial hostage and valuable resource. Informal safeguards include goodwill and reputation. Similarly, other studies (e.g. Smith et al., 1995; Dekker, 2004) suggest that firms can adopt formal and/or relational governance mechanisms to control inter-organizational collaboration. Formal governance consists of contractual obligations and organizational features such as legal contracts, structural design, and share ownership. Informal governance involves social control, trust or social ties created by previous collaboration experience. Most previous studies (e.g. Fey and Birkinshaw, 2005) have mainly focused on the choices of governance mode for external R&D activities in high-technology industries. There is much less empirical evidence on external knowledge search activities for innovative ideas in the service sector. The contribution that this study aims to make is to enhance understanding of the role of governance mechanisms in facilitating sourcing external knowledge during new service development process.

Taiwanese convenience store chains compete in introducing new products/services quickly to consumers in order to attract and retain them. To enable this, convenience store chains must integrate multiple sources of knowledge residing within their firms or outside the firms' boundaries to develop and launch new services in a timely manner. They combine acquired related resources with the existing advantages of 24-hour service, high store density, strong information system, and professional distribution systems to carry out "Clicks and Mortar" services, which in turn, help them respond quickly to market dynamics and consumers' needs.

This study draws on empirical evidence from the four convenience store chains in Taiwan. Two e-commerce services (Online shopping with store pick-up service and Multiple media kiosk service) in the convenience store industry were selected to address the issue of governance mechanisms during service innovation process. Formal and informal governance mechanisms are considered in this study. Particular attention is devoted to understanding what combinations of governance mechanisms are best suited for each type of new service development.

The rest of the paper is set out in the following way: In the next section, the open innovation literature and governance mechanisms are reviewed. The methodology of the research is then described, followed by a discussion of the findings. In the concluding section, the theoretical and managerial implications and limitations are discussed.

THEORETICAL BACKGROUND

The context of open innovation

The concept of open innovation has gained popularity in academic debate and analysis over recent years. Some studies (e.g. Pavitt, 1984; von Hippel, 1986; Tidd, 1993; Dahlander and Gann, 2007; Trott and Hartmann, 2009) suggest that it has been the tradition in research on innovation to interpret new product or service development from the notion of an open approach to innovation. Open innovation is widely acknowledged as being vital to a firm's innovation activities. The implementation of open innovation also differs across industries (Christensen, *et al*., 2005). But the success of open innovation model may depend on such factors as the product modularity, the requisite tacit knowledge, the speed of industrial change, and the complexity of interface (Gassmann and Enkel, 2004).

Innovation can stem from a firm's internal development, but it can also be acquired externally from the so-called "source of innovation", namely suppliers, consumers, competitors and research institutes (von Hippel, 1988). In order to acquire related resources and knowledge for new service development, firms may need to access different types of network and form different types of collaboration with network members. Similarly, open innovation model suggests that a firm should collaborate and share its valuable knowledge/resources with external companies, so as to take internal ideas to market through external paths (Chesbrough, 2006). Through an 'open business' model which emphasizes reaching out to external ideas and sources of knowledge, firms can ease the process of accessing new technologies and markets and unlock their economic potential. However, according to agency theory, external collaborators or partner firms may use partnership opportunistically to advance their interests. The cost incurred in managing unintended leakage of business secret or sensitive knowledge during innovation process can be high. This potential problem highlights the importance of considering not only effective partner selection, but also the forms of inter-firm relationships required for effective information flow in open innovation process.

Many previous studies suggest that when firms adopt an open business model, they need to have some formal or informal links with external companies in order to tap into their partners' specialized resources and strategic assets while protecting own sensitive knowledge. For example, Tidd *et al*., (2005) made a distinction between horizontal and vertical alliances. According to them, firms may engage in vertical alliances with suppliers or customers to share complementary know-how/resource and thus shorten time and reduce cost of new product/ service development. Horizontal alliances may be set up for exchanging valuable knowledge with peers and competitors in order to develop new products or services. von Zedtwitz and Gassmann(2002) argued that firms need to adopt some forms of governance in order to implement open innovation activities. More recently, a few studies (e.g. Fey and Birkinshaw, 2005) suggest that firms should use different governance modes (e.g. contract) to manage the relationships with external partners. Birkinshaw (2007) extended the open innovation theory and argued that fully open model and traditional closed model can be differentiated by considering the issues of distribution of knowledge (concentrated vs. dispersed), degree of control, and degree of trust and reciprocity.

Formal and informal governance mechanisms

Innovative knowledge that spans firm boundaries is often embedded in inter-firm relationships (Dyer and Singh, 1998). In order to share, transform and integrate related knowledge for innovation purposes, firms need to adopt different types of governance and organizational form to manage inter-organizational collaboration. Nooteboom (2001) identified two kinds of relational risk in inter-firm collaboration. These are risk of dependence ("hold-up" risk) and risk of knowledge loss (spillover risk). To minimize these risks, focal firms need to implement appropriate governance mechanisms. Dyer (1997) put forward two types of safeguard (formal and informal safeguards) which aim to bring equity among participating firms. Formal safeguards include financial hostage and valuable resource. Informal safeguards include goodwill and reputation. His research concluded that financial hostage hold by Japanese automakers will encourage their suppliers to make partner-specific investments, which in turn lead to the increasing interdependence between partner firms. Likewise, other studies (e.g. Smith *et al*., 1995; Dekker, 2004; Scarbrough and Amaeshi, 2009) suggest that firms can adopt formal and informal (relational) governance. Formal governance refers to contractual obligations and organizational features such as legal contracts, structural design, and share ownership (Scarbrough and Amaeshi, 2009). In general, governance can be classified as outcome, behavior, and social control mechanisms (Ouchi, 1979). Formal governance mainly consists of outcome and behavior control mechanisms. Outcome control mechanism includes ex-ante control (e.g. goal setting and incentive systems/reward structures) and ex-post control (e.g. performance monitoring and rewarding). Outcome mechanisms can be seen as a control to monitor and reward desirable performance targets. Behavior control includes ex-ante control (structural specifications: planning, procedures, and rules/ regulations) and ex-post control (e.g. behavior monitoring and rewarding). It concerns how firms monitor partners' behaviors in collaboration process.

In contrast, informal governance involves social control, trust or social ties created by repeated interactions between firms. Social control mechanisms also include ex-ante control (e.g. partner's goodwill and capabilities based on interaction, reputation, and social network) and ex-post control (e.g. trust building based on risk taking, joint decision making and problem solving). Trust is often argued to be the principal mode of social control in inter-organizational relationships which can ease the communication between cooperative firms and encourage information and knowledge sharing. In addition, mutual trust may motivate cooperative firms to invest specific assets and to refrain from opportunism and goals conflicts. Trust has been discussed from different theoretical perspectives. Sako and Helper (1998) combined economic, sociological and psychological theories and defined trust as: *"An expectation held by an agent that its trading partner will behave in a mutually acceptable manner, and will act fairly when the possibility for opportunism is present"*. Other studies on inter-firm relationships also identified different dimensions of trust such as reliability, benevolence and competence (Swan, *et al*., 1985; Medlin, 2002; Seppänen et al., 2007). Reliability is a belief that partner firms have the ability and competence to perform. Benevolence is a belief that the other partner firm will treat the risking partner well under new conditions. Similarly, Sako (1992) suggested a similar typology of trust. According to her, trust can be distinguished into contractual trust, competence trust, and goodwill trust. Contractual trust is shown when a partner firm fulfills the requirements of written contracts or oral agreements. Competence trust refers to the partner firm's ability to fulfill contracts.

Goodwill trust is the most abstract form focusing on the partner firm's intention to fulfill agreements. This classification is useful in identifying the characteristics of relationship between firms.

The complementary or substitute relationship between trust and formal governance (e.g. contracts and ownership) is still being debated. When formal governance mechanisms are unreliable, alliance partners may rely on relational-based governance mechanisms (Dyer and Singh, 1998; Dekker, 2004). Also, it has been argued that formal governance supplements and enhances the level of trust between cooperative firms by reducing the risk of inter-firm collaboration such as opportunism. Formal governance mechanisms may also improve the trust relationship between firms by objective monitoring of partners' performance and behaviors. The choice of form of collaboration may depend on prior social ties or repeated interactions between firms. When a reciprocal inter-organizational relationship is developed and sustained between firms, relational-based governance would allow the flexibility which partners need, to deal with future relational uncertainties (Poppo and Zenger, 2002).

Building on the above discussion, this paper argues that a better understanding of governance mechanisms which underpin the complex inter-firm relationships is necessary. The issues of formal and informal governances are discussed next in order to understand how a firm uses formal and/or informal relationships to share related knowledge with partner firms and to protect its own valuable knowledge.

The following questions will be answered in this paper:
1. What kinds of governance mechanism do the Taiwanese convenience store chains adopt with their partner firms in new service development process?
2. Does the use of governance mechanisms vary in different types of new service development?

RESEARCH DESIGN AND METHOD

This research uses a comparative case study design (Yin, 2003) and draws on empirical evidence from the four biggest convenience store chains in Taiwan. Two e-commerce services (Online shopping with store pick-up service and Multiple media kiosk service) in the convenience store industry were selected to address the research questions. Before developing a full-scale investigation, two of the biggest convenience store chains in Taiwan were selected as pilot cases to test the logic of the initial research design. Such pilot studies also help this research to unpack the complexity of factors that underlie inter-firm relationship.

Study Population and Unit of analysis

The study population of this research includes the Taiwanese convenience store chains and their cooperative firms involved in the selected service development. The four convenience store chains (including Company E, Company F, Company H, and Company O) which together control 95.51% of the market in Taiwan have been chosen in order to fulfill all the required data collection tasks in my research case. The unit of analysis of this research is the new service development project. Online shopping with pick-up at store service and multiple

media kiosk service were selected for investigating how convenience store chains use governance mechanisms with their partner firms to control and share related knowledge for new service development. Their partner firms include logistic companies, information system integrated companies, platform providers, service content companies, and hardware manufacturing companies and so forth.

Data collection and analysis

Two methods of data collection were used in this research: documentation and interviews. Secondary data were gathered from periodicals, books, magazines, newspapers, research reports published by research institutes, corporate websites, and annual reports published by case companies and their partners. Semi-structured interviews were also adopted in the data collection process as they allow for two-way communication and the flexibility to probe for details as well as gaining a range of insights on research issues. In total, there were 42 interviewees from the four convenience store chains and their partner firms participating in this study. Interviewees include managers and section staff of convenience store chains and the staff of partner firms who were involved in the selected service development projects. Some informants were interviewed twice. All together, 52 interviews were conducted.

The interviews were analyzed using the thematic framework approach (Gibbs, 2008). In developing a thematic framework which represents the patterns and relationships in the interview data, I drew on the existing literature and research questions to create codes and to identify key thematic ideas. The thematic framework was then applied to guide initial data analysis in order to understand how Taiwanese convenience store chains use different types of governance mechanisms with partner firms in order to acquire external resources/ knowledge and avoid leakage of sensitive knowledge in new service development. Moreover, cross-case synthesis (Yin, 2003) was chosen as the analytical technique to summarize the findings from the individual cases. This technique is also useful in identifying the similarities and the differences between the two service development projects. The findings of cases are presented next.

RESEARCH FINDINGS

Governance mechanisms adopted between convenience store chains and their partners

This section discusses the formal and informal governance mechanisms used by convenience store chains to manage their relationships with partner firms in the two selected new service development projects.

Online shopping with pick-up at store service- Formal governance mechanism

Company E cooperated with its affiliate companies in marketing, logistics, and IT functions. Their relationships tend to be characterized by shared ownership of specialized investments and switching costs. Company E mainly relied on these partner firms to develop and execute the same functions in the target services. As to dealing with suppliers of applied software system, Company E used annual contracts to manage the collaboration with different firms that have similar capability in the same domain. Compared with Company E, Companies F,

H, and O formed a joint venture to develop this service and used shared ownership mechanism to control the partnerships with a marketing company. The relationship between this group of companies and logistics companies tend to be characterized by shared ownership and switching costs. Convenience store chains relied on these logistics companies to deliver goods to each convenience store. This group of companies cooperated with an IT system supplier to develop and maintain IT system for the development of online shopping with pick-up at store service on the basis of incentive rewarding (profit sharing). Contracts were used to manage the cooperations with e-shops.

The main difference between Company E and Companies F, H, O can be explained by the level of interdependence between them and their third party distribution companies in service structure. Company E owned one distribution company which can provide the same service as third-party distribution companies in its service structure. In contrast, Companies F, H, and O relied on third-party distribution companies to manage and collect goods from e-shops. Then these third-party distribution companies redistributed and delivered these goods to this group of companies' self-owned distribution companies.

Table 1 shows that two groups used different formal governance mechanisms to cooperate with related actors in online shopping with pick-up at store service development.

Table 1: Two groups use different formal governance mechanisms with related actors in Online shopping with pick-up at store service development

Development actors	Company E	Companies F, H, and O
Owned distribution company	Shared ownership and switching cost	Shared ownership and switching cost
Software suppliers	Shared ownership and switching cost	Incentive rewarding - profit sharing
Third party distribution companies	Service contract and structural design	Service contract
E-shops	Service contract	Service contract
Marketing company	Shared ownership	Shared ownership

Source: Summarized by author

Online shopping with pick-up at store service- Informal governance mechanism
Company E had long-term cooperation experience with its affiliate companies in different functions (e.g. logistics and IT). Inter-personal trust underpins its cooperation with a marketing company. Company E also authorized the marketing company to continue developing this service because Company E's former employees who fully understood the development process were working at the marketing company. Company E cooperated with the suppliers of applied software system based on their previous interactions and the capability of suppliers. Companies F, H, and O also had long-term cooperative experiences with their own distribution companies. These distribution companies helped convenience store chains deliver goods for different services to each convenience store. Companies F, H, and O cooperated with a marketing company based on joint decision making and problem solving. The marketing company was responsible for developing this service and integrating different convenience store chains. The collaboration between this group of companies (Companies F, H, and O) and an IT system supplier was on the basis of shared development

risk and related knowledge. The IT system supplier also had good capability and reputation in this domain. Similarly, the cooperation between E-shops and convenience store chains is underpinned by reputation and capability. The main difference between Company E and Companies F, H, O can be explained by the different level of trust they have on third party distribution companies. Company E did not solely count on third party distribution companies to perform delivery service because its owned distribution system can provide the same service. This implies that Company E's self-owned distribution company has a potential competitive relationship with third party distribution companies. In contrast, Companies F, H, and O cooperated with third party distribution companies because of their previous cooperative experiences and the established inter-personal trust. Companies F, H, and O relied on these distribution companies to manage e-shops and deliver goods to their individual distribution system.

Table 2 shows that two groups used different informal governance mechanisms to cooperate with related actors in online shopping with pick-up at store service development.

Table 2: Two groups use different informal governance mechanisms with related actors in Online shopping with pick-up at store service development

Development actors	Company E	Companies F, H, and O
Owned distribution company	long-term cooperation experience	long-term cooperation experience
Software suppliers	long-term cooperation experience	shared development risk and related knowledge
Third party distribution companies	previous cooperative experiences, reputation and capability	previous cooperative experiences, inter-personal trust
E-shops	reputation and capability	reputation and capability
Marketing company	Inter-personal trust	Joint decision making and problem solving

Source: Summarized by author

In summary, for Online shopping with pick-up at store service development, Company E used formal governance mechanisms (e.g. shared ownership and switching cost) and informal governance mechanisms (long-term cooperative experience) to manage the collaboration with its group companies to develop fundamental functions such as IT system and logistics. Compared with Company E, Companies F, H, and O used formal governance (valuable resource) and informal governance mechanisms (risk sharing and good capability) to manage their cooperation with an external company to develop the IT platform. As to the development of logistic function, Companies F, H, and O used shared ownership mechanism to control their self-owned distribution companies. When the delivery process (from e-shops to the distribution system of convenience store chain) is considered, Companies F, H, and O used service contracts to control third party distribution firms. These third party distribution firms had good capability to deliver goods to each convenience store chain's owned distribution companies. In contrast, the relationship between Company E and third party distribution companies was potentially a competitive one as its own distribution company can provide the same service. All convenience store chains cooperate with e-shops on the basis of partner firm's reputation and capability. Regarding the development of marketing function,

shared ownership and inter-personal trust underpin the collaboration between Company E and its affiliate company. Companies F, H, and O, on the contrary, cooperated with their marketing company on the basis shared ownership and joint decision making and problem solving.

Multiple Media Kiosk service- Formal governance mechanism

The relationships between Company E and its affiliate companies (Company Q and two software suppliers) were characterized by shared ownership and switching costs. These affiliate companies execute the same functions for Company E in the target services. The suppliers of applied software system were contracted by Company Q to develop some kiosk's functions. Compared with Company E, Company F used shared ownership mechanism to cooperate with its affiliate company (applied software system supplier) to develop the MMK service and to develop certain parts of IT system. Company F provided system requirements and check lists to its partner firm. Their collaboration was characterized by high switching costs and the provision of valuable resources. Regarding the cooperation between convenience store chains and hardware manufacturers, Companies E and F used manufacturing contract mechanism. They relied on hardware manufacturing company for some development suggestions. Similarly, Company H also used contract mechanism to cooperate with its hardware manufacturing company. It only provided its requirements and specifications to the hardware manufacturer in order to produce hardware for use. Company O relied on software suppliers and hardware manufacturing company to develop this service because Company O did not invest any equipment in this service development. Companies E, F and H often signed a contract with service content companies in order to enrich service contents in kiosk.

Table 3 shows that four convenience store chains used different formal governance mechanisms to cooperate with related actors in Multiple Media Kiosk service development.

Table 3: Four convenience store chains use different formal governance mechanisms with related actors in Multiple Media Kiosk service development

Development actors	**Company E**	**Company F**	**Company H**	**Company O**
IT system suppliers	Ownership	Switching cost	Internal development	Contract
Applied software system suppliers	Contract	Ownership	Internal development	Contract
Hardware manufacturing company	Manufacturing contract	Manufacturing contract	Manufacturing contract	Manufacturing contract
Service content companies	Selling Contract	Selling Contract	Selling Contract	None. This company did not cooperate with them.

Source: Summarized by author

Multiple Media Kiosk service- Informal governance mechanism

Company E cooperated with its group companies in marketing and IT system functions on the basis of previous cooperative experiences and partner firm's good capability. The collaboration between suppliers of applied software system and Company E was based on their previous cooperative experience and partner's capability. But Company E also had cooperations with other applied software system suppliers that have the same capability to perform the same task. Compared with Company E, Company F had a long-term cooperation with an applied software system supplier and a long-term cooperative experience with a capable software supplier. The software supplier company also shared related knowledge and provided training courses to IT department's staff of Company F. Company H used cross-functional team within its company to develop the MMK service. The collaborations between Company O and software suppliers were underpinned by partners' reputation and capability in their domains. Regarding the collaborations between convenience store chains and their respective hardware manufacturing companies, previous cooperative experience and manufacturers' good reputation and capability were the main determinants of partner selection. Companies E, F and H cooperated with service content companies on the basis of previous cooperation experience and partner's reputation and capability. For example, some service content companies had joined the bill payment service of Companies E, F and H.

Table 4 shows that four convenience store chains used different informal governance mechanisms to cooperate with related actors in Multiple Media Kiosk service development.

Table 4: Four convenience store chains use different informal governance mechanisms with related actors in Multiple Media Kiosk service development

Development actors	Company E	Company F	Company H	Company O
Software suppliers	Long-term cooperation experience.	Long-term cooperation experience. Knowledge sharing and training.	Internal development	Partner's capability and reputation
Applied software system suppliers	Previous cooperation experience and capability	Long-term cooperation experience	Internal development	
Hardware manufacturing company	Partner's capability and reputation	Partner's capability and reputation	Previous cooperation experience	Partner's capability and reputation
Service content companies	Previous cooperation experience, reputation and capability	Previous cooperation experience, reputation and capability	Previous cooperation experience, reputation and capability	None. This company did not cooperate with them.

Source: Summarized by author

Based on the above discussion, convenience store chains used different formal and informal governance mechanisms with related actors in the two selected services. This research found that convenience store chains used shared ownership mechanism and had long-term interactions with partner firms in developing important functions of service such as IT system and logistics. These functions are important in constituting the online shopping with pick-up at store service and they have to be continuously improved at different stages of service development. Convenience store chains have to monitor the development progress and the quality of service development. The combination of formal and informal governance mechanisms may help convenience store chains to minimize transaction costs and to increase flexibility and openness between cooperative firms. In the MMK service, convenience store chains used similar governance mechanisms in developing the IT system. Given the availability of alternative partners in the market, convenience store chains often used the contract mechanism to manage their collaborations with e-shops and service content companies. The previous cooperation experience between convenience store chains and some service content companies in the bill payment service may reduce their communication barriers.

CONCLUSIONS AND MANAGERIAL IMPLICATIONS

This research found that Taiwanese convenience store chains often use formal governance mechanisms (e.g. shared ownership and switching cost) to collaborate with partner firms in developing strategic functions such as IT system and logistics. They rely on partner firms to develop and perform the same tasks in the target services. Affiliate companies depend on convenience store chains for financial provision, and in return they provide services to convenience store chains. The long-term cooperation between them also helps trust building, minimize monitoring costs and reduce communication barriers. Companies F, H, and O formed a joint venture in online shopping with pick-up at store service development. The joint venture then collaborated with subcontracting firms on the basis of mutual benefits and interpersonal trust for value creation. This mode of governance mechanism can reduce transaction cost and mitigate opportunistic behavior. In addition, the collaboration between convenience store chains and e-shops or service content companies tends to be characterized by contractual relations. Given the availability of alternative e-shops and service content companies with similar resources and capabilities, convenience store chains' choice of partners would depend on potential partners' reputation and capability in its domain. If potential partners have previous cooperative experience with convenience store chains in other service provision areas, they will be the prioritized partners of convenience store chains, especially in multiple media kiosk service developments. This is because some of the business modules developed during the existing cooperation between convenience store chains and partner firms can be simply transformed and moved to new client interface (Kiosk). To control non-strategic partners, convenience store chains should use more formal governance mechanism such as legal contract combined with non-compete clause.

This research offers some managerial implications. Firstly, firms should cooperate more closely with strategic partners (e.g. IT and logistics functions) by using the mechanisms of shared ownership and financial commitment initially and then developing long-term relationships and trust. Such a progressive approach can be very helpful in controlling the progress and quality of new service development, minimizing transaction costs, and

mitigating partners' opportunistic behavior. It can also facilitate knowledge and resource sharing between firms and speed up new service development. Secondly, it may be more appropriate for firms to cooperate less intensively with non-strategic partners, as these partners are less strategically important to the success of new service development. Formal governance mechanisms such as contractual obligations can be used to manage partnerships with non-strategic firms in order to prevent leakage of valuable knowledge. The appropriate combination of governance mechanisms would depend on the importance of partner firms' role in service development and the existence of market alternatives.

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CUSTOMERS' RESPONSES AND THE FORMATION OF A DOMINANT DESIGN: THE EARLY MP3 INNOVATION EVOLUTION

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ABSTRACT

The formation of a dominant design is an important milestone in the evolution of an innovation. Previous researches must focused on examining this process from the aspect of the firms. In this study, we incorporated the dominant design theory and the socio-cognitive theory to examined the customer's responses in the dominant design formation process. We studied the US portable MP3 player industry and found that dominant design (in this case the iPod) plays an important role in customers' understanding of the innovation.

Keywords: Dominant Design, Socio-cognitive Theory, MP3 Players

INTRODUCTION

This study takes two perspectives account for the emergence and the evolution of a new product within product-market. First, we take technological evolution perspective that focuses on the emergence of dominant design within the portable digital audio player industry. Second, we take socio-cognitive perspective that point at the interaction of tacit knowledge structure with respect to the new product at individual level in customer's mind and the dynamic of shared knowledge structure at societal level.

The Role of Dominant Design in Early Stage Innovation

The studies of dominant design began on industrial innovation in the 1970s (Srinivasan el at., 2006). In the early stage of industry evolution, both technology and market are highly uncertainty. Technological uncertainty associates with the degree of newness of knowledge and design solutions which is grounded on the nature of technology cycles (Tushman & Rosenkopf, 1992; Biazzo, 2009), while market uncertainty is the difficulty on understanding dynamic customer needs (even customers themselves have no idea what they really want) and capture these needs by transforming technologies into functional and symbolic aspects of a product (Tushman & Rosenkopf, 1992; Utterback, 1994; Klepper, 1996; Nelson & Winter, 2002; Biazzo, 2009). These uncertainties open a window for the diversity in product design. Firms strive to introduce wide variety of products to the emerging market in order to figure out what does the market really want. Under this circumstance, both producers and consumers are in the process of "probe and learn" and the competition between product designs may eventually catalyzes the appearance of dominant design (Utterback, 1994).
However, a dominant design is neither a radical innovation, nor necessarily the best technology. Dominant design is a set of features embedded in a particular design, which gain

significant market acceptability. The definitions of dominant design in extant literature are quite diverse (Srinivasan, Lilien, & Rangaswamy 2006). We adopted the definition offered by Utterback (1994) and operationalized the dominant design construct using Anderson and Tushman's (1990) suggestion. As they pointed out:

> *"…it accounts for over 50 percent of new product sales and acquires more than 50% market share of the product category and maintains it for four consecutive years."*

Source: (Anderson and Tushman 1990)

Anderson and Tushman (1990) syntheses previous literature and propose the concept of technology cycle which consists of four major components—technological discontinuities, era of ferment, dominant design and era of incremental change (Anderson & Tushman, 1990, 1991; Tushman & Rosenkopf, 1992). From technological evolution perspective, every technological cycle begins with technological discontinuity (breakthrough) in *stochastic* way. This implies that technological uncertainty is grounded in the nature of technology cycle and technology evolves through cycles of variation, selection and retention (Tushman & Rosenkopf, 1992).

In the era of design competition, new radical technologies are usually crude when they are first introduced and refinements are made frequently in order to compete with different technologies, thus, resulting in the *variation* of product designs. This competition between product designs may give birth of a dominant design. Once dominant design emerges, it serves as a transitional point that closed the era of ferment, and initiates the era of incremental change, which lies on the *selection* of a single product configuration.
After the dominant design appears, technologies are much more well-defined and product attributes turn out to be more specific. At this time, innovations are mostly elaborate and extend the dominant design in an incremental ways (*retention*).
In general, the era of ferment is associated with uncertainties in both technology and market. While new technology usually is not well understood as it first introduced, the product market is ill defined and product characteristics are in the absence of standard (Utterback & Abernathy, 1975; Anderson & Tushman, 1990). Both producers and consumers are in a process of experiment.

For producer, the competition is not only between variety of product design, but also between the old technology and the new technology (Anderson & Tushman, 1990). They tend to introduce wide variety of products in attempt to identify and to meet customer's needs and capture customer acceptance in shorter possible time (Clark, 1985; Sanderson & Uzumeri, 1995). The knowledge with respect to how technology should be improved and what customer really wants is remaining unclear in the era of ferment (Nelson & Winter, 2002). For consumer, choosing a new product among wide variety of product designs in the absence of standard come along with risk. When users encounter problems with the usage of product, they may provide feedback to the producer. In turn, producers learn from users' feedback and solve users' problems by launching a modified product subsequently to supplant the current model over time. This is how user and producer interact with each other and facilitates market learning (Utterback, 1994; Antonia Rosa et al., 1999). Beside, by staying close with product user, producers are able to observe how their product is actual used, what product

features are preferred and in what way to strike an effort in order to close the gap between user needs and product requirements (Utterback, 1994).

As years rolled on, due to the cumulative effort on the process of "learning by doing", the direction toward future development gradually turns out to be clear. While certain product design gradually captures considerable market acceptability, such product design is term as dominant design. Once the dominant design emerges, it reduces uncertainties in both technology and market, provides producers a clear direction for future technology development, encourages producers to make intensive investment on production, weaken consumer's 'wait-and-see' attitude, and catalyzes the diffusion of new technology and new product (Utterback & Abernathy, 1975; Anderson & Tushman, 1990). In this sense, the era of ferment is end by the emergence of dominant design.

The Emergence of Dominant Design

The emergence of dominant design is important to both producer and consumer since it serves as a guidepost to reduce uncertainties. However, there is no stand-alone theory or perspective that can completely explain what factors contribute to the emergence of dominant design.

Departing from technological evolution perspective, there are many factors contributing to the emergence of dominant design such as 1) a set of *complementary assets* (Teece, 1986), 2) the *network externalities* or *bandwagon effect* (Katz & Shapiro, 1985, 1986), 3) the *strategic maneuvering* at firm level (Cusumano, Mylonadis, & Rosenbloom, 1992) , and 5) *the communication between producers and users* (Utterback, 1994). In Srinivasan et al. (2006) findings, it showed that "dominant design is more likely to emerge with weak appropriability, weak network effects, low product radicalness, and high R&D intensity". Weak appropriability means "technology is almost impossible to protect" (Teece, 1986).

As dominant design emerges, it serves as a watershed that closes the era of ferment and initiates the era of incremental change as well as shapes the type of the innovation (from product to process innovation). This study will elaborate more on the era of incremental change in next section.

Hypothesis Development

Given the firm-customer interaction nature of the dominant design. While existing literature has been focusing on the firms' methods of promoting the formation of a dominant design; few researchers tried to understand the role of the customers in the dominant design formation process. We are trying to understand such question by examining the relationship between customer's responses and the formation of a dominant design.

Incidentally, this study using customer reviews from Amazon website as data source as well as defined it as a way of communication based on the definition of diffusion terms as "the process in which an innovation is communicated through certain channels over time among the members of a social system. It is a special type of communication, in that the messages are concerned with new ideas" (Rogers, 2003, p.5).

In addition, the formation of a dominant design stands for the resolution of the design competition and frequency of product innovation decreases. Customers, as the users, are likely mention less about the product design aspect of the innovation in question. Thus, we propose that,

***H_1**: The frequency for the customers mentioning about product innovations would decrease over time, as dominant design emerges*

Social Cognitive Perspective and the Formation of a Dominant

Taking only technological evolution perspective may not fully capture the phenomenon of market dynamic. This study also takes socio-cognitive perspective to discuss on how consumer and producer interact, make sense and shape each other's behaviors within the product market over time based on their knowledge structure at conceptual level. We tend to focus on consumer side.

Based on customer-oriented approach, product market is defined as "the *set of products* judged to be *substitutes* (Hill & Jones, 2007, p.44; Grant, 2008, p.85), within those usage situations in which similar patterns of benefits are sought, and the *customers* for whom such usages are relevant" (Day, Shocker & Srivastava, 1979). The definition implies that the substitutability of two products depends on the degree of similarity based on the product attributes within a product category and the way of usage condition (Antonia Rosa et al., 1999).

Furthermore, White (1981) proposed markets are "self-reproducing *social structures* among specific cliques of firms and other actors who evolve roles from observations of each other's behavior". Following the work of White, Antonio Rosa et al. (1999) defined product markets as "socially constructed knowledge structures that are *shared* among producers and consumers--sharing that enables consumers and producers to interact in the market". The definition implies that product markets are define by neither consumers nor producers but evolved from the interaction feedback between producers and consumers.

In addition, the demands of both parties—consumer and producer are different. While consumer demands grounded on the variety and usage of product (Day, Shocker, & Srivastava, 1979), whereas producer demands stem from the competitive positioning aim at achieving profitability and gaining market share (White, 1981; Antonio Rosa et al., 1999). While market provides a ground for both parties interact with each other.

In this sense, such a self-correction mechanism is spontaneously activated in the course of interaction and eventually an agreement at conceptual level is established and shared in between knowledge structure among both parties, which serves as guidance on how specific product are categorized (Clark, 1985; Antonio Rosa et al., 1999). This mechanism is similar to the process of the formation of a dominant design. Thus, we are trying to combine these two theories to describe the early evolution process from the customers' aspect.Under the Socio-cognitive View, the early stage of emerging product market, market conditions are always unstable and information is incomplete.

Portable MP3 Player Innovation and the iPod as a Dominant Design

Since the emergence and evolution of MP3 (MPEG-1 Audio Layer 3), a digital audio encoding format, which has brought a considerable impact on music industry as well as reshape the way people listening to music. In the period around late 90s' until the beginning of the millennium, the market opportunity was identified by great number of firms. These firms launched different brands and various models of portable MP3 player with large number of attributes to emphasize on differentiation within short period of time to the highly uncertainty market in order to catch up with the trend of music revolution. The evolution of portable MP3 player industry throughout these years provides fruitful evidence account for the industry evolution as well as product market evolution. Thus, this research selects portable MP3 player as product class to study.

Both producers and consumers have only little knowledge on each other. Once a new product (e.g., portable MP3 player) is debuted in a product market, consumer tends to deal with the novel experience arise by looking at the attributes of the new product which are similar to attributes of pre-existing product categories (e.g., CD walkman) in order to "know" the new product. Since new product usually combines both shared and unique attributes (Sujan & Tybout, 1988; Meyers-Levy & Tybout, 1989).

Based on cognitive science, people often rely on categorization or schemas to simplify and organize new things they encountered in complex environment in order to learn in an efficient way (Sujan & Tybout, 1988). By definition, a schema is "an organized mental or cognitive list that includes characteristics, facts, values, or beliefs about people, events, or objects" (Plotnik & Kouyoumdjian, 2008, p.420). The categorization activities in consumer's mind primarily involve grouping and distinguishing. This categorization process mostly rely on past experience, memory retrieval and other high-level processes which has been widely studies in marketing research such as beliefs, attitude and choice (Antonio Rosa & Porac, 2002).

Once a new product possesses certain attributes similar to the attributes of pre-existing products (previous innovations—CD walkman), the new product is consider as a member of existing product categories in consumer's mind. In contrast, if the novel product is highly innovative and incongruent with consumer's current knowledge structure, it is difficult for customer to assimilate the novel product into the existing product categories in mind. In this situation, the new product shakes the ground of customer's knowledge structure and destabilizes the boundary of existing product categories at conceptual level. As a result, the novel product tends to be positioned as product with unique core attributes in consumer mind (Clark, 1985; Antonio Rosa et al., 1999). In this sense, both cognitive knowledge structure and behavioral pattern need to be readjusted.

As new product continuous evolves over time within the product market, customer reviews contain information of new product disseminate through the market place and re-stabilize the product categories, thus the new product concept (portable MP3 players) would eventually integrates into pre-existing knowledge structure and becomes part of the knowledge structure. Thereafter, consumer relies on this "updated" knowledge structure to pilot within the "new"

product market. In this sense, the frequency of using pre-existing categories as a reference faded away as dominant design (iPod) emerges. Thus we propose that,
***H_2**: The frequency of using previous innovations as reference would decrease over time as dominant design emerges*

In the course of market dynamic which consist of mutual influence between conceptual knowledge and external stimulus, the pre-existing product category at conceptual level originally use to deal with "new" stimulus, once destabilized by new product concept gradually become stable again because of the diffusion of customer review over time. Thus, the new product "image" eventually stored in consumer's minds, consumers are gaining familiarity with the new product, in turn, the new product is gaining market acceptability, and becoming benchmark within the product category (Antonio Rosa et al., 1999). The benchmark in this study tends to derive from demand and usage condition of a product from customer viewpoint. Typically, the phenomenon of shifting in product acceptability is similar to the dominant design theory. Thus, we draw the following hypothesis that,
***H_3**: The frequency for the customer using a dominant design as benchmark would increases over time as the innovation be accepted by the market.*

METHODOLOTY

Research Design

Content analysis (Neuendorf, 2002), Z test for proportion (Berenson, Levine & Krehbiel, 2006, p.325) and logistic regression (Neter et al., 1996; Hosmer & Lemeshow, 2000; Hair et al., 2006 & Tabachnick et al., 2007) are employed in this study.

Content analysis, which is the study of recorded human communication (Babbie, 2007, p.320), is fit to the objective of this study--to investigate the interaction between consumer and dominant design, and how consumer views dominant design. The unit of analysis of this study is the customer review at message level. Content analysis is employed using *qualitative* judgment on text-form data and then coded into *quantitative* data for statistical data analysis. Human coding (2 observers) is applied in the text-form customer reviews. Both manifest content and latent content are used in the coding of this study (Babbie, 2007, p.325). While relying on human judgment, the quality of the data--the agreement among independent coders, is considered as a critical issue (Hayes & Krippendorff, 2007). In content analysis, *intercoder reliability*, which is different from other research's reliability measurement, is refers to "the amount of agreement or correspondence among two or more coders" (Neuendorf, 2002). Cohen's *kappa*, which is known as the most widely used reliability coefficient, is employed in this study (Perrault & Leigh, 1989).

Z-test for proportion and logistic regression are then applied for data analysis. Z test is employed on testing the differences between proportions of two groups of sample because of the comparison between proportions is considered to be more appropriate than directly counting on the frequencies between two sample groups in order to avoid bias. While logistic regression is used, mainly because of the dichotomous nature of dependent variable based on the coded frequencies from content analysis. For Z test and logistic regression, year 4th (2001) is used as a cut point in the period of time representing the debut of iPod in real world

as well as the emergence of dominant design in theory. The statistical analysis software SPSS (Statistical Package for the Social Sciences) 13.0 is applied in this study.

Data Source

The data of this study is the customer reviews (messages) of portable MP3 player posted on Amazon website. The main reason of choosing Amazon website as the source of data collection is because of the wide variety of portable MP3 players as well as a large pool of customer's reviews are available on Amazon website. In addition, Amazon website is considered as a platform where customers provide feedback and exchange information.

The nature of the text-form data can be counted as the way customer expresses and *communicate* their attitude and opinion toward the product under post-adoption situation, namely, the product adoption is an actual behavior and has already happened. While, there are several assumptions underlie in the customer reviews. First, the reviews are assumed written by the product users who *actual* owned the product. Second, the reviews are written by the product users who have *used experience* with the product. Third, the product users are *honest* with their written text. Forth, the reviews are *voluntary feedback* by the product users. Data are in the form of two hierarchical levels. According to the work of Tushman and Murmann (1998), dominant design is mostly describe at product level. Therefore, the first level data in this study is aim at product level that consists of different brands and various product models serves as an individual product design (n=796), which launched in between 1998 to 2006. The second level data are the customer reviews in text form under each product, which has a total of 31,830 messages (recorded on September 28, 2008). While, the unit of analysis in this study is the customer review at message-level.

Follow the work of Suarez and Utterback (1995) that separate the time period into pre-dominant design and post-dominant design. In this study, product-level data are divided into pre-iPod and post-iPod, which consists of three categories using the iPod[1] first launched date (October 23, 2001) as cut point. Three categories are pre-iPod (which portable MP3 player launched before iPod debut launched), non-iPod (which portable MP3 player launched after iPod debut launched by other firms), and iPod. iPod first launched date is defined as a watershed separated pre-iPod from iPod and non-iPod in term of time.

Among total samples (n=796) at product-level, 285 (36.8%) of the total samples are not available due to the absence of launched date, thus they are excluded in this study. The remained samples (n=511) at product-level fall into 3 categories, of which 70 samples belong to pre-iPod category, 410 samples include in non-iPod category, and 31 samples fall into iPod category, respectively. As for message-level sample, 25,963 (81.6%) samples out of 31,830 total samples remain in three categories, of which 3,050 samples under pre-iPod category, 16,501 samples under non-iPod category, and 6,412 samples under iPod category are served as sampling frame.

[1] http://en.wikipedia.org/wiki/IPod

Sampling

Both stratified sampling and systematic sampling are employed in this study in order to draw appropriate proportion of samples from homogeneous subgroups to achieve greater degree of representativeness by decreasing the sampling error (Babbie, 2007, p.205) and to draw sample across the whole sampling frame with a random start to avoid human bias (Babbie, 2007, p.202). At first, 350 samples (68.5%) out of 511 samples at product-level are randomly draw in non-replacement way using Microsoft Excel. Among 350 product-level samples, of which 50 samples are stratified into Pre-iPod category, 19 samples are grouped into iPod category, and 281 samples are categorized into non-iPod category.

There are total 17,821 reviews at message-level under 350 product samples. The sampling interval is 16, which divided 17,821 by desired sample size 1,100 (Babbie, 2007, p.204). The desired sample size[2] is estimated by sampling error within 3 percent at 95 percent level of confidence (Neuendorf, 2002, p.83; Berenson, Levine & Krehbiel, 2006, p.278). Systematic sampling are then applied to message-level samples for each product respectively. Microsoft Excel is applied to select the first sample at random to avoid human bias (Babbie, 2007, p.202) based on the sampling interval between 1 and 16, and the sequential samples are then draw in every 16th samples in cyclical way (Neuman, 2006, p.232).

However, due to the "open system" on Amazon website, the number of customer reviews are different from the initial record date (September, 2008) and the actual data access date (April, 2009). As a result, there are 1,204 samples at message-level instead of original desire samples (n=1,100). The sample's distribution in this study will be reported in next chapter.

Operational Definitions

Product Innovation

As mentioned in previous section, both manifest content and latent content are applied in the coding of this study. Wordings such as "iPod is *new* to me, *innovative* features" are considered as latent and manifest content, respectively and defined as product innovation in this study.

Previous Innovations

Wordings such as "cassette walkman, CD walkman, MD walkman, cassette, CD, MD" are considered as manifest content in the coding process, and defined as previous innovations in this study.

iPod as Benchmark

Wording such as "iPod is the *best* player, buy iPod, get iPod" are considered to have an underlying meaning in benchmark from customer perspective. The operational definitions of variables in this study are show in Table 1.

[2] $n = (P*Q)(Z_{\alpha}/e)^2$

Table 1: Operation Definitions of Variables

Variables	Operational Definitions	Source/Reference
Product Innovation	"new technology or combination of technologies introduced commercially to meet a user or a market need."	Utterback & Abernathy, 1975
Previous Innovations	The product categories introduce prior to current product category. (eg. Portable cassette player, portable CD player, portable MD player)	Define by this study.
iPod as Benchmark	Using iPod as a point of reference from which measurement can be made.	Merriam-Webster's Collegiate Dictionary, 11e, 2003; define by this study.

DATA ANALYSIS

Sample's Distribution

Of which 350 product-level samples, there are 50 samples (14.3%) fall into pre-iPod category, 19 samples (5.4%) belong to iPod category, and 281 samples (80.3%) categorized into non-iPod category. As for message-level samples, there are 163 messages (13.5%) in Pre-iPod category, 270 messages (22.4%) in iPod category, and 771 messages (80.3%) in non-iPod category. The sample's distribution is showed in Table 2.

Inter-coder Reliability

2 human coders worked independently in the coding process in content analysis. A total of 1,204 text-form messages were coded. In the pilot study, we have a lower *kappa* values due to the disparate opinion, but after putting effort on communication and stick to the definition of coded variables, the final inter-coder reliability for each variables in this study are show in Table 3 measuring by Cohen's *kappa* values.

Although the standard of inter-coder reliability is still in debate, there is a widely accepted rule of thumb suggests that *Kappa* value achieves at .7 is consider as reliable, while above .75 is consider as high reliable (Neuendorf, 2002, p.143). In this study, the variable product innovation has a poor agreement with kappa value of .108, the variable previous innovations has a kappa value of .574, achieving a fair agreement, and the variable iPod as Benchmark has a kappa value of .734, which is consider achieving a good agreement (Byrt, 1996).

Table 2: Sample Descriptive Summary

Sample level	Product category			Total
	pre-iPod	iPod	non-iPod	
Product level	50	19	281	350
%	14.3%	5.4%	80.3%	100%
Message level	163	270	771	1,204
%	13.5%	22.4%	64%	100%
1998	20	0	0	20
1999	23	0	0	23
2000	30	0	0	30
2001	90	6	44	140
2002	0	7	136	143
2003	0	24	166	190
2004	0	65	126	191
2005	0	168	288	456
2006	0	0	11	11

Table 3: Cohen's Kappa

Variable	Cohen's *Kappa*	Agreement
Product Innovation (Y/N)	.108	Poor
Previous Innovations (Y/N)	.574	Fair
iPod as Benchmark (Y/N)	.734	Good

Hypothesis Testing & Results

Z test for proportion and logistic regression are applied in this study for testing on H_{1-3}. Z test is primarily used for testing on the differences between two proportions of consumer mentions about product innovation (H_1). While logistic regression is mainly testing on the probability of mentions previous innovations by consumer over time as iPod emerges (H_2) and the probability of using iPod as benchmark by consumer over time as iPod emerges (H_3). The independent variable is the introduction date (year) of each product models that transforms into numerical form. The summary of the hypothesis results is show in Table 4 and detailed data analysis will discuss in the following sections.

Table 4: Hypothesis Testing Results

Hypothesis	Statistical Method	Sig.	Result
H_1	*Z* Test for Proportion	.236	H_1 not supported
H_2	Logistic Regression	.000	H_2 partially supported
H_3	Logistic Regression	.097	H_3 supported

Product Innovation

Grounding on dominant design theory, as dominant design emerges, it diminishes the rate of product innovation and the innovation activities will shift from product innovation to process innovation. Hypothesis 1 predicts the frequency of mentions about product innovation by consumer would decrease over time as the dominant design (iPod) emerges. Using the year 4 (2001) as the cut point to classify data into pre-iPod and post-iPod. Z test for proportion is employed to test the different between two proportions of mention about product innovation. In Table 4-4, p1 is the proportion of mention about product innovation in pre-iPod years (1998-2001), while p2 is the proportion of mention about product innovation in post-iPod years (2002-2006).

The finding of this study suggests that there is no statistical significant different between pre-iPod period and post-iPod period (Z= -1.184, $p > .05$), Thus, H_1 is not supported. The finding is inconsistent with this study's prediction as well as the extant dominant design theory. One possible explanation for the finding might be attributed to the influence by the small portion of consumer mentions about product innovation. Overall, there are only 31 samples (2.6%) out of 1204 samples mentioned about product innovation (see Table 4-5).

Table 5: Z Test Result

D.V.	p1	p2	S.E.	Z	sig.
Product Innovation	.014	.028	.012	-1.184	.236

* $p < .05$

Table 6: Contingency Table (Product Innovation--Year)

Year	Mentioned Product Innovation		Total
	No	Yes	
Pre-iPod (1998-2001)	210 98.6%	3 1.4%	213 100%
Post-iPod (2002-2006)	963 97.2%	28 2.8%	991 100%
Total	1173 97.4%	31 2.6%	1204 100%

Previous Innovations

Based on the dominant design theory and socio-cognitive theory, this study expects the emergence of dominant design would reduce market uncertainty dramatically, while the decrease of ambiguity in consumer's knowledge structure leads to the decrease in frequency of using previous innovations as a reference to deal with new product. Hypothesis 2 predicts the frequency of mentions about previous innovations would decrease over time as dominant design (iPod) emerges.

In order to capture the drastic reduction in the phenomenon, piecewise logistic regression with two slopes is applied to test H_2. The result of the logistic regression show in Table 4-6 is the combination of two separate logistic regressions. Year 4th (2001) is used as a cut point to classify the total samples (n=1204) into 2 sub-samples (n_1=213, n_2=991) as well as to

separate new products' introduction date into 2 periods (PreiPod starts from 1998 to 2001; PostiPod starts from 2002 to 2006). The first logistic regression treats PreiPod as independent variable with n_1, while the second logistic regression using PostiPod as independent variable with n_2.

In Table 4-6, the variable PreiPod represents the effect of years for *before* iPod emerges, while the variable PostiPod represents the effect of years for *after* iPod emerges. As int1 represents the intercept for the years *before* iPod emerges, whereas int2 representing the intercept for years *after* iPod emerges. The finding shows that there is no significant (-.276, $p > .05$) prior to the emergence of iPod, whereas it is statistically significant (-.337, $p < .01$) once iPod emerges. Thus, H_2 is partiallt supported. The coefficients, B, is the natural logs of the odds ratio = e^B. The odds ratio of $e^{-.337}$=.714 means the odds of consumer using previous innovations to deal with new product (iPod) decreased by 28.6 percent (1-.714) as likely with one year passes by (Neter et al, 1996, p.577; Tabachnick et al, 2007, p.462). Note that, in this model, Cox & Snell R Square & Nagelkerke R Square are not valid and should not reported[3].

Table 7: Logistic Regaression Results on Previous Innovation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
int1	-1.572	.690	5.182	1	.023	.208
int2	-1.153	.156	54.615	1	.000	.316
PreiPod	-.276	.326	.718	1	.397	.759
PostiPod	-.337	.061	31.100	1	.000	.714

Note: Exp(B) = odds ratio

iPod as Benchmark

In this section, samples in pre-iPod category (n=163) are excluded due to the samples are prior to the debut of iPod. Only post-iPod category samples (n=1041) consists of iPod category and non-iPod category are used for data analysis.
This study expects the frequency of using iPod as benchmark would increase as iPod emerges as dominant design and gaining popularity over time. The finding is statistical significant ($p > .1$). The odds ratio of 1.108 suggests that the probability of consumer using iPod as benchmark increased by 10.8 percent as likely with one year passes by. Thus, H_3 is supported.

Table 8: Logistic Regaression Results (iPod as Benchmark)

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
INTRO_D1	0.102	0.062	2.752	1	0.097	1.108
Constant	-2.048	0.436	22.016	1	0.000	0.129

Note: Exp(B) = odds ratio

[3] http://www.ats.ucla.edu/stat/spss/faq/piecewise.htm

DISCUSSIONS

Discussions

Product Innovation

The finding of this study on H_1 is not compatible with the existing dominant design theory. It indicates that there is no different in product innovation as iPod emerges. There are several possible reasons yield the finding. First, the different perspective in product innovation might cause different finding. While the product innovation in this study, is defined in the eyes of customer rather than firm's perspective. Second, the insufficient cases of consumer mentions about product innovation might fail to provide persuasive conclusion. Third, in high-tech industry, the fast changing rate in technology, the shorter product life cycle and the dynamic customer's demand might be the forces drive firms to innovate in order to strike for survival in competitive environment as well as distinguish from other competitors. Thus, the rate of product innovation persists, regardless of the emergence of dominant design. Fourth, the dominant design theory might not be able to generalize across industries (Klepper & Simons, 1996).

Previous Innovations and Using iPod as Benchmark

When portable MP3 player market first emerges, it is full of uncertainty in both technology and market needs. Typically, in the early of new emerging market, there are wide variety of new portable MP3 player. While customer encountered a new portable MP3 player which is not compatible with pre-existing product categories such as CD walkman and MD walkman, they feel ambiguous because of the unfamiliarity brought by innovativeness and tend to rely on existing knowledge structure on pre-existing product categories' attributes and retrieving own past memory or usage experience in order to deal with the new portable MP3 player. In this sense, attributes of pre-existing products are used as a point of reference in a reverse way to cope with ambiguity and to process information in an efficient way. Grounding on dominant design theory, as iPod appeared to be a dominant design in the portable MP3 player market, it reduces the market uncertainty as well as consumer's ambiguity. As a result, the frequency of mentions about pre-existing products decreases over time as iPod emerges. The finding of this study is compatible with the dominant design theory.

Although, iPod is not the first mover in portable MP3 player market, however, the empirical finding in this study shows that the frequency of using iPod as benchmark gradually increases over the years. This implies that iPod is not only captures market share in real world, but also gradually destabilizes the existing knowledge structure mainly grounded on pre-existing product category and eventually become the frame of reference for portable MP3 player in customer mind. In other words, as the product market evolving, customer's knowledge structure is changing! In this sense, iPod is facilitating the diffusion of innovations.

Managerial Contributions

The following are the contributions of this study.

1. This study is able to fill the gap in previous literature by providing empirical evidence

regarding the impact of iPod on portable digital audio player industry from customer perspective. The text-form customer review analyze by content analysis in this study is different from the existing viewpoint (i.e. producer-side) on dominant design. The nature of data is derived from customer's perception toward dominant design at product level.

2. This study is different from previous researches in technological evolution theory and socio-cognitive field that are conducted separately. This study combines both technological evolution theory and socio-cognitive theory to portray the evolution of an industry as well as the dynamic of product market.
3. This study can be a reference for managers in portable digital audio player industry. It portrays customer reviews on several issues, such as their feedback toward dominant design, how they mentioned about dominant design at product level, what kind of attributes or features are preferred in portable digital audio player.
4. This study provides an alternative method in measuring the impact of dominant design which is different from previous research. In the existing dominant design literature, the product innovation is count on the basis of an individual product, whereas in this study, product innovation is count on the frequency of mentions about product innovation which derive from customer perception.

Limitations

The limitations of this study are show as follow,

1. The varying quality of customer reviews on website is uncontrollable due to the open space for any customer without having any filtering on the reviews. While the customer reviews might be affected by perception and individual difference.
2. There might raise a challenge of assuring the customers who provide review on Amazon website can be the representative of the whole population of portable digital audio player's user.
3. Due to the poor agreement on the inter-coder reliability on product innovation with Kappa value of .108, it is difficult to operationalize on product innovation.
4. As years rolled on, same needs at different given point in a period of time are not grounded on the same property. For example, storage capacity with 512MB is considered as large storage capacity in the early stage of technology's development, whereas it is treated as insufficient storage as technology continue evolves and improves over time. In other words, both product's features and customer's needs are dynamics in longitudinal perspective. Thus, increase complexity and challenges for this research.
5. There are some interesting phenomena can only be captured in qualitative study. For example, once a new technology emerges, it serves as a solution for a particular problem, but at the same time; it opens a window for new problem. Say, as CD emerged when cassette was still served as mainstream in music industry, CD permits sustained storage life for keeping music relatively longer to cassette. However, it opened the skip problem for CD walkman at the same time. The skip problem remains through the development of portable digital audio player, until the hard drive based portable audio player shift to flash memory based player.

Future Research

The future researches for this study are show as follow.

1. Larger sample size can be considered in order to provide persuasive empirical evidence in the future study.
2. The data collected from Amazon website are mainly come from the customer in United Stated. Customer from different regions might yield different opinions.
3. The interaction between dominant design and other complementary assets such as iTunes and personal computer (PC) is consider to be included.
4. The complexity and dynamic of cognitive structure might be only partial understand, remain room for future study.

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THE INNOVATION IN MODELLING THE IMPORT DEMAND

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ABSTRACT

This study investigates the effect of real exchange rate and domestic production on import demand by using the evidence of Taiwan's Phosphor Bronze (PB), which is one of the most important materials for producing connectors of computer, communication and consumer electronic products. Monthly data for the period of January 1989 to December 2008 are used to estimate the import demand function. Time series methods applied in this research are cointegration tests and error correction models. The results suggest that the effect of domestic production on the import demand of PB is not significant. Real exchange rate serves as a more important indicator of the import demand. The evidence of Taiwan's imports of PB provides two implications in inventory management to the importers and exporters in the copper industry. First, the quantity of domestic production of PB does not influence the import demand of PB significantly. Second, any changes of real exchange rate may produce great uncertainty in the exporting countries of PB.

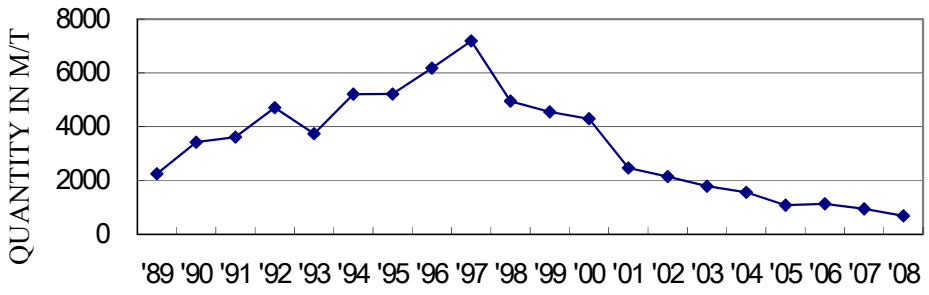
Keywords: Innovation, Inventory Management, Import Demand, Phosphor Bronze

INTRODUCTION

According to Greenspan (2009), Taiwan and China together are now the world's largest original euipment manufacturers (OEM) of computer, communication and consumer electronic products (3C-products). One of the most important materials in producing these products is Phosphor Bronze (PB). PB is an alloy of copper with 3.5% to 10% of tin. These alloys are known for their hardness, tension strength, and low resistance to electric current. Mostly, PB is used to make some electrical circuits due to its low resistance to electric current. ASTM C51000, C52100, and C50700 of PB are commonly used for many connectors in a wide variety of 3C-products.

Japan has been the biggest exporting country of PB since 1989. According to Taiwan's Bureau of Foreign Trade, about 93% of PB was imported from Japan in 2008. In 1989, about 2,225 metric tons of PB was imported from Japan. This was increased to 7,192 metric tons in 1997 and then gradually reduced to 688 metric tons in 2008 (FIG. 1).

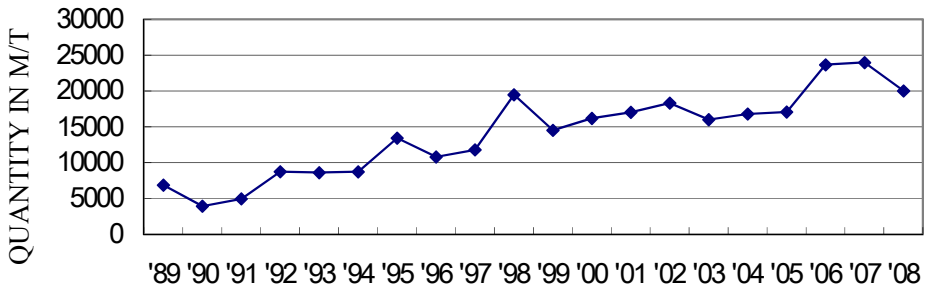
FIG. 1 *Quantity of PB imported from Japan*



Source:Taiwan's Bureau of Foreign Trade

In 1989, there are 6,897 metric tons of PB produced in Taiwan. The quantity was steadily increased to 23,972 metric tons in 2007 and slightly decreased to 20,024 metric tons in 2008 (FIG. 2).

FIG. 2 *Quantity of PB produced in Taiwan*



Source: AREMOS

At the beginning of the 1990s, personal computer (PC) industry was growing very fast in Taiwan, which increased the consumption of PB. On average, the growth rate of PB demand in Taiwan was more than 20 percent annually in the 1990s. In the meantime, the manufacturers in Taiwan gradually moved their factories to China to lower their manufacturing costs. In a very short time, Taiwan and China have become the largest 3C-product OEM countries in the world. However, the Chinese manufacturers were not able to supply high-quality PB. Therefore, Taiwan served as a material and component provider to China. However, Taiwan's PB producers had great difficulty in meeting the demand of the market. The manufacturers in Japan could meet the difference of PB and export more than 90% of PB to Taiwan. Because of the need for 3C-products in the global market, Taiwan has become a very important supplier of PB to China. Therefore, to estimate the import demand for PB and the effect of real exchange rate on import volume of PB in the Taiwan market have become an important issue. In this study, the effect of the domestic production of PB and the real exchange rate of the New Taiwan Dollars (NTD), the Taiwanese currency, on the import demand of PB from Japan will be examined.

LITERATURE REVIEW

In the past two decades, several studies have found the evidence of a negative relationship between real exchange rate and import demand (Kenen and Rodrik, 1986; Koray and Lastrapes, 1989; Arize, 1998; Arize and Shwiff, 1998). Some research use price elasticities to explain import demand. Stone (1978) found that the demand for steel was highly sensitive to price. Most studies use steel as evidence of import demand (Crandall, 1982; Foroutan, 1986). Williams and Botzman (1994) used the quarterly data between January 1981 and December 1990 and investigated the effect of the USA–Canada Free Trade Agreement (FTA) on imports and exports of steel products. These previous studies all shows that the import demand for steel is affected by the real exchange rate and domestic production of steel. However, whether we can apply the previous results of steel to PB has become an important issue since PB is such an important material for producing connectors of 3C products, but there were hardly any studies relating to the import demand for PB after the 1970s. In addition, these previous studies did not consider the problems of stationarity of the data. Therefore, this paper will find a suitable model for the import demand for PB and provide managerial suggestions to the importers and exporters in the copper industry.

MODEL SPECIFICATION

A traditional import demand model developed by Gotur (1985) explains the long-term equilibrium of supply and demand functions. Gotur's (1985) model is applied to investigate Taiwan's import demand for PB products. In this model, the volume of PB imports from Japan is assumed to depend on the domestic production of PB in Taiwan and the real exchange rate, i.e. the ratio of import price and domestic price of PB expressed in the same currency. The general function of the model is as follows:

$$M_t = f(Y_t, ER_t)$$

where M_t is the volume of Taiwan's imports in time period t, Y_t is Taiwan's domestic production of PB, ER_t is the real exchange rate measured in terms of NTD per US dollar. An increase of ER means a depreciation of NTD. This will make the costs of Taiwan's PB imports more expensive.

The formula for ERt is the following:

$$ER_t = EN_t * P_t^f / P_t^d$$

where EN is nominal exchange rate of NTD per US dollar, P_t^f is Taiwan's import price of PB, P_t^d is the PB price in Taiwan's domestic market.

Following Gotur (1985), we obtained the model as follows:

$$M_t = \beta_0 + \beta_1 Y_t + \beta_2 ER_t + \varepsilon_t$$

where β_0 is the intercept, β_1 is the coefficient of domestic production of PB in Taiwan, β_2 is the coefficient of the real exchange rate, andε_t is the residual.

METHODOLOGIES

This study uses unit-roor tests, cointegration tests, and error correction models (ECM) to analyze the effect of the domestic production of PB in Taiwan and the real exchange rate on the PB imports of Taiwan. The classical regression model assumes that the time series data of both the dependent variable and independent variables should be stationary and that the errors have a zero mean and a finite variance. If the time series data are not stationary, there might exist a spurious regression (Granger and Newbold, 1974), which has a high R^2 and t-statistics that are significant but the results are without any meaning. Therefore, augmented Dickey–Fuller (ADF) tests (Dickey and Fuller, 1981) are applied to examine the stationarity of the data for the higher order of integration. Then, the first cointegration relationship is established between the volume of Taiwan's PB imports and domestic production of PB in Taiwan. The second cointegration relationship is established between the volume of Taiwan's PB imports and real exchange rate. The short-run and long-run of the above relationship are examined by error correction models.

Unit Root Tests

In order to provide a stationary process, time series data must be examined by how many times they have to be differenced. These data are defined as first difference if they have to be differenced once to achieve stationary. ADF tests are applied to obtain the order of their integration.

Cointegration Tests

Granger (1981) and Engle and Granger (1987) first developed cointegration. If Taiwan's PB imports, Taiwan's domestic production of PB, and real exchange rate are separately integrated of first difference, then the cointegration is applied to investigate whether there is any long-run relationship between them. If these time series data have the conjoint movements, then we can define Taiwan's import demand for PB to be cointegrated with Taiwan's domestic production of PB and real exchange rate, respectively. Once there is a linear combination between them, the residual ε_t of the regression model of Taiwan's PB imports on Taiwan's domestic production of PB and real exchange rate is integrated of order zero.

Error Correction Model

If the import demand for PB is cointegrated with Taiwan's domestic production of PB and real exchange rate, respectively, we can continue to examine whether there are immediate adjustments in the changes of Taiwan's PB imports, their previous levels and domestic production of PB and the real exchange rate in term of their short-term and long-term equilibrium. The error correction model allows the long-term factors of PB imports to follow equilibrium constraints. In the mean time, their short-term factors have a flexible dynamic adjustment as well. Therefore, this model may explain the observed disequilibrium of PB imports in term of their long-term equilibrium behavior. The error correction model can be written as:

$\Delta M_t = \varphi + \lambda\varepsilon_{t-1} + w_0 \Delta Y_t + w_1 \Delta ER_t + e$
where Δ represents rate of change of variable; ε_{t-1} denotes residual of regression as
$M_t = \beta_0 + \beta_1 Y_t + \beta_2 ER_t + \varepsilon_t$

The error correction model not only suggests the immediate adjustments in the changes of PB imports, the short-term run changes in domestic production of PB and real exchange rate, but also relates the changes of the PB imports to the residual of the previous date. It allows the combination of long-term and short-term information on PB imports in the same model.

DATA AND RESULTS

We use monthly data for the period of January 1989 to December 2008, which allows us to obtain 240 observations for each of the data series for the unit-root and cointegration tests. The data are obtained from several sources. Data on Taiwan's imports of PB and the price of imported PB are from Bureau of Foreign Trade, Taiwan[1]. The domestic production, prices of PB in Taiwan and foreign exchange rate data are from AREMOS[2] of the Ministry of Education, Taiwan. The domestic PB prices are from the wholesale prices and the import prices are based on the CIF Taiwan.

Results of Unit Root Tests

Table I reports the results of unit root tests of Taiwan's PB imports, its domestic production of PB and real exchange rate. The ADF results show all the time series data tested are not stationary. However, Taiwan's PB imports, its domestic production of PB and real exchange rate are respectively stationary at first-difference level.

TABLE I THE RESULTS OF ADF TESTS

	Levels	First difference
PB IMPORTS	-1.317	-6.459*
DOMESTIC PRODUCTION OF PB	-1.697	-10.544*
REAL EXCHANGE RATE	-0.301	-6.413*

NOTE: * indicates 1% level of significance level

These results allow us to test if Taiwan's imports of PB move together with its level of domestic production of PB and real exchange rate, respectively.

[1] The website of Bureau of Foreign Trade, Taiwan is http://cus93.trade.gov.tw/FSCI.

[2] The website of AREMOS is http://www.aremos.org.tw.

Results of Cointegration Tests

Table II reports the results of the cointegration tests between Taiwan's imports of PB and the domestic production of PB. Our test statistic of 19.796 is greater than the critical value of 17.147. This means the rejection of the hypothesis of no cointegrating relationship.

TABLE II Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.080788	19.79606	17.14769	0.0201
At most 1 *	0.035157	8.410516	3.841466	0.0037

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table III reports the results of the cointegration test between Taiwan's imports of PB and real exchange rate. Our test statistic of 49.066 is greater than the critical value of 17.147. This means that we can reject the hypothesis of no cointegrating relationship.

TABLE III Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.188438	49.06671	17.14769	0.0000
At most 1 *	0.136767	34.56164	3.841466	0.0000

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Therefore, these results support that Taiwan's PB imports are cointegrated with its domestic production of PB and real exchange rate.

Results of Error Correction Model

After we examined the regression equation of $M_t = \beta_0 + \beta_1 Y_t + \beta_2 ER_t + \varepsilon_t$, we found that the coefficient β_1 is not significant. Therefore, we decided to change the regression model to $M_t = \beta_0 + \beta_2 ER_t + \varepsilon_t$ and estimated the new regression equation again. The results are the following: $M_t = 643.665 + (-291.135) ER_t + \varepsilon_t$. Then we saved the residuals of the regression equation and used them to estimate the error correction model:

$\Delta M_t = \varphi + \lambda\varepsilon_{t-1} + w_1 \Delta ER_t + e$
The results of the error correction model is as follows,
$\Delta M_t = 0.029 + (-0.276)\varepsilon_{t-1} + (-89.558)\Delta ER_t + e$

CONCLUSION

This study models import demand of Taiwan's PB imports. The results show that Taiwan's import of PB is cointegrated with the real exchange rate and domestic production of PB. However, the effect of domestic production of PB on the import demand is not significant. The results of PB are different from those of steel products shown in the previous studies. The evidence of Taiwan's imports of PB is very important to the importers and exporters in the copper industry. First, the domestic production of PB may adversely affect the import demand of PB, but its effect is not significant. This means that the quantity of the domestic production is not very important to the import demand. Importers in the copper industry should pay more attention to the real exchange rate. Second, any changes of the real exchange rate may produce great uncertainty in the exports of PB. This is very important for importers and exporters to do inventory management. We suggest that future studies may use lagged variables to examine the simultaneous effect. In addition, we only examine the effect of domestic production and real exchange rate on the import demand for PB. We also suggest future studies to include wider product range to obtain more meaningful results.

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ACCEPTABILITY OF WIND POWER

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ABSTRACT

The global economical crisis affects on the operating conditions of different business fields. The crisis has different kind of impacts on different fields depending on the capital intensity and the need of the product or service from the standpoint of the consumer. Energy industry is special due to its capital intensity, long pay back times for investments, regional political guidelines and general acceptability. In addition to economical crisis the need to cut down CO2 emissions because of the global warming has adapted the operating environment in the field.

The goal of this research is to evaluate and analyze the factors that have an affect on the acceptability of wind power investment in decisions making situation. The used research methodologies were an action analytical and a constructive case research. Empirical data was collected by using formal questionnaires, observations of the researcher and informal discussions.

The results showed that the support for wind power is high in EU-countries that have relatively little wind power in relation to country's surface area. Respectively the support for wind power varies depending on if there is visual contact or not to the property of the respondent. The resistance is higher among those who presume that they have direct view to the wind power project.

The results of this research help investors and decision makers to learn and understand how the operational environment affects on energy investments that are important for the society and also on the factors that have an effect on the growth of renewable energy forms.

Keywords: multi-criteria decision making, innovation and learning, wind power, strategic management, conditions of investment and energy industry

INTRODUCTION

The changes in energy politics have been rapid during the last few decades relative to the long pay back periods in the industry. The changes have been in the framework of the industry and in the single technical-economical guidelines. On one hand energy industry is local because of the restricted mobility of the final product (electricity). On other hand the industry is global because of the global fuel (etc. coal, nuclear and gas) and equipment market. This means that the guidelines made in EU affect differently on competitive advantage of each member country in energy production if the countries have the possibility to carry out the political goals. Parallel impact can be seen between Europe, Russia and China.

The changes in energy politics are causing modification or total renewals in the existing energy production plants. At the same time the need to build new plants is growing because of the rise in energy consumption (14).

In addition to global politics, energy production can be examined trough feelings of citizens. Politically accepted energy production form is not automatically accepted by the local people who live in the target area of the energy production project. In this research it is examined how people regard wind power in Finland, where there were only 119 wind power plants by the end of 2008 (13).

The amount of wind power construction can be reviewed with several specific indicators. These indicators can for example be the total built wind power efficiency and wind power efficiency per km^2. The relative amount of built wind power in relation to population and surface area can be reviewed with intensity factor. Intensity factor means the built wind power efficiency multiplied by the popular density per km^2 in the country in question. The intensity factor in Europe has been shown in figure 1.

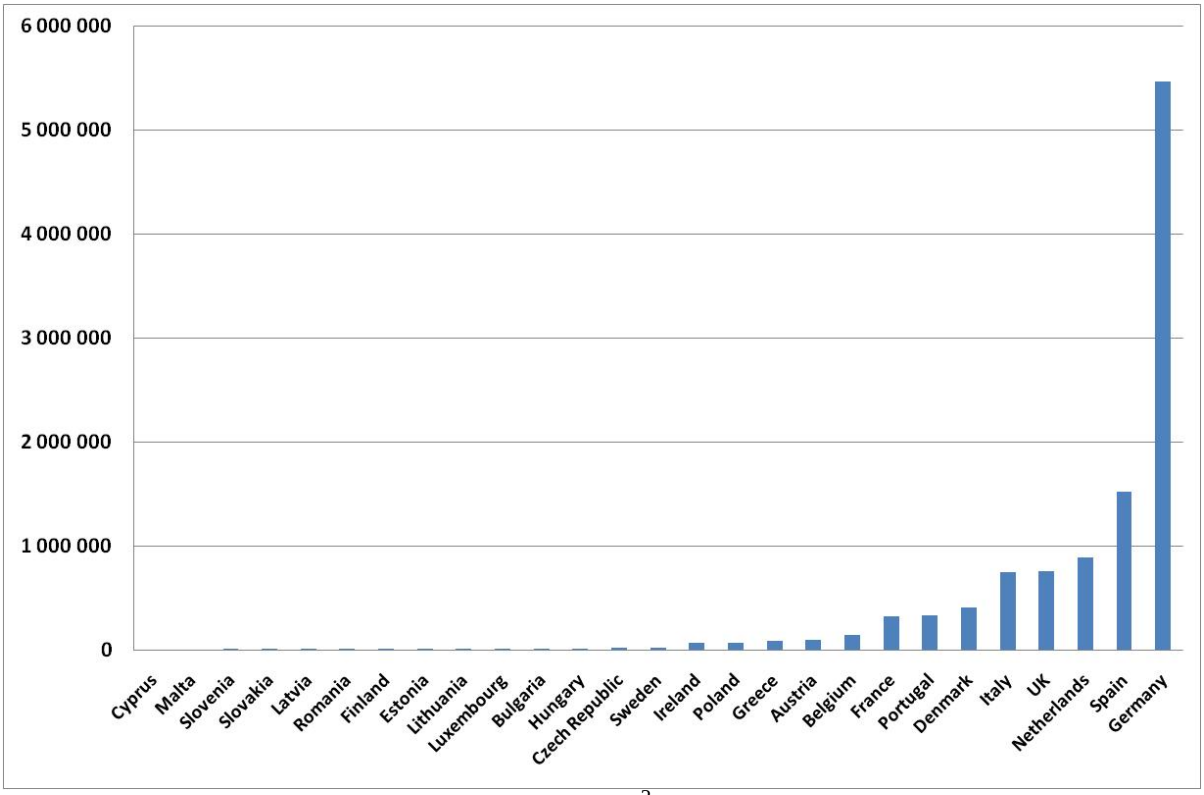

Figure 1: Population per square kilometer (km^2) multiple installed wind power capacity (MW) per each EU 27 country by the end of 2008 (9; 10)

According to figure 1 there are intensity factor about 2 200 in Finland. At the same time that factor is 888 000 in Netherlands, 1 520 000 in Spain and 5 472 000 in Germany. This means that the people experience different amounts of wind power in their everyday life depending on where in Europe they live. Maarten Wolsink (23) has researched how the wind power unit and also wind power park acceptability changes in different project phases.

Typically preparation for energy production investments can take several years, even a decade. Respectively the building stage takes typically from a year to five years and the production stage from several years to decades (cf. wind, nuclear and hydro power). This means that already during the planning process the framework can be changing. This creates a considerable uncertainty on how the operating conditions for energy power plants evolve over the years and decades.

The goal of the research

The goal of this research is to evaluate and analyze the factors that have an effect on the acceptability of wind power investment in decisions making situation. This research is restricted to apply only to wind power acceptability, because technological options are similar worldwide and economical profitability depends on each country's legislative framework. Evaluation is made by examining the acceptance of wind power projects in countries where the level of built wind power per surface area is relatively low in EU level but still produces remarkable amounts of wind power related technological products (workplace affect).

Niiniluoto (21) has used example the following formula with six Es in assessing (Technology Assessment) information and communication technology (ICT) and the qualities of technologies:

$$Technology\ Assessment = (Efficiency\ x\ Economy\ x\ Ergonomics\ x\ Ecology\ x\ Esthetics\ x\ Ethics) + Social\ consequences$$

The purpose of the formula is to make clear what factors have to be taken into account when launching ICT products. Because of the nature of the Formula, any of the Es cannot be left without consideration so that the qualities of the technology can meet the needs of the consumer.

From an ecological point of view there are several models that can be used in reviewing the consequences of the project. These models are for example the IPAT (12) and ImPACT-model (22). York et al. (24) have researched the detailed differences between these two models.

By utilizing these existing models, a specific and innovation formula can be constructed to wind power industry. With the help of the model the investment decision conditions of wind power construction can be assessed. The model consists of three factors: A= acceptance, E=economy and T=technology. In this research the model is called TEA-model.

When considering energy production projects innovation TEA-model points out on what technological (T) choices the investor can affect on. Economics (E) of the project are influenced by the price of energy, taxation and other economical and political guidelines. The acceptance (A) of the project is influenced by several outside factors, which are considered in this research.

In wind power industry TEA-model can also be reviewed as an equation:

$$F(x) = T(x) * E(x) * A(x)$$

$$0 \leq T(x) \leq 1$$

$$0 \leq E(x) \leq 1$$

$$0 \leq A(x) \leq 1$$

If $F(x) > 0$, a lot of wind power construction is taking place in the area in question. If $F(x) = 0$, wind power construction is not possible in the area.

The equation means that building wind power is possible if it is technically possible, it meets economical conditions and the project has general acceptance. Some of the factors can be left out of the equation on the grounds of obligations and entitlements based on local legislative decisions.

It can also be assumed that the same wind power technology is available everywhere in the area in question. This means that it doesn't explain the differences between countries in building wind power (see figure 1). Therefore TEA-model can be simplified in to $F(x) \sim E(x) * A(x)$.

Uncertain operating environment affects on the economical risk margins of the project and thereby required profit expectations. Anthoff and Tol (3) have researched the complexity of the planning by examining expectations for return on investment in different locations.

The large amount of technological solutions is part of the uncertainty of operating environment. When examining the development of sustainable energy production Lund (19) has found three starting points: savings in energy consumption will be remarkable when examining consumption (5; 18); energy production should be more and more efficient (16; 17); fossil fuels will be replaced by renewable energy fuels (1; 2). EU's climate and energy political decisions also support these three points (6; 7).

Wind power investments are typical capital intensive investments. The fixed costs are remarkable compared to variable costs. The length of absolute lifecycle of investments has a great impact on the profitability.

This also has a great affect on assessing the risk that has an impact on the whole profitability of the project. The framework of future is hard to asses and therefore the influence it has on energy investments future profits and costs structure.

With the technological choices of the energy production method it is possible to impact on the cost efficiency and therefore profitability. The relative efficiency of energy production in relation to investments in the long run tells about the efficiency of the production method.

RESEARCH DESIGN, STRATEGY AND THEORETICAL FRAMEWORK

The design of this research has been constructed so that it meets the epistemological and ontological world of the research. Research epistemology addresses how we come to know the reality by identifying the particular practices. Respectively ontology explains the relation of the research to the real world. Epistemological topic definitions are made in the part that

concerns the goals of the research. Ontological part is being answered trough observations that are made based on the research results. Empirical observations of the research increase the ontological relation to the real world.

In this research, an innovative and theoretically justified solution is created for a practical problem. Research approaches that are used in economic sciences can be classified with different methods. Neilimo and Näsi (20) have identified four different research approaches: nomothetical, decision oriented, action oriented and conceptual. Kasanen, Lukka and Siitonen added a constructive approach to the list above in their publication in 1993 (15). Respectively Arbnor and Bjerke (4) have identified three methodological approaches through the debates concerning research paradigms (figure 2).

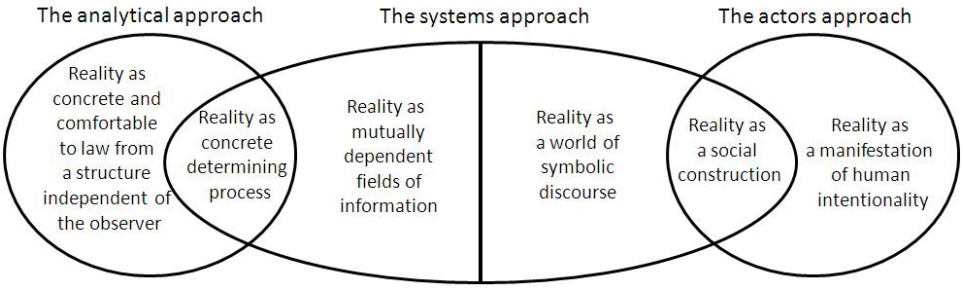

Figure 2: The three methodological approaches (4)

This research has features from several different research approaches. According to Neilimo's and Näsi's (20) definitions the research is closest to action oriented research approach. According to Neilimo and Näsi (20) characteristics of action research are the following

- teleological explaining method,
- action science,
- the goal is to understand,
- empirical part usually consists of only few units,
- there is no established methodological rules and
- results are often concept systems.

Respectively when reviewing the research with Arbnor's and Bjerke's (4) definitions the approach is closest to systems approach.

This research is constructed around qualitative research approach. In a qualitative research the goal is to understand the researched phenomenon. This means determining the meaning or purpose of the phenomenon and constituting a deeper conception on the topic (11).

In this research, empirical data was collected by using formal questionnaires and by using the researcher's observations including informal discussions. 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 (15).

The research method is an action research in which the research is combined with existing theoretical knowledge and after that empirical results are compared with existing theory. The external validity of the model has been tested with a "weak" market test including a questionnaire for citizens. The internal validity of the model was tested by raising the amount of applicants.

BUILDING THE RESEARCH METHOD

This research focuses on analyzing the acceptance of wind power and strategic decision making in changing operation environment. This is new because researched focusing country where wind power is quite new and viewpoint is different than researched which focusing general public acceptance or how to the acceptance develops during the project (8; 23).

The research method is based on large survey conducted by random sample in which the respondents were asked about their background, experiences and their ideas about future of energy industry in general and especially about wind power.

Research data was collected by a separate questionnaire. The questionnaire was implemented in native tongue of the respondents. (Finnish and Swedish). Questionnaire was targeted by a random sample so that it considered a real wind power plant and real project plans in Finland. Background of the respondent was examined and the fact if the respondent was able to see the planned wind power plant from his property. As an appendix of the questionnaire a report about the wind power plant and its details was delivered to the respondents so that they were able to relate their own positions toward the project.

The key questions focus on each

- project area and the familiarity of the respondent with and the use of the area,
- experiences of the respondent on wind power plants,
- attitude of the respondent toward different energy production modes,
- views of the respondent on the current stage of their living environment, the project and its impacts and
- background information of the respondent.

Questionnaire was constructed with the help of TEA-model so that the sub-groups of Acceptance (A) factors, which are required for external acceptance, were analyzed from the standpoint of wind power projects.

Planned wind power plants are located in an area, where there already exists a component industry that focuses on energy production. This means that the research focuses on areas where there already are wind power related jobs even though there is not a lot of wind power production.

RESULTS AND ANALYSIS

This research was conducted in Finland, in the area of western Finland, where the wind power industry has mainly focused. The results of the research form around nine different

wind power projects. People for this research were selected by a random sample selection and a standardized questionnaire was used in order to raise the quality of the answers.

The questionnaires were delivered by a random sample to households located near the project areas in spring and summer 2009. 2 782 persons answered the questionnaire; answering percentage was 30 per cent. 39 per cent of the respondents were females and 61 per cent males. The most active age group was 51-65 year olds.

The answers were gathered concerning both land and offshore wind power projects. Land wind power projects were quantitatively more but unit sizes were smaller than in offshore wind power projects. The impact factors were divided into positive and negative impacts. The questionnaire was conducted in a two-way manner so that the respondent was able to determine the level of negative or positive response.

In examining the positive impacts of wind power plants, separate surveys were made considering the impacts on image and economy of the city, employment rate and climate change. The results were compared between two groups; the respondents who have direct view to the wind power plants and the respondents who have not.

One interesting fact is that on the base of the research results the respondents expect that wind power plants have relatively more positive impact on the image and economy of the city and employment rate than on climate change. Other significant fact is that the direct view to the wind power plant has no remarkable significance when analyzing the positive impacts.

Respectively when analyzing negative impacts of wind power plants based on landscape, birdlife, cultural environment, residential satisfaction and noise it can be seen that the negative impacts accentuate among the respondents who have direct view to the plant. The negative impacts are largest among birdlife and landscape.

In addition to negative and positive impacts the respondents were asked how energy should be produced in the future in Finland. The citizens would like to have new wind power plants (72%), new incineration plants (42%) and new power plants in biofuels (41%) (figure 3).

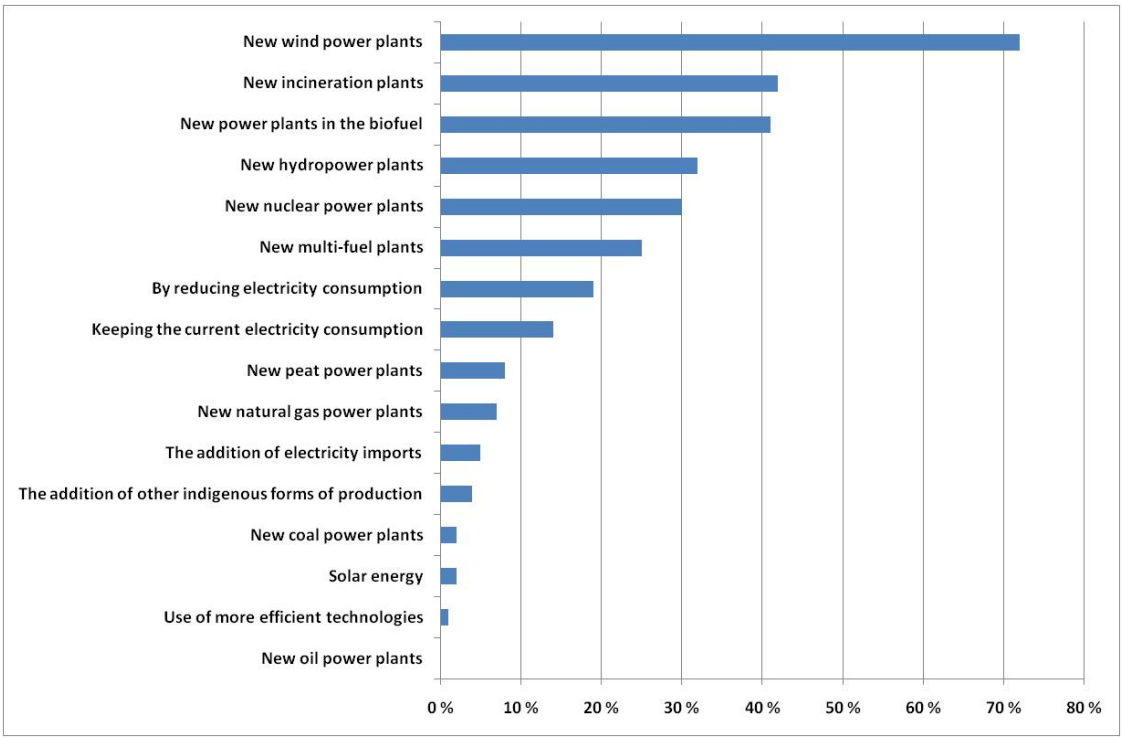

Figure 3: The desired way to produce future energy in Finland (n=2534)

When reviewing energy production in Finland on a general level, the respondents had the chance to comment energy production in general and therefore the weight towards the nearby designed wind power plant decreased. The results show that wind power is supported in general but not so strongly in nearby areas.

When accounting the Acceptance (A) factor, which is a precondition for realization of wind power plants, a clear connection is found between the two respondent groups: the ones who have direct view to the plant and the ones that have not. The location of the plant clearly has an effect on the attitude of the respondent towards the plant.

The accounting was implemented by transferring the responses of Acceptance factors into numerical form:

highly negative	0
rather negative	0.25
no effect	0.5
rather positive	0.75 and
highly positive	1.

Based on the responses a weighted average of Acceptance factors was calculated between two different respondent groups.

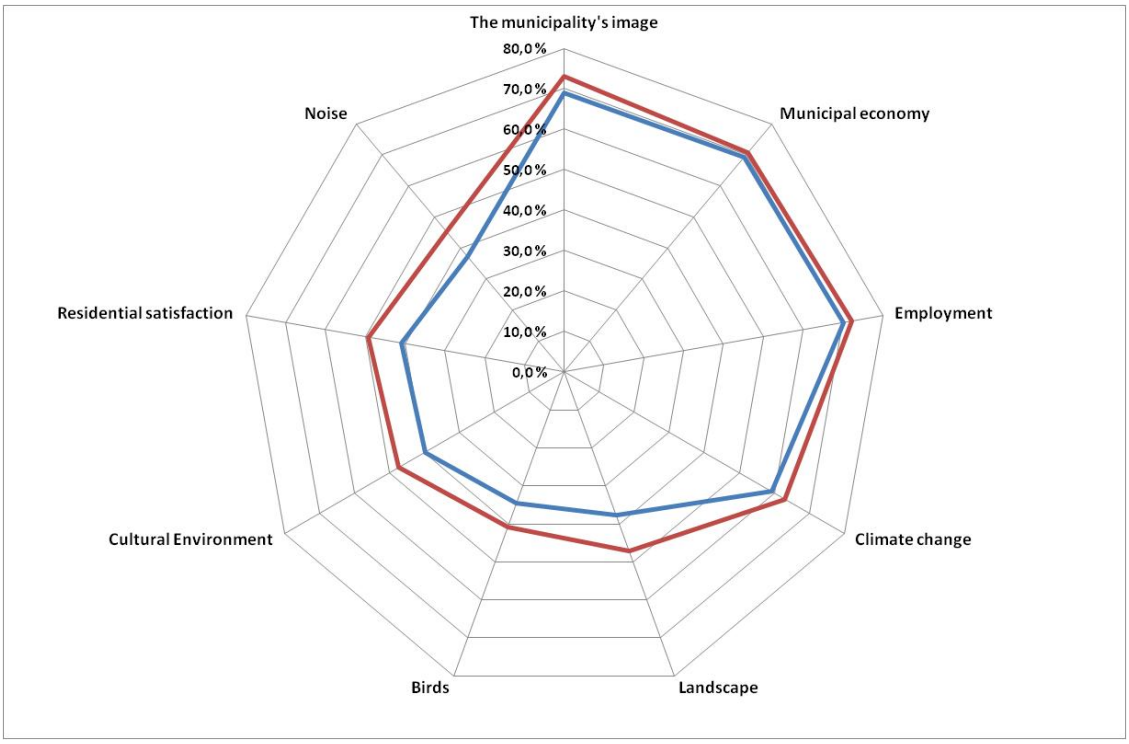

Figure 4: Differences on Acceptance factors of wind power between the respondent groups who live nearby the project area who have not direct view to the project area (red line) and who have direct view to the wind power plant (blue line)

According to the research 72 per cent of the respondents support wind power on a general level (compare figure 3). Respectively when examining the Acceptance factors among the group who live nearby the wind projects the support rate is 56.7 per cent and 50.9 per cent among those who have direct view to the project area (figure 4). Significant fact is that when reviewing group who have direct view to the project area, the impacts were seen more negative in every single Acceptance factor.

When reviewing the relative differences of the results between two different respondent groups, especially the impacts on landscape, residential satisfaction and noise come up. Irrespective of the respondent group the impacts on employment and municipal economy are seen parallel within both groups. Figure 5 clarifies the relative differences in the answers of two respondent groups: the ones who have direct view to the planned plant and the ones who have not.

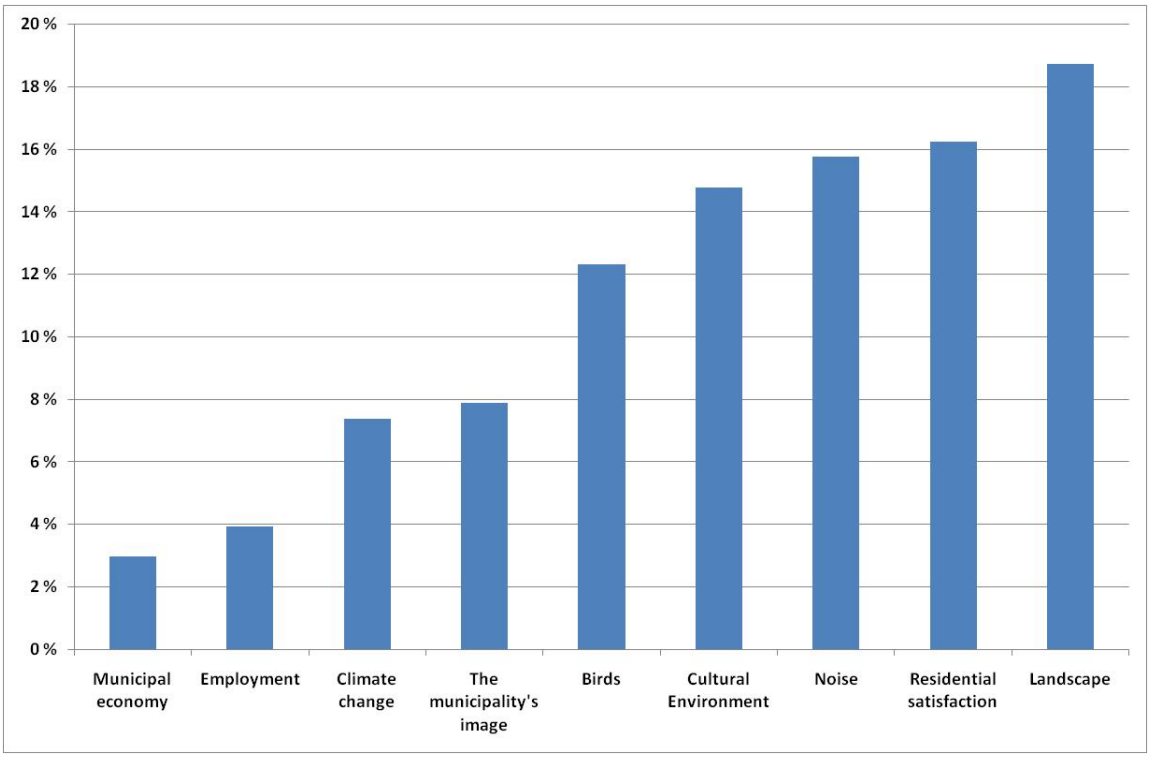

Figure 5: The relative difference of respondent groups on different impacts

According to the research results it can be seen that general acceptance for building wind power is on a relatively high level in Finland. The closer to the planned wind power plant people live the more the acceptance rate decreases.

Hence on the grounds of the research results the original TEA-model formula $F(x) = T(x) * E(x) * A(x)$ can be defined so that factor A(x) is dependent on the population rate in the area where wind power construction is being planned at. The effect of this factor can be reduced by legislative control.

Respectively economical means (factor E(x)) can be utilized in growing wind power construction. This means for example better ability to pay compensation for the people that are harmed by the project.

EVALUATION OF RESULTS AND FURTHER RESEARCH

At the moment wind power is something quite new in Finland. Finland has the thirteenth least installed wind power in Europe in 2008. The current energy and climate politics support the increase of renewable energy sources in EU and also Finland.

The results of the research are based on vast questionnaire partly conducted in areas in where there are plans for wind power parks. Based on the results it can be seen that Finns are ready for building of wind power, especially in cases where the plant is not planned in the nearby area of their property.

The research material was gathered by mail delivered questionnaire. In this research citizens were asked on their opinions about the wind power by several different questions. The research is partly quantitative and partly qualitative.

When reviewing the quantitative part of the research the validity and reliability of the methodologies of information gathering are crucial for research results. In this research the reliability was raised by measuring the same factor with several variables. Special attention was paid to most crucial factors, which delivered new scientific information for scientific discussions. Validity was tested by using evaluations of experts in the industry on how the asked questions measure the examined factor.

In wind power industry innovation TEA-model equation $F(x) = T(x) * E(x) * A(x)$ means that wind power construction comes possible if the building process is technically possible, if economical conditions are met and the project has general acceptability. Some of the factors in the equation can be disregarded on the grounds of legislative obligations and authorizations.

It can also be presumed that same wind power technology is available everywhere. Therefore it does not explain differences in wind power construction between countries (see figure 1). Hence TEA-model equation can be simplified into form $F(x) \sim E(x) * A(x)$. The acceptability factor A(x) of the equation is dependent on the population rate in the project area and the country's legislation. With economical factor E(x) it is possible to influence on factor A(x), so that the conditions for the investment are met.

Possibilities for further research are deepening the research results and improving the quality by conducting the surveys on every area where there are plans for wind power parks in Finland. It is also possible to widen the research by making international comparison between different countries.

CONCLUSION

The objective of the research was to evaluate and analyze the factors that have an effect on the acceptance of wind power and thereby on the conditions of investment decisions. The examination was made on three different levels: by examining the general acceptance of wind power, the acceptance in areas where wind power parks are planned and the attitude of those who have direct view to the planned park.

The goals that were set for the research were achieved. Based on the research it was found out that in a country where there is little wind power relative to surface area, the attitude towards wind power is mainly positive. The closer to the planned plant people live, the more the positive attitudes decrease. On deciding on the international emission reduction not only economical factors should be taken into account but also the impacts of general acceptance of wind power.

The research results help decision makers to learn the piece of the framework around building wind power and especially in Finland. The research is a contribution to science because they fulfill the goal that was set for this research and the research results fulfill scientific debate on

construction of energy production modes, especially wind power, from investors' point of view. This work links also to the existing scientific research.

In the future the research can be broadening to cover different countries. Comparison can also be made within the country in relation to time and examine more deeply how E(x) and A(x) are dependent on each other in different countries at different times.

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COMPARISON OF COMMERCIAL ERP AND OPEN SOURCE ERP IN PRODUCTION PLANNING AND CONTROL MODULE

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ABSTRACT

An Enterprise Resource Planning (ERP) program is regarded as factory operating system. Due to a trend of using information technology in improving organization and the lower cost of information technology device, a lot of Small & Medium Enterprises (SMEs) have implemented the ERP systems in resent yeas. One of the obstacles in implementing computerized factory management system such as ERP for SMEs is the implementation cost. Currently, the ERP market is still dominated by big and expensive products such as SAP or Oracle. In 2007, SAP had 42% market share of ERP license and 27% of total ERP implementation market share. Therefore, many SMEs has looked into cost sensitive alternative, in this case, an open source ERP.

This research intends to access the gap and study the difference between SAP ERP package, the well-known open source ERP called "Openbravo", and theoretical framework in production planning and control proposed by APICS (the Association for Operations Management). The results of this research can be used as recommendations or guidelines for SMEs in implementing the open source ERP to achieve the similar results in production planning and control as SAP implementation. Based on the gap analysis, both of ERP packages: SAP and Openbravo, do not complied with APICS framework. However, most of SAP workflows in its production control module follow the APICS production planning and control framework except the supply plan. SAP only focuses on the finished product demand and its relationship with sale history and demand forecast. Supply plan is recommended by APICS framework which is a report the shows all available capacity of resources. The planners will able to see how much they can increase or decrease demand. The supply plan will help planner to quickly analyze and respond to management & marketing changes in strategy or execution. Unlike SAP, Openbravo has many missing features comparing to APICS framework. The significant missing features are the manufacturing resource planning and analysis such as rough cut capacity planning and capacity requirement planning. In other words, Openbravo is generally has a weakness in implementing MRP II concept (known as Manufacturing Resource Planning). However, this weakness does not lead to the conclusion that SMEs should avoid using Openbravo when manufacturing resource analysis is critical. Instead, a small program or application, such as spreadsheet, should be developed and linked with Openbravo database in order to analyze the capacity required by each resource in each production period.

Keywords: Open source ERP, MRP, MRPII, SAP, Production planning and control

1. INTRODUCTION

An Enterprise Resource Planning (ERP) program is regarded as factory operating system. Most of the large and successful companies commonly implemented the ERP application in their organizations. Similarly, the Small and Medium Enterprises (SMEs) also considered the benefits of implementing information technology like ERP to increase the effectiveness of their operations. Due to the trend of lowering cost of information technology device, a lot of SMES have implemented the ERP systems in resent yeas. One of the obstacles in implementing computerized factory management system such as ERP for SMEs is the implementation cost. Currently, the ERP market is still dominated by big and expensive products such as SAP or Oracle. In 2007, SAP had 42% market share of ERP license and 27% of total ERP implementation market share (Jacobson et. al., 2007). Therefore, many SMEs has looked into cost sensitive alternative, in this case, an open source ERP.

Recently, the open-source ERP have become a popular alternative and widely been implemented among small and medium enterprises (SMEs) due to a lower cost in particular license fees. In addition, source codes of open-source ERP always visible and available to download. Developers of each company can modify the program to be suitable for their business. The open source ERP vendor, Openbravo S.L., is selected as open source ERP application in this research. The Openbravo S.L. provides two software solutions which are ERP and POS (Point of sale). The ERP program is fully web-based system, so that the users can access the system from anywhere, if they have an internet connection. Head office of Openbravo S.L is in Spain. The company revenues are from sale and delivery of services to their partners around the world. Some service types are fee-based, like training, supporting, custom development, consultancy and providing an important source (McConnachie, 2007). The reason of selecting this vendor is Openbravo ERP is the successful installing in SME business (Serrano and Sarriegi, 2006), and it has the highest downloads and project activities in 2007 (Johansson and Sudzina, 2008). It represents that this ERP vendor has high potential grasping the market share from any other open-source vendors or even license ERP vendors.

Open source ERP	November 27	September 13	Downloads during ten weeks	Start of the project
Compiere	1,296,098	1,267,160	+28,938	June 8, 2001
OpenBravo	401,262	300,716	+100,546	March 9, 2006
Opentaps	311,964	284,429	+27,535	August 10, 2005
Facturalux	235,897	231,031	+4,866	September 1, 2006
WebERP	149,010	138,064	+10,946	January 7, 2003
TinyERP	21,116	6,953	+14,163	March 25, 2005

Figure 1. Number of Downloads of open-source ERPs 2007
Source: ERP systems and open source: an initial review and some implications for SMEs (B. Johansson and F. Sudzina, 2008)

Although an idea ERP system should support the majority of enterprise business process, the production planning is the most complicated area for manufacturing company. Due to

changing demand and strategy, most of companies prefer flexible system more than constraint-based logical planning. SAP provides Production Planning and Control module (PP) which are many planning base such as discrete manufacturing or shop floor production, Repetitive manufacturing, Process manufacturing, Kanban and Engineering to order production. On the other hand Openbravo provides Material Requirement Planning module (MRP) and Production Management module (PM) which is orientated toward covering the usual necessities of a discrete production environment.

	Average Number of Users	Average Software $'s	Software $'s per User	Average Service $'s	Average SW+Service $'s	Software + Services $'s per User
Infor	104	$237,170	$2,290	$169,035	$406,205	$3,922
Lawson	195	$408,333	$2,086	$383,333	$791,667	$4,044
QAD	148	$328,706	$2,201	$301,633	$630,339	$4,221
Oracle	440	$1,159,091	$2,633	$960,455	$2,119,545	$4,816
SAP	385	$830,033	$2,249	$1,382,500	$2,212,533	$5,995

Source: AberdeenGroup, August 2006

Figure 2 Average Software and Service $'s by Vendor
Source: The Total Cost of ERP Ownership by Aberdeen Group (Jutras C., 2006)

In addition to the cost of SAP, customers have to pay license and service cost for SAP. The total cost is calculated by summation of software cost and service cost. From Figure 2, the company has to pay on the average at least $5,995 per one user. This amount considered as a huge amount in an emerging market such as South East Asia, South Asia, China or Africa.

Therefore, this research offers suggestions about what the SMEs needs to do if the SME want to implement the open source ERP system as cost-wise alternative as SAP implementation. However, the focus of this research is on the production planning and control module. The production planning and control module is considered as a critical module. From Metaxiotis et. al. (2003), they concluded that production planning and control area cover more than one-third of ERP areas. The company will save a lot of money if they use open source program instead. Also, by using APICS production planning and control framework as based line for this comparison, some suggestions about SAP implementation is included in this research.

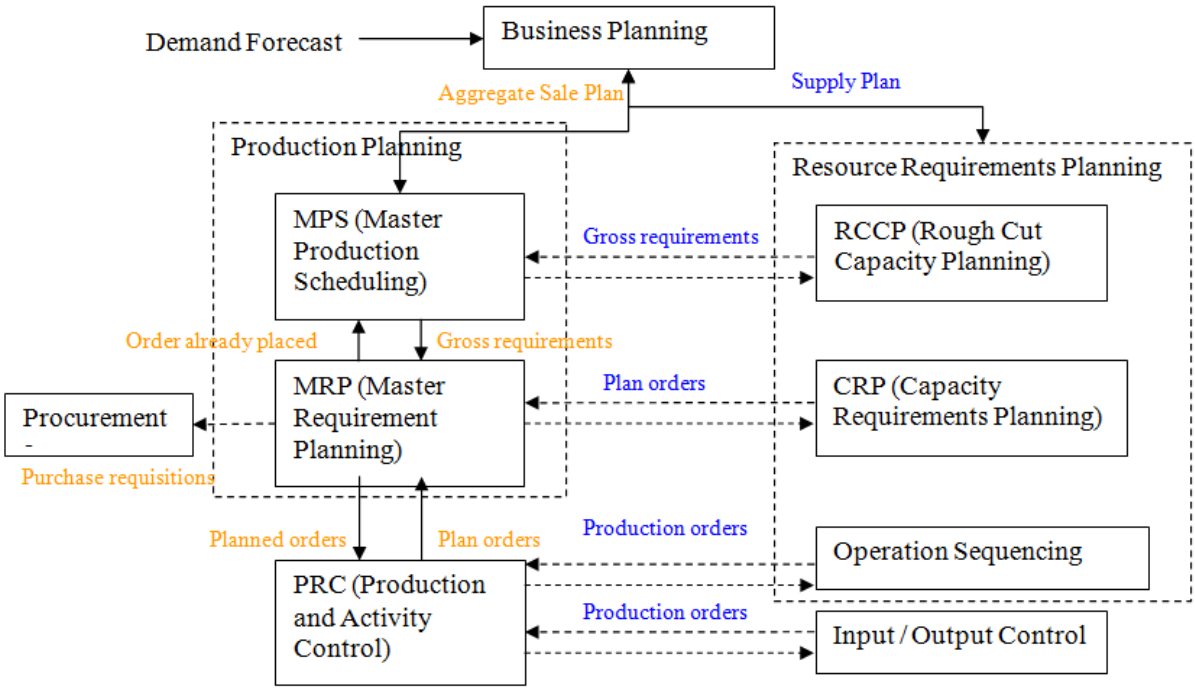

Figure 3 Traditional Material and Capacity Planning Hierarchy
Source: Enterprise Resource Planning and Beyond by APIC

2. PRODUCTION PLANNING AND CONTROL FRAMEWORKS

APICS (The Association for Operations Management) is a not-for-profit international education organization, offering certification programs, training tools and networking opportunities to increase workplace performance. It was founded in 1957 as the American Production and Inventory Control Society, and currently has more than 43,000 individual and corporate members in more than 10,000 companies worldwide. The module Production Planning and Control of APICS is named Traditional Material and Capacity Planning Hierarchy and the framework is as shown in Figure 4.

SAP (System Analysis and Program Development), the highest license revenue share (42%) of ERP license vendors and 27% of total market share in 2007. Recently, SAP officials said there are over 100,600 SAP installations serving more than 41,200 companies in 120 countries. SAP production planning and control framework is as shown in Figure 5.

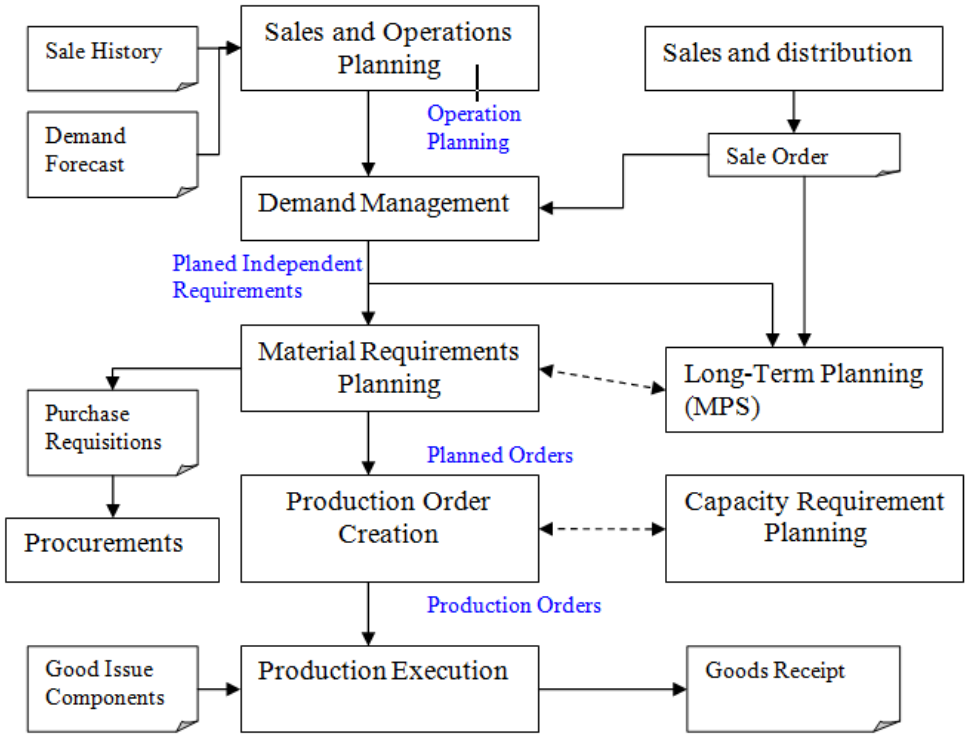

Figure 4 SAP Process in Production planning and Control
Source: Production Planning and Control with SAP® by SAP PRESS

Openbravo is the company that provide open-source software for ERP and POS (Point of Sale). It has the highest download open-source ERP in 2007-2008. Openbravo ERP is a fully web-based and it is the only one system that clearly describe itself as having a focus on SME business. The head office is in Spain. Openbravo has framework in Production Planning and Control area as shown in Figure 6.

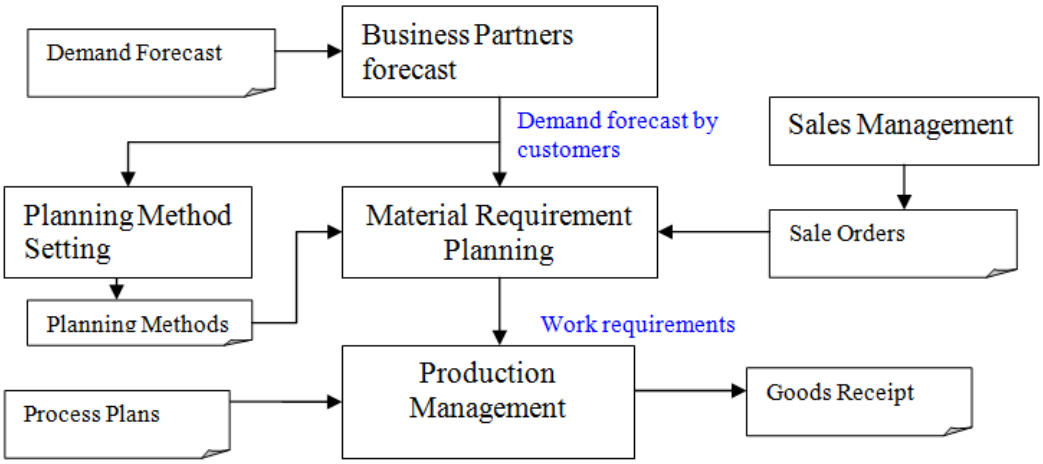

Figure 6 Openbravo framework in Production planning and Control

3. COMPARISON AND ANALYSIS

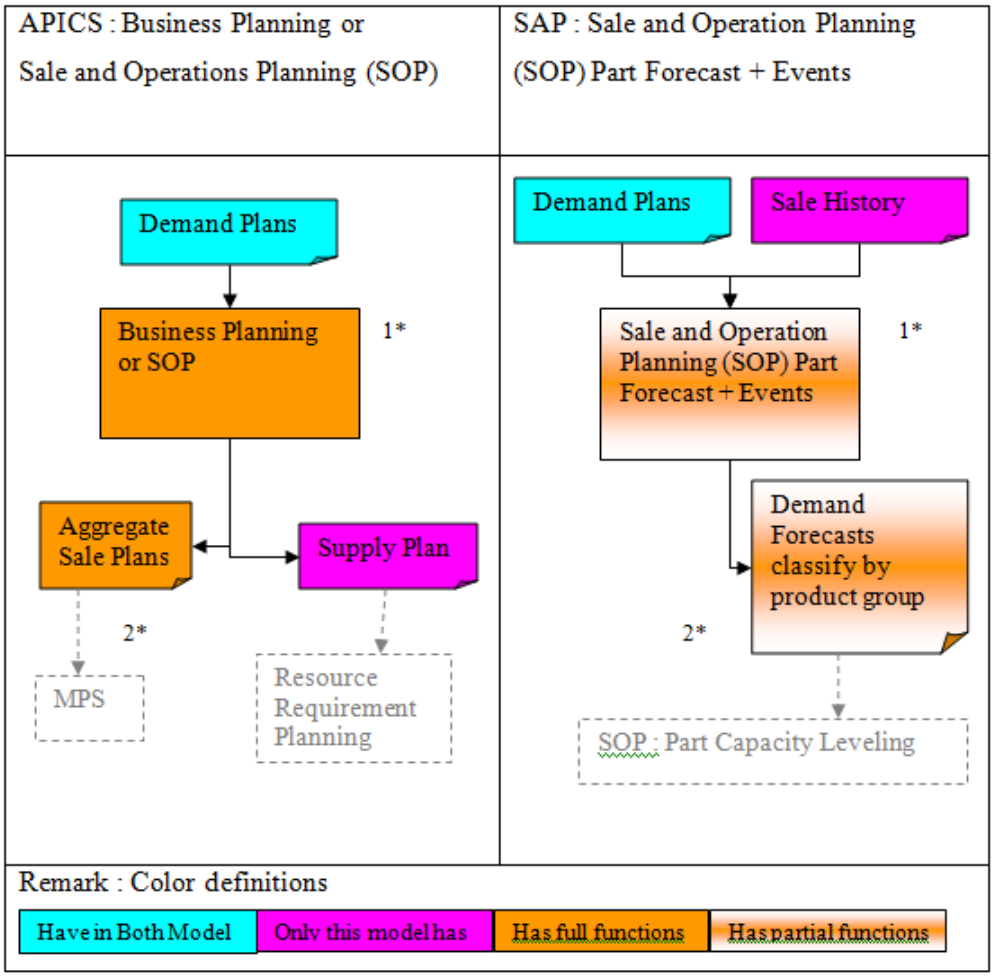

Figure 7 Comparison between APICS framework and SAP workflow

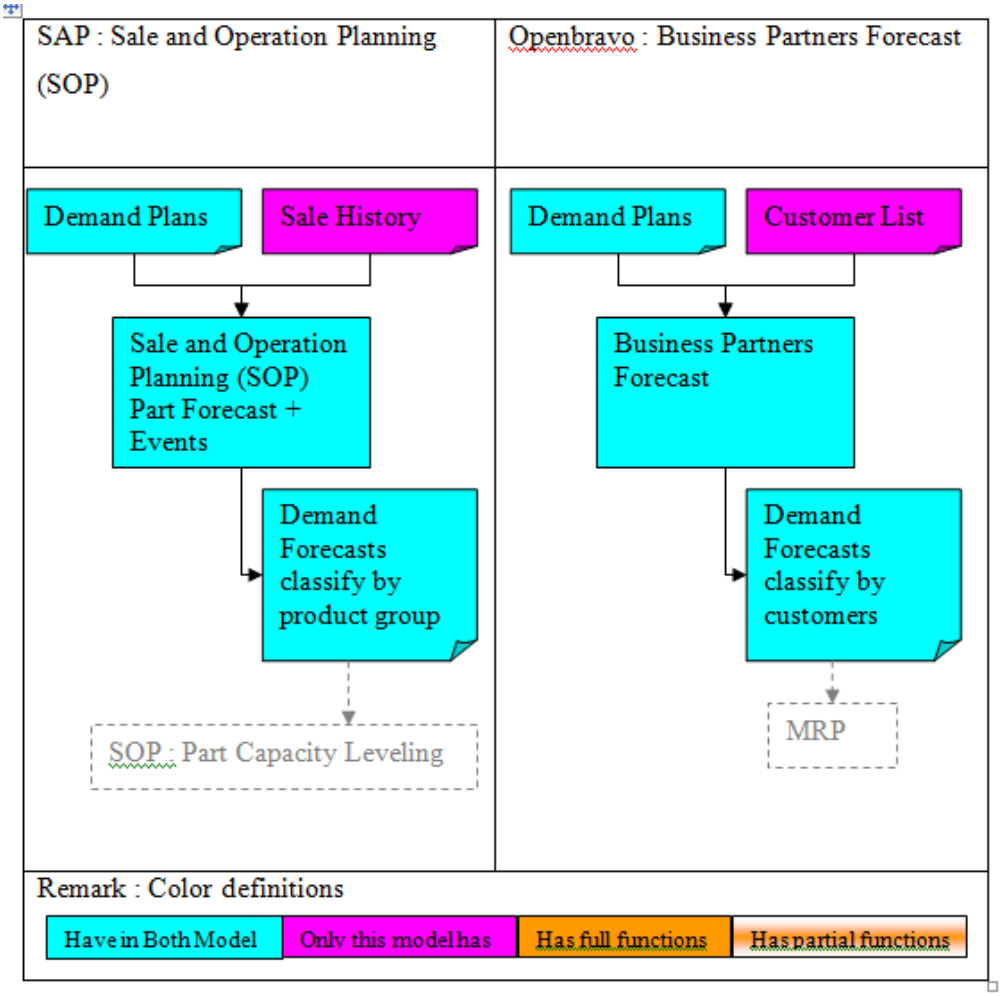

Figure 8 Comparison between SAP and Openbravo workflow

Table 1 Summary data of APICS Business Planning, SAP Sale and Operation Planning (SOP) and Openbravo Business Partners Forecast.

	APICS: Business Planning (Sale and Operations Planning)	SAP: Sale and Operation Planning (SOP)	Openbravo: Business Partners forecast
Purpose	Bring together all the plans for business into one integrated set of plans for minimum 12-18 months.	To define the product type and quantities to be sold for 4-12 months.	To define the product type and quantities to be sold for 4-12 months.
Input	• Demand Forecasts • Production factors • Supply constraints	• Demand Forecasts • Sales History	• Demand forecasts • Customer list
Process explanation	It is reviewed by top management at product group level.	Standard SOP use product groups in conjunction with level by level planning.	It is reviewed outside the system.
Method	• Linear Programming Mixed Integer Programming is in suggestion.	Basic Disaggregation • Level by Level Planning • Hierarchical Production Planning	The users have to created spreadsheet program manually and input to the system classified by customers.
	• Spreadsheet programs using demand and supply to formulate	Special quantity from events will be included in this step.	
Output	• Aggregate Sale Plans • Supply Plan	Demand forecast classify by product group.	Demand forecast classified by customers.

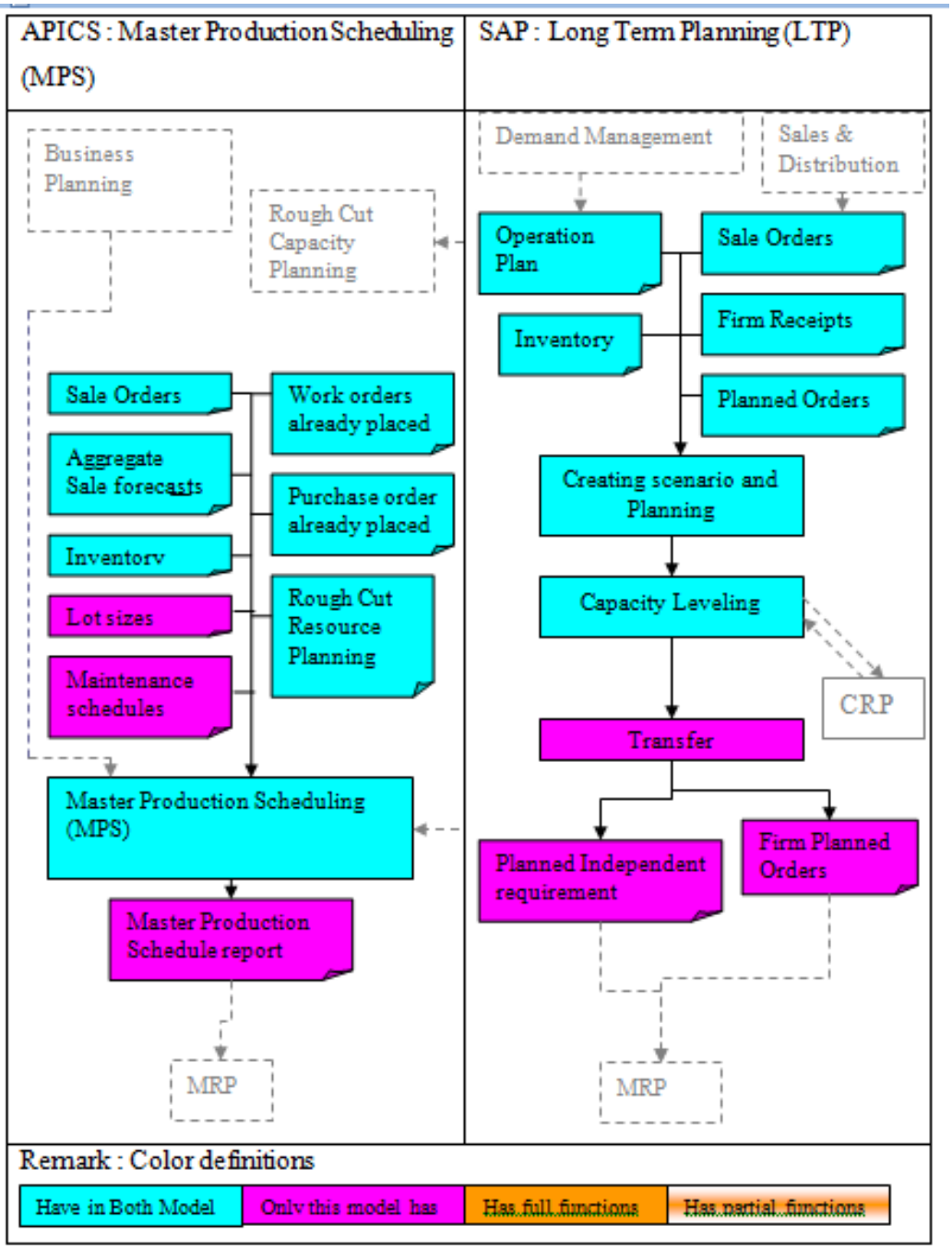

Figure 8 Comparison between APICS Master Production Scheduling framework and SAP Long Term Planning workflow

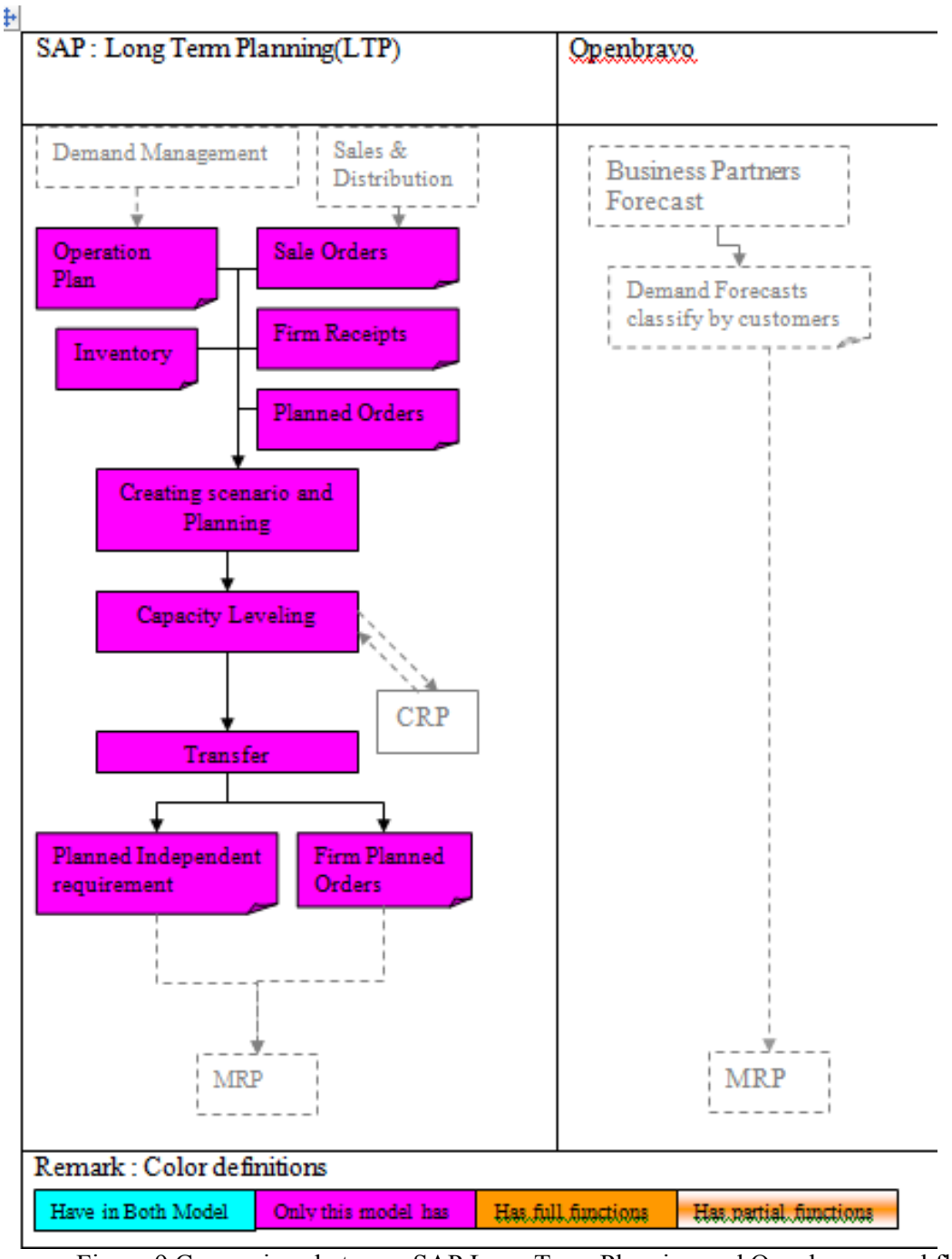

Figure 9 Comparison between SAP Long Term Planning and Openbravo workflow

Table 2 Summary data of APICS Master Production Scheduling (MPS), SAP Long Term Planning (LTP) and Openbravo.

	APICS: Master Production Scheduling	SAP: Long Term Planning (LTP)	Openbravo
Purpose	To plan how many of each item will be manufactured in each period.	To simulate planning on long-term to medium-term requirement and capacity	MPS is not represented in Openbravo. All product classes is calculated in MRP level.
Input	• Sale Orders • Aggregate Sale Plan • Inventory • Work orders already placed • Purchase order already placed • Lot sizes (user define) • Rough Cut Resource Planning • Maintenance schedules	• Planned Independent • requirement (from DM) • Sale orders • Inventory • planned order • Firm receipts	
Process explanation	MPS will be calculated when the available inventory is less than Actual orders or Sale forecasts (use the greater)	The system uses demand from DM which is fixed to calculate next period's plan then check capacity again.	
Method	Order promising On-Hand Available = Previous On-Hand + MPS – Actual order/Sale forecasts (use the larger) + order already placed MPS : Compute when Actual order/Sale forecasts is greater than On-Hand + order already placed, depends on how to define lot sizes. ATP = On-Hand + MPS - ∑Actual before next MPS	• Use Time-Phased record (MPS technique) • Capacity Leveling (To check capacity again)	ATP for Openbravo will represented in Sales Management (SM) Formula: ATP : = On-Hand – Order reserved
Output	Master Production Schedule report	• Planned Independent requirement • Firm planned orders	

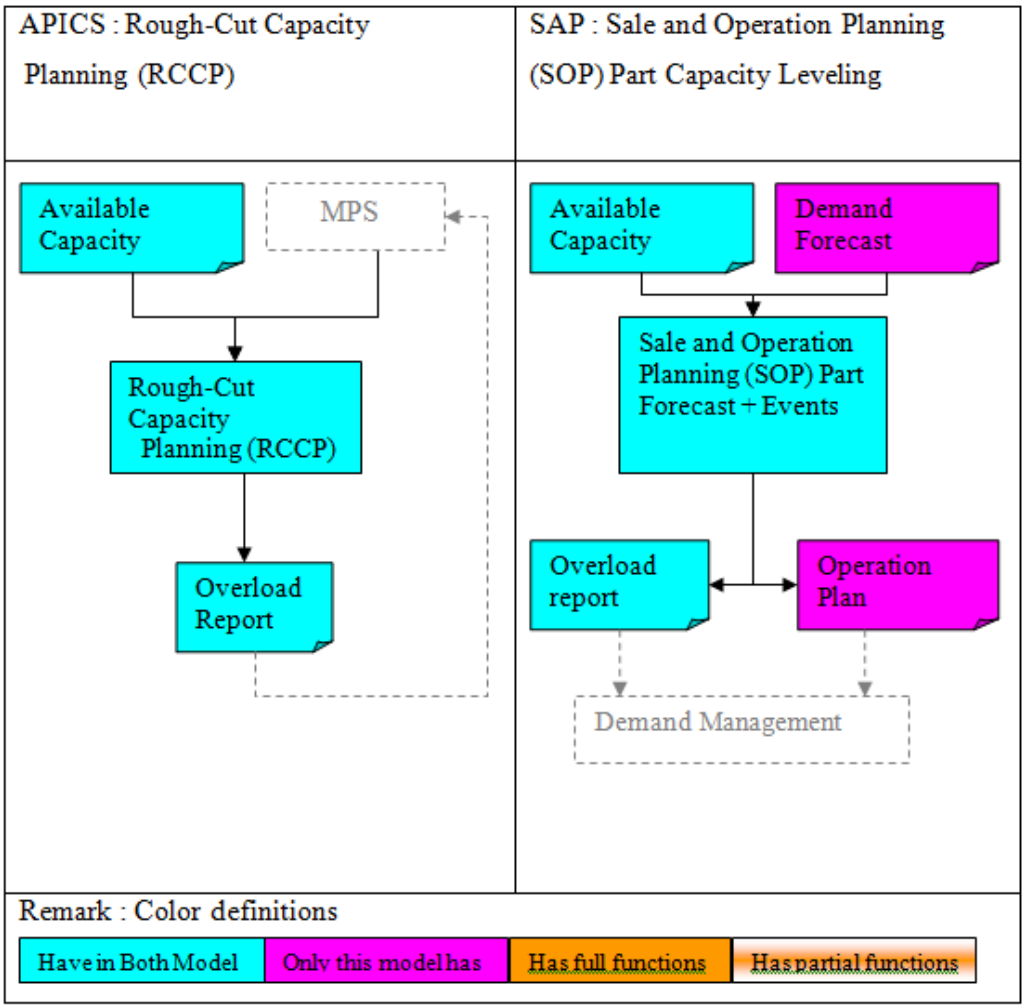

Figure 10 Comparison between APICS Rough-Cut Capacity planning framework and SAP Sale and Operation Part Capacity Leveling workflow

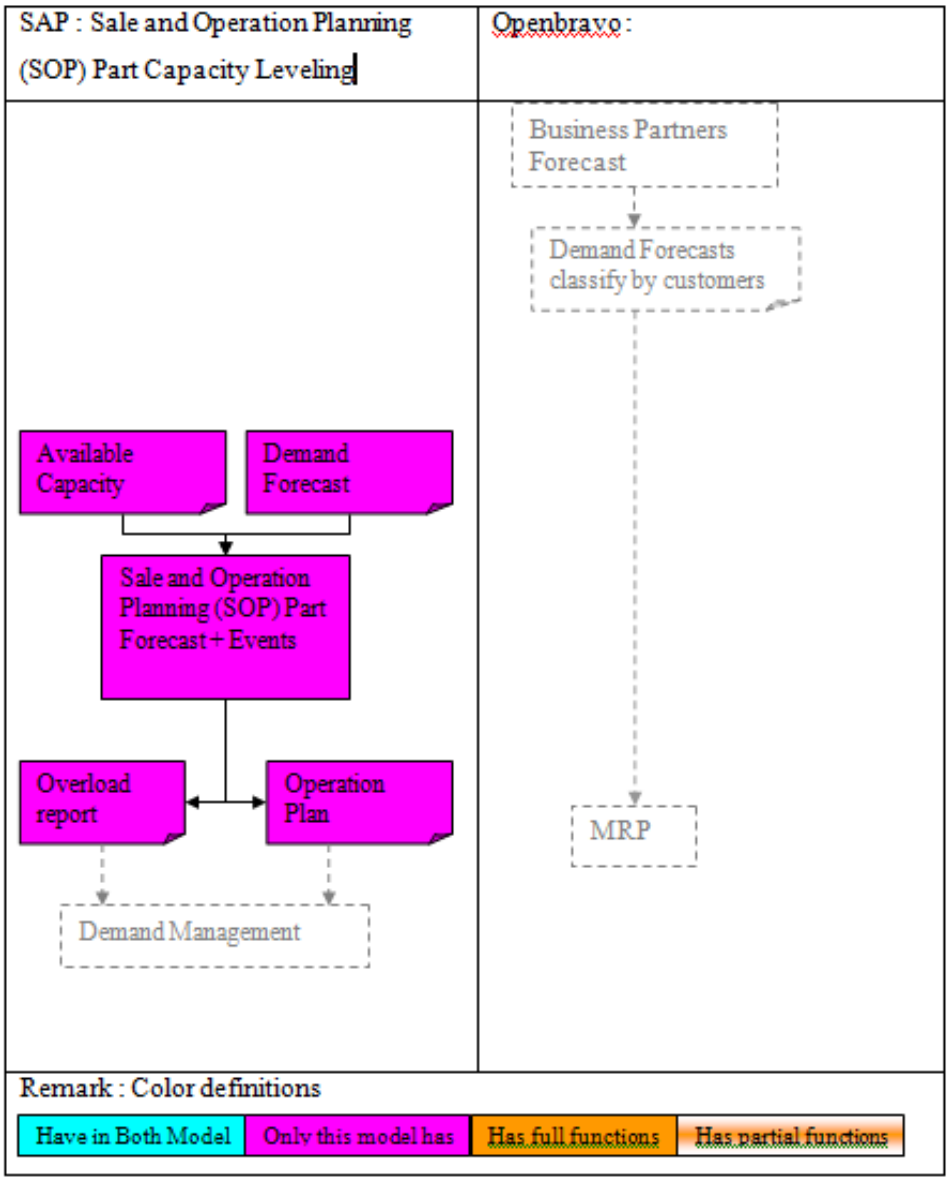

Figure 11 Comparison between SAP Sale and Operation Part Capacity Leveling workflow and Open bravo

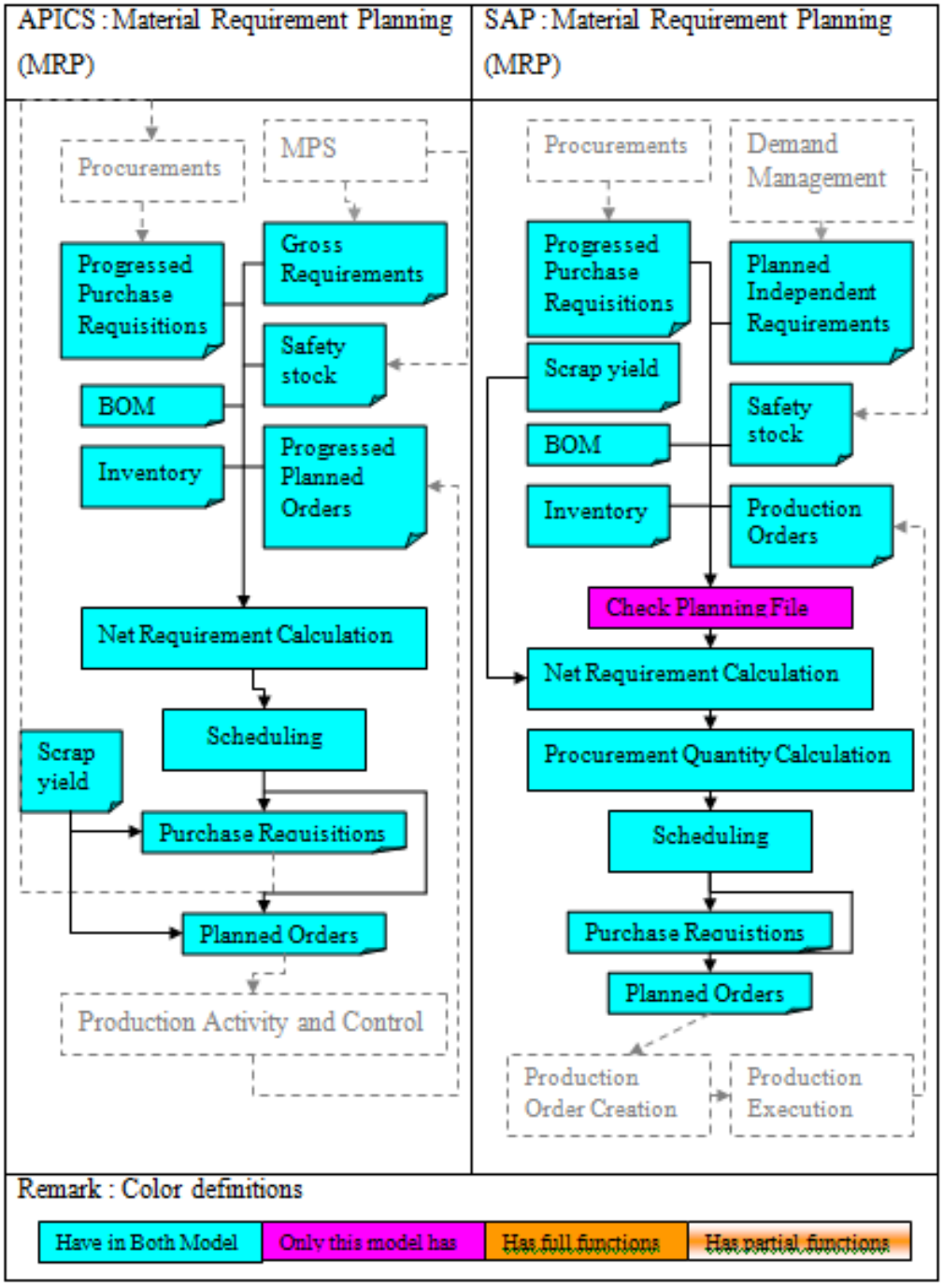

Figure 12 Comparison between APICS MRP framework and SAP MRP workflow

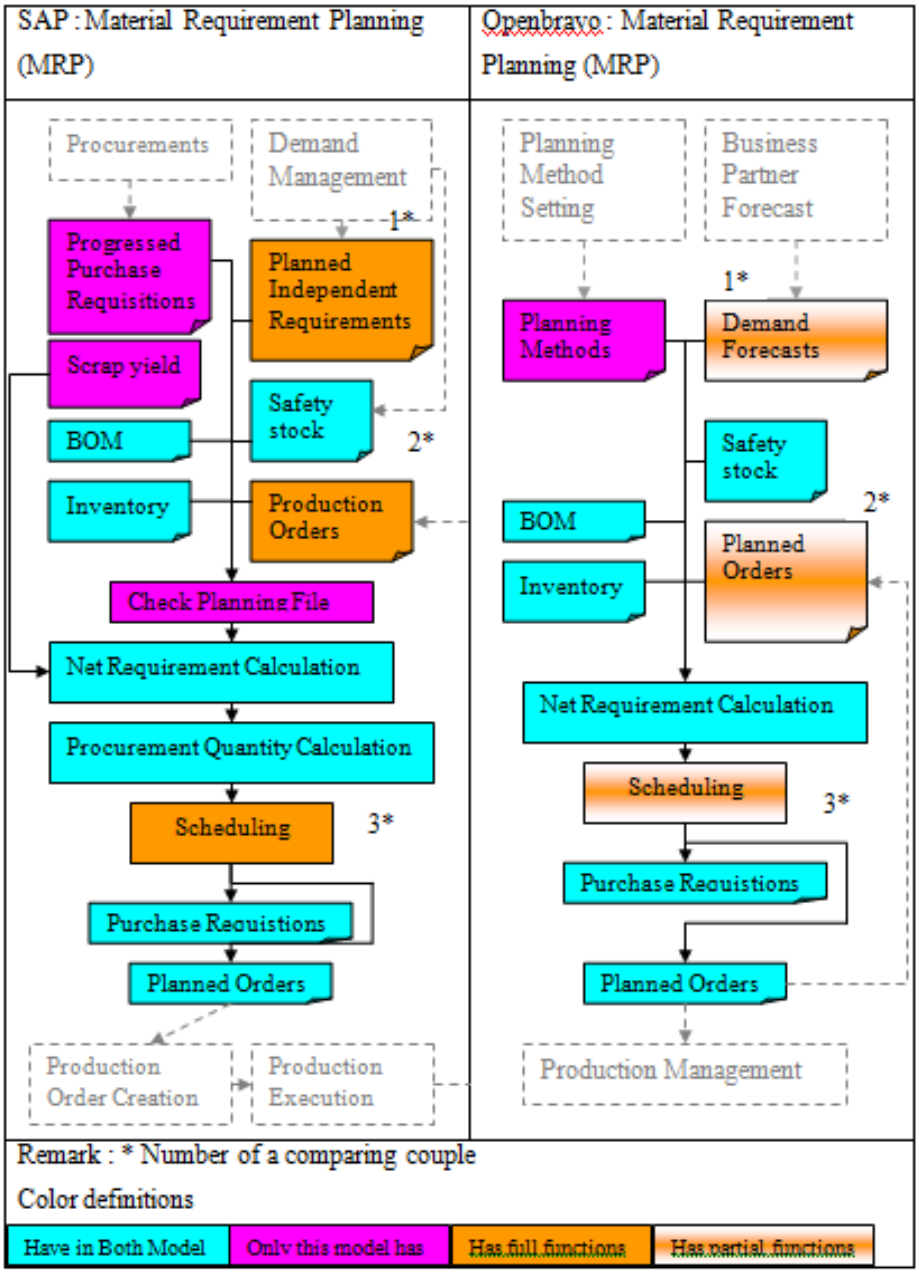

Figure 13 Comparison between SAP MRP and Openbravo MRP workflow

Table 5 Summary data of APICS Material Requirement Planning, SAP Material Requirement Planning and Openbravo Material Requirement Planning.

	APICS: Material Requirement Planning (MRP)	SAP: Material Requirement Planning (MRP)	Openbravo: Material Requirement Planning (MRP)
Purpose	To produce right item, in the right quantity, at the right time	To calculate net requirements of materials to fulfill demand program and create planned order.	To created work requirements and material requirements base on product demand.
Input	• MPS (Gross requirement) • Inventory • Safety stock • Progressed Purchase Requisition • Progressed Planned orders • Scrap yield • BOM	• Planned Independent requirements • Inventory • Safety stock • Progressed Purchase Requisition • Progressed Planned or production orders • Scrap yield • BOM	• Demand Forecasts • Inventory • Safety stock • Planning methods • Planned order (Suggested work requirements) • BOM
Process explanation	Compute Net requirements for each of their components by exploding the BOM.	Compute Net requirements for each of their components by exploding the BOM and determine basic dates again	The product trees are exploded and all products related are planned.

Table 5 (Continued)

	APICS: Material Requirement Planning (MRP)	SAP: Material Requirement Planning (MRP)	Openbravo: Material Requirement Planning
Method	Formula : Project Available = Previous + Schedule receipts + Planned order receipts – Gross requirement – safety stock Net requirements = Negative Project Available Lot size : Fixed, EOQ, lot for lot technique	• Material requirement planning method Available Stock = Plant stock – Safety stock + Planned order receipt + Schedule receipt – Requirement quantity x (1+ scrap yield) Net requirements = Negative Available stock • Backward scheduling method Lot sizes: SAP provide over 13 selection lot sizes including EOQ and fixed lot size.	Formula : Net requirements = Demand forecast+ Safety stock – Inventory – Planned Orders Proposal lot size : Selecting • Fix lot size and round up • Multiple fixed value • Lot for lot
Output	• Planned orders • Purchase requisition • MRP Reports	• Planned orders • Purchase requisition • MRP reports	• Planned orders (work requirements) • Purchase requisition • MRP reports

Table 6 Summary data of APICS Capacity Requirement Planning , SAP Capacity Requirement Planning and Openbravo.

	APICS: Capacity Requirement Planning (CRP)	SAP: Capacity Requirement Planning (CRP)	Openbravo: Business Partners forecast
Purpose	To predicts which resource will have capacity problems.	To check the feasibility of scheduling and create a sequence of operation.	There is no capacity planning for Openbravo. Users have to calculate outside base on daily capacity and set in product configurations. Formula: Daily capacity = Machine run rate x work hour To avoid overload in one period , before process work requirements user have to check: Work req. qty released ≤ (daily capacity x days of production)
Input	• Planned orders from MRP • Shop Floor control/feedback (delayed orders) • Work center capacity Maintenance schedule • Routings	• Planned orders from MRP • Shop Floor control/feedback (delayed orders) • Work center capacity • Routings	
Process explanation	Find the specific resources base on routings and check which resource constraint will be exceeded	Base on routings ,CRP check the overload of the capacity on each work center .	
Method	Capacity Leveling	Capacity Leveling: Time Consideration. Formula :	

Table 6 (Continued)

	APICS: Capacity Requirement Planning (CRP)	SAP: Capacity Requirement Planning (CRP)	Openbravo: Business Partners forecast
Method (Continued)	Over / Under Load = Delay from the previous + requirement capacity – available capacity Overload : Positive number Underload : Negative number	Capacity Req = (Standard value x Order quantity) / Base quantity Base qty: Max. qty of each work center Standard value: Setup time + Machine time + Labor time The capacity will not allowed to confirm if it is overload.	
Output	• Planned orders • The alarms or reports show which resources will have capacity problems	• Planned orders to Long Term Planning • Production orders to Production Order Creation • The alarms or reports show which	

Table 8 Summary of comparison analysis

Models / Functions	APICS	SAP	Openbravo	Remark
SOP	✓	☒☑ 50%	☒☑ 50%	Both SAP and Openbravo should create Supply Plan.
MPS	✓	✓	×	Openbravo user should monitor MPS by providing spreadsheets outside the system.
RCCP	✓	✓	×	Openbravo user should do RCCP by providing spreadsheets outside the system.
MRP	✓	✓	☒☑ 80%	Openbravo should add scheduling process in MRP.
CRP	✓	✓	×	Openbravo should add Capacity Requirement Planning Function.
PAC	✓	✓	☒☑ 80%	Scheduling in PAC can be ignored if Openbravo add it in MRP process
DM	×	✓	☒☑ 50%	This function is not necessary for SME. planning.

Symbol Remark : ✓ Have full function, × Not have function and ☒☑ % Have partial function.

4. CONCLUSION

In Business Planning area, by comparing with APICS model, SAP and Openbravo have partially function because they do not have Supply Plan . SAP and Openbravo have the same process in this area. The method of SAP is automatic while Openbravo is Manual. SME need Supply plan to be a guide line for capacity planning.

In Master Production Scheduling area, by comparing with APICS model, SAP has quite similar approach under the name of Long Term Planning (LTP). For Openbravo, MPS by tagging data from the system and do manually in spreadsheets. Therefore, SME need MPS to be a guide line for sale planning.

In Rough-Cut Capacity Planning, APICS RCCP framework operates data from MPS while SAP operates data from Raw Demand. In contrast, Openbravo does not have Rough-Cut capacity planning. SME should either has rough-cut capacity planning or calculate manually before sending data to MRP.

In Demand Management, APICS does not have Demand management in its ERP definition. By comparing with SAP, Openbravo has one same function that is defining time period for demand. However, there is a chance that demand management is not essential for SME production planning because the demand is less complex.

In Material Requirement Planning, APICS and SAP model have the same MRP process. By comparing with APICS model, Openbravo has partial function due to Demand data is raw and no scheduling theory in Openbravo. There is rough scheduling in Openbravo related with daily capacity of each product. However, most of the SMEs need only the net requirement process, but for scheduling, it can do manually. Since detail scheduling is the most complex process in ERP. The system needs more resources to create this function.

In Capacity Requirement Planning, both APICS and SAP model have Capacity Requirement Planning but different methods. Openbravo does not have Capacity Requirement Planning. If the production ro Capacity Requirement for SME is not essential in case of there is a supply plan using as guide line.

In shop floor control, APICS does not define details in shop-floor due to they are depend on individual specific for each ERP. SAP has all APICS requirements. Openbravo does not have scheduling in shop-floor control. SAP and Openbravo shop floor processes are totally different after releasing orders. Scheduling in Shop Floor is not essential for SME.

5. RECOMMENDATION

According to the conclusion from the previous part SAP and Openbravo have some recommendations to develop by following APICS model.

For SAP Production Planning and Control, although it can operate in SME but one of component that SAP should create for planners is supply plan. Supply plan is the report that shows all available capacity of resources. The planners will able to see how much they can

increase or reduce demand and then they can quickly respond to top managements. The suggestive framework for SAP is represented as below.

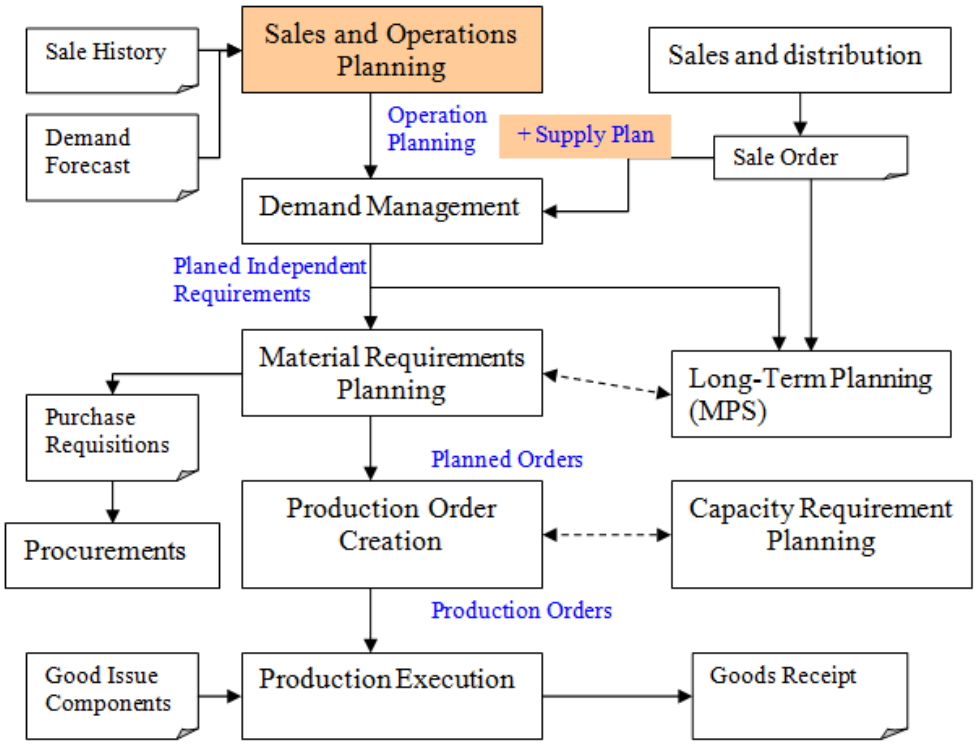

Figure 14 Recommended Production Planning and Control Framework for SAP that follows APICS (Additional workflow is highlighted)

For Openbravo, there is no MRP II functions (Resource Capacity Planning) in the tested version. To serve all types of SMEs, Openbravo teams should created MRP II functions in their ERP. By following APICS model, the recommeded framework for Openbravo is shown below.

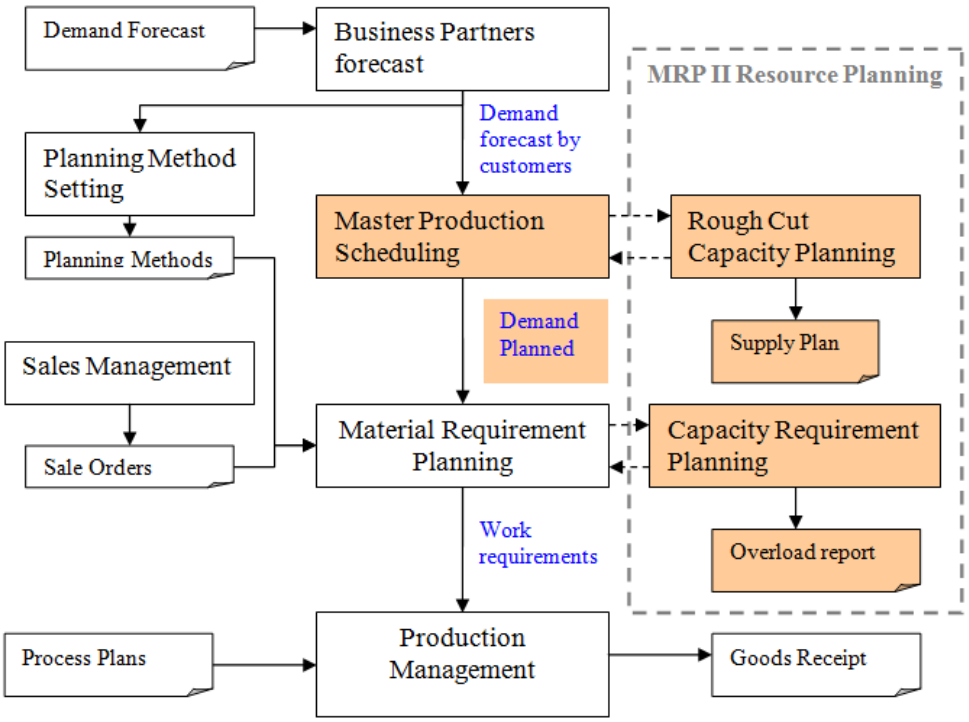

Figure 15 Recommended Production Planning and Control framework for Openbravo that follows APICS (Additional workflow is highlighted)

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E-COMMERCE - CUSTOMER AND DIGITAL NATIVE GENERATION PROTECTION AND NEW MARKET OPPORTUNITY

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ABSTRACT

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 safe for customer of different age, different digital alphabetization, enormous digital divide gap. In this role of important part of our life it must be a service offered from the society to citizens without being afraid from technology.. This research illustrates the problem between ecommerce development and the difference of knowledge of customer. The digital divide between generations and between teachers, parents and children. A different way of approach the net in easy-way without considering risks and technological effects. The current research is an excursus of the state of Digital Knowledge and dangerous consequence of using web as a market without Knowing risks

Keywords: ecommerce, internet, security, risks, ecommerce, security seal, malware, Digital native, innovation, participation gap

INTRODUCTION

Internet is the greatest public space of the world. At the same time it is a new territory with rules and laws not enough completed. Today Internet is the first form of communication and the main market in the world. All the information across the world are faster then before and people are participating in the process of the information passing from a passive role to an active one. World wide web is un-material-un-territorial, virtual, digital but always a part of this world. What is legal off-line is legal on-line.

CONCLUSION

At the beginning world wide web was considered as a fast experience, a sort of game, now it's a market and an information media, in the future It will be our life, our digital life in every field. Considering this public space without rules and security systems is dangerous especially concerning that new generations, called Digital Natives, are faster customers and actively engaged with their parents, which are new "pupils" about what's going online. Parents and teachers are not in a strong position because they are not engaged as their children in online life. This dynamic gap of Internet knowledge is the first thing to try to reduce as the first part of Internet safe problem. The web is an incredible instrument of education, ecommerce, public administration, but it has to be developed in safety.

There are no easy answers for our digitally mediated life or for the participation gap but it's necessary to consider new solutions for the future digital age from this point of no return.

Internet is the greatest public space of the world. At the same time it is a new territory with rules and laws not enough completed. Today Internet is the first form of communication and the main market in the world. All the information across the world are faster then before and people are participating in the process of the information passing from a passive role to an active one. World wide web is un-material-un-territorial, virtual, digital but always a part of this world. What is legal off-line is legal on-line. The investment of production in technology is one of the most important part of the budget for companies and today it's impossible to have a role in markets without an internet site. This shop-window in the main street of the world, a virtual street, is the best investment to show products to people. We have to consider that one of the biggest problems in medieval age for merchants and trade relations in general was the absence of a single law for national and international markets, main rules followed between people from different countries. They decided to follow uses and rules self-made for markets and commercial relations and they were able to develop a market code. It was a sort of commercial code made by norms which was respected by all the people in commercial uses because it was the only system to be a part of the commercial trade in contracts composed by words, payments and deliveries without the burden of uncertainty. This complex of often unwritten uses and behaviours took the name of *lex mercatoria.* After hundreds of years in this historical moment of digital development of markets we have the same necessities, fears, lack of certain of medieval mediators. If we consider that the un-material World Wide Web market is composed by bits as a unit of measurement and that it's often impossible to know who is the person on the other side of world is, who is chatting, who is connected, who is writing me or asking me something, it becomes easy to understand difficulties of developing on-line markets. From many parts an international electronic law is always remarked as a necessity. As often happen in technological world everything is faster than law and politician intentions and we started using this new technology without rules to follow, without codes and without knowing risks, a sort of no man's land. Suddenly it appeared clear that we were living a point of no return and the digital reality have to be considered the present. Actually, internet landscape appears in the same condition, crowded, uncertain, full of thousands of web sites and companies, sometimes false, constant fighting to find space and to catch the attention of customers, interested in improving their position and developing on-line activities. On-line visibility it's a mirror of investments, an important part of the brand. Starting from the on-line position it's easy to understand and discover the position of a company in markets. Many companies try to have first position in search engine. From this position they can meet customers immediately, before other competitors in respect of a new marketing strategy. The target is changed and in strategies and plans of marketing one of the first point to remark is considered the problem of reaching customers, without considering the age of the customer, how to take the first position in search engine results, how to be the first on the on-line list, how to clean the on-line reputation, in case of difficulties, because it is difficult to cancel from the electronic memory of the world wrong information or bad information. It's a system used also in the political world, putting on the top level of search engine information better information and postponing the worst one pages and pages behind the important meaning. This is made by a software called reputation cleaner, but it could be very dangerous for the quality of the information, as a normal research on the web without considering the creator of the information and the quality of his

article because people can only evaluate the quality of a given peace of information after consuming it. One of the new on-line web business is to help companies to have a better position in online market research, to take a positive location in search engine results. On the web, marketing one-to-one and customer satisfaction, are keywords to take position in on-line markets and to win competitors by investing money in technological resources. Having a direct contact with the customer is one of the first point of winning strategy, offering services, especially online, and follow a product during his life, also in the hands of the customer, it's an important service and a marketing idea that could make the difference or more as FAQ(Free Asked Question) about the product, how to use it, giving site advices about the product and guaranty, ask directly to the company-site about claims for ADR(Alternative Dispute Resolution) or ODR(Online Dispute Resolution) to resolve law situation that could involve national and international courts. This kind of online services could do the difference between company and company and help the consumer to decide for a product instead of another(part of the customer satisfaction) and for a brand instead of another.

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. In this present all the world is linked and if the analogical world seems unequal the digital world is worst. A part of the population of the world in this century doesn't yet reach the minimum power in material things and is now compelled to pursue the rest of the world in a crazy race of technology which is lost at the beginning. The result of this race without winners is digital divide. In 1923 Paul Valery has written: modern man-tired from technological instruments-is afraid form the excess of his wealth… an excessive capital not utilizable.

In this sentence there is an important warning: technology could not be a form of wealth if not well utilized.

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 of culture on different levels of the world society. It's a problem of education, of culture, a political problem of privacy, of economy. The discussion is huge and it involve human rights and social programs and it will probably absorb the work of the all world institutions and it will takes a new Breton Woods in the field of Democracy and Privacy.

The first point of view to discuss is what is generally known as digital divide. This concept means difficulties in using technology, necessity of technological alphabetization, division between generations, division between people at the same time, different possibilities of access on web, different capability of internet access, democracy problem of access to information, different approach of countries to technology. Another important problem of World Wide Web for the entire world is protection and privacy of information. The difference between rich countries and poor countries is increasing more and more and close

to the wound of analogical 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. It's always correct talking about "population" rather than "generation" considering that just 1 billion of the six billion people in the world even have access to digital technologies and the real division is between who have and who have not technology and so the young population in the world is digital divided in native (kids)and Digital native(cyberkids). For billion people technology and cyber alphabetization are mere abstractions. It's not just a problem of access, but a not singular problem of learning digital literacy, of learning and improving the technological alphabet of this hybrid world. This type of inequality must be overcome. The costs of our absence in this field will be higher that we should be willing to bear. 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. The real benefit of the diffusion of online culture is the increasing of participation starting from the developing of digital capability that can lead to stronger democracies. This will be the result of the involvement of people in culture movements, blogs, other sources of information and discussion, a long path called participatory culture.
So the meaning of the words "free access" is wide, too ample to close it in a few words.

In the new form of communication mediated by technology(CMT) there is the replace of the direct experience with a sort of mediated perception. In the electronic space there is not physical contact but a new virtual contact transferred by a mediator. Digital media have modified the growth of new generation called Digital native for the different confidence with technology which is very familiar and a form of natural expression very far from old generation.

As we said for companies strategies, in online world there is a difference to bring into relief between different types of consumer and customer. We have to distinguish who is the receiver, the addressee of the information and his grade of ripeness. Adults, old people, astute digital native and not digital kids read, at the same time, a mitigate information and it could be easy or not to understand the asymmetry between reality, commercial suggestion, marketing communication.

An interesting analysis is to remark the different of access on the web between generations, and more in the same generation between digital native and not digital native, between boys and girl, between parents and sons.

Let's analyze some interesting data: an important American research(Cyberatlas, 2002) showed the Internet was already the first instrument of information and communication for the new generation(12-17 years old),81% used email for communication with friends and relatives,70 % used chat line. This research shows that in USA the Internet was the first form of communication at the beginning of the century. In the research of Mediappro(2006) the result was that in Quebec 90% of "cyberkids" used Internet like Intranet like a sort of private net, and they don't use mobile phones. In Italy as Japan, the other way round, the mobile

generation (98%) preferred form of communication is mobile telephone(mediappro 2006) and it's used by "cyberkids" for normal communication (14 years old) and in the version smartphone for Internet (15-29 years old) Censis 2007.

The real result is that new media are new form of private personality a sort of new identity mediated by technology: more related to could be and not must be.
Other changes are becoming in the evolution of the utilization of the net. In particular the location of use of the net. A part form the case of mobile phone connection another difference it's easy to find comparing 2005 and 2008 concerns. In 2005 the use at school and at home, with a standard computer ,was very common in Europe. Starting from 2008 6-17 years old in European Community countries were much more likely to use the internet at home (65%) than school(57) or anywhere else, and 34% are now going online using their own computer.
An interesting research ,made by The London school of Economics and Political science in internet use by age shows that use increases with each year the child gets older by the age of 10-11, in 2005 it was by the age of 12-13 years old, but obviously the range is different cross-national difference. In countries with an overall higher internet use children are much younger when they start to use the internet. In this countries the internet use is very popular among the 6 to 7 years old children.

There are also a few difference in internet access and amount of use between boys and girls. It consist in a social inequality. There is an historical tendency for younger boys, digital native, to have more places to use the internet, to get online earlier and generally to use the internet more than girls. Most of all, the importance of the difference is made by education and parents that sometimes don't want to provide their children with an internet access. Sometimes the attention of girls in technology star later than for boys. It's easy to see the evidence that once they have gained access the use become so frequent with the age.

A very important result is the fact of the increasing of parents' use. Many parents are know online as children, reversing the first impact with technology and reversing the previous trend but the difference is still important just in countries where the internet is a relatively recent arrival. The other way round children whose parents use the internet are significantly more likely to use the internet(79%) than those whose parents are not online(54%).

In all the world there is an important gap between generations, between young people and their parents and teachers. The result of this gap is that new generation are often at risks in an environment that could be very unfriendly. This fault is the base to be afraid from technology and doesn't encourage positive steps. Fear could be the death of new technology, a ban would mean giving up on the many possibilities of the internet and giving up the future. It's very important to focus energy to analyze the cause of the problems and we have to be able to resolve problems without cutting the future at the beginning starting with the resolution of the risks with the help of companies that offer online services that, of course want to improve markets by helping customers, especially young unprotected customers, not just digital natives which are one step up than others.

Parents, teachers, companies and institutions must be part of the debate of digital culture and an important part to create safety in the online world.

In this online identity, just a part of a multiple identity, so important considering the development of e-commerce and e-marketing an interesting position is covered by multitasking, the new behaviour of multiple action started by the net population that change every form of interaction in analogical world and of course in the Digital one.

It's impossible to focus markets without considering the capability of Digital Native to consume more media content in the same time and this trend is rapidly going up but it's yet on discussion and difficult to demonstrate the role played by multitasking on learning.

People connected on internet are on shop-window, and we can say an effective definition of a connected man as a "glass-man". This problem is generally related to all people using internet, but in special way consumers connected for commercial reasons. In this case the problem involves e-commerce and in this field all the companies interested to web market. The sites must have privacy policies available on it, and any sites that targets a children's audience must have special concerns and requirements. If the customer on web is named "weak-consumer" a child connected without enough knowledge and malice could be in danger especially for malware (malicious software) and for the possibility of on-line meeting with dangerous people during a research of a favourite videogame, toy, cartoon, music.

Special form of privacy policy, especially forms of protection of "cyberkids", Digital Native or not, are studied in all the world. The incidence of risks experienced by children online varies cross-nationally this is the motive of the strong reflection made by countries which involve policy, laws, academics disciplines, media studies and consumer research. Starting with the lack of an international cyberlaw of protection children of "cybergeneration" we can just have a look on a not exhaustive list of form protection applied in the world is necessary to focus the attention on this transversal topic. For example in Japan there is a particular attention about safety and risks in young people's online behaviour, and in particular a sort of difficulty was identified and related when young people adopting mobile Internet as a moral panic and social isolation called "Hikikomori", a form of refusal of social life with the substitution of real life with technology and the world with their room. They live every difficult as a defeat and prefer to live in a software world in which they can be everything they want. Other topics included phishing, spamming and fraud and every sort of violation of a space often perceived as an intimate space of friendship as what happen in social-network and their concept of friendship. A particular law passed in Japan in 2003 "Legal Plan to Address Entrapment of Children through Internet Dating Industries", the criminalization of using online sites to arrange dates with minors.

In Australia as in Europe are suggested safety measures including Service Providers filter, parental control filters for monitoring and surveillance and in general the control of Internet content as application of international protocols. In USA there is a big policy discussion about online safety and Internet protection. It's one of the most salient issues and social networks are also perceived as problems with the necessity of a series of agreements with companies to add safety features and there is a particular act called COPPA (Children's Online Privacy Protection Act) concerning online protection for children and frequently Consumers take active part in decisions made by Federal Trade Commission according with companies and was promulgated a set of "Online behavioural Advertising Privacy Principles".

The time spent by net-generation connected to the internet is increasing day by day. In South Corea expert believe the average teenager spends two hours on line per day. China there is public concern about "Internet addiction" as a public problem of health with sophisticated centre of studying new form of illness related to technology. Information from the World Economic Forum indicates that while about half of the countries judge their system of regulation enough adequate on internet issues in general, other countries consider more regulation are needed to have a medium level between countries. It's obvious that cross-national difference between countries depend on different levels of general education, the higher general level of education of a country, the higher it's children online use, the higher is the level of regulation or the level of the request of safety.

Analyzing the contest of online safety we have to admit that we can find analogical problem transferred in online world. What it's considered illegal, what we consider as a crime in offline contest has a counterpart online. World wide web is just a new vast territory for using offline behaviour with the disadvantage that this behaviour is not immediately related to a person but just to an address. The most important thing to consider talking about online behaviour is that in many cases we have to talk about an invisible behaviour made by a glass-man. Starting from this reflection we have to improve our efforts in discovering online traces of malware and criminal behaviour or simply to help cyberkids in separate reality from just commercial offer and a correct information to a risky one.

A primary form of control used by parents in technological countries are filters(parental control)with the help of software companies. They play a concrete role to protect children from harmful online contents but they are often used and requested from "cyberparents", very close to Digital Native generations. Other kind of filters are located directly to the server but in this case they ensure a standard level of protection without considering the age of the consumer or his level of cyber experience. The activity of control is delegated to a software that help is work by keyword or blacklist sites to block the access to particular contents. A new search engine just for kids help them in searching on the web, answering questions after an evaluation of contents considered appropriated.

All the time spent online by digital native is studied by parents as a problem and by marketing as a resource for net-economy.
The difficult is to help kids to have skills and enough tools to spend, live safety, their time online and to consider themselves what is wrong and what is good without the supervision, if not possible, of parents, teachers, relatives but very important at the beginning of online impact.

The educational system is utterly confused about the impact of technology in learning. Giving computer to a student or a son is not a solution to be on time.

The best way to find solution for reducing safety risks is mix all the forms of help which are: education(familiar and school), technology development(markets and science), social norms and law. The first solution is to give, as a responsibility of the society and of the government, the skills to the digital native and new generations to defend themselves on web and to recognize a correct information from a wrong one. Second approach is to give, at the same time technological skills to parents and teachers, often related to old mechanism of learning

that needs to have the same step of technologies, to help them to walk in technology as a part of their time without being afraid from what is considered new. Follow every form of netiquette(net-etiquette) as a based rule of the technological society and teach technological rules as a materia. Sharing digital technologies in between cyberkids, parents, teachers, police, companies and work together in the same direction. Ask for international rules in online education, society, economy and markets starting from the a medium level of knowledge, a model of shared and distributed governance, administrated from adequate institutions.

Markets have a fundamental role. Companies have strong incentives to develop technologies in quality, they have the social responsibility to participate on safety projects. If we consider how many boys and girl daily took information from the web, buy things on web, especially from e-marketplace to spend less money without knowing risks and without considering the level of safety, judging the system at the end giving a feedback. They don't have an idea about who is giving the information, the safety of the information, the seller, his or her identity, the country of the server, of the seller, the country in which bought objects are. They buy in the dark. People can only evaluate the quality of a given information after consuming, and they start to ask themselves question just after being victims of fraud. Reputation systems and evaluation systems could help to point the attention but they are not enough. It's normal that market will find in their own systems and technology the solution to grow up. One of the best solution for quality of sites is the label of quality a sort of seal of guaranty for consumer and customer. They are symbols of the level of quality or accuracy of the information, products or service and help the buyer to consider safety what is sold. In e-commerce it's a good solution and it's also a great solution to protect minors from harmful content on websites. This sort of certification it's an index of serious content and of adhesion to a code of norms in respect of predicted standard. A constant control of contents is always necessary to decide if a site deserves the label and at the same time the participation of consumers in panels of decision is always promised.

Turning to market, consumer privacy, not just for a digital native or un protected generation is an increasingly important issue and there are areas of special concern, such as health-related information.

Many e-commerce providers have realized that the data they handle, even without care, may be the most valuable asset and will resist any attempt to limit their rights to use customer's profile. This kind of data, personal data are always objecting of a particular kind of law, usually very strict and protective. It's always good behaviour handle with care and proceed carefully in allowing usage because a customer can ask every time information about the way of handling his data and ask for punishment in any case of intrusion, not allowed, in his privacy.

All the norms related to customers and on –line customers must find enough space on internet sites, they must be listed in a particular part of the site (called "us-ability")for an easy reading and research from the customer.

All the data about the company, address, email, main office, fiscal data, owner, webmaster, must be at complete disposal of the customer, frequently asked questions, insurance

information, green number for immediate contact, possibility of solution for small claims without legal cases but using alternative dispute resolution (ADR) or On-line dispute resolution (ODR).

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, but the other way round 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. The possibility of introducing a special seal on the website, as a symbol of security in dealing, as a part of a ratified code of commerce is always promising. A sort of serious credential demonstration for the companies and a small insurance for the consumer.

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THE IMPACTS OF COOPERATION AND COMPETITION ON SUBSIDIARY'S CAPABILITIES BUILDING: AN EMPIRICAL STUDY OF FOREIGN SUBSIDIARIES IN TAIWAN

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ABSTRACT

Given the importance of dynamic capabilities for the subsidiaries, the aim of this study is to focus on the question of how foreign subsidiaries actually develop dynamic capabilities that can be seen as critical for the entire MNC. Specifically, this study tries to identify the different impacts of internal and external network partners influencing the development of dynamic capabilities of subsidiaries. Based on the empirical study of 81 Taiwan's foreign subsidiaries, it is found that when facing higher level of competition, higher technology embeddedness with local external network, the subsidiaries' exploration capabilities will be enhanced. In addition, when the intra-firm climate is higher emphasis on cooperation, the subsidiaries' exploitation capabilities could be enhanced.

Keywords：MNC subsidiary, exploration, exploitation, dynamic capability, cooperation, competition.

INTRODUCTION

Knowledge is an important resource for firms to develop and retain competitive advantages (Grant, 1996). The ability of Multinational corporations (MNCs) to leverage their knowledge across dispersed foreign subsidiaries has become more essential than before (Gupta & Govindarajan, 1991). Evidently, these perspectives and related empirical efforts have offered rich insights into the importance of capability building for subsidiaries. However, one gap still remains: Most previous studies have investigated knowledge transfer between parent and subsidiary, but have not yet systematically explored the importance of how the acquired of shared resources and capabilities are further exploited in subsidiary (capability exploitation) and how new resources and capabilities are upgraded and built (capability exploration). From the dynamic capability perspective, capability exploitation and exploration is essential not only for survive of subsidiaries but also for MNCs' competitive advantage. Through learning and generating dynamic capabilities, subsidiaries could continuously renew their competitive advantage to ensure sustained financial performance, and could be centers of excellence to disseminate their capabilities to other subsidiaries to enhance MNC's competitive positions (Zhan& Luo, 2008).

A number of studies have examined such new phenomenon as center of excellence (Moore & Birkinshaw, 1998), subsidiary-specific advantages (Moore, 2001), and subsidiary entrepreneurship (Birkinshaw et al., 1998). Following this stream of literature, this study tries to address the importance of capability exploitation and exploration in subsidiaries. We

attempt to examine how capability exploitation and exploration are affected by cooperative and competitive environments in which subsidiaries are embedded.

Based on traditional view, headquarters is an important source of new knowledge for subsidiaries. Acting as a conduit, subsidiaries can exploit the knowledge transferred from parent MNC to prosper in local markets (Blanc & Sierra, 1999). The more recent literature on MNCs, influenced by the "market-as-networks" perspective, however, has argued that external partners can constitute a very powerful resource. External partners can be very important for capability development in subsidiaries (Birkinshaw & Hood, 1998). In this study, we take local embeddedness and intra-firm embeddedness as two major channels to learn for subsidiaries. Given the importance of dynamic capabilities for the subsidiaries, the aim of this study is to focus on the question of how foreign subsidiaries actually develop dynamic capabilities that can be seen as critical for the entire MNC. Specifically, this study tries to identify the different impacts of internal and external network partners influencing the development of dynamic capabilities of subsidiaries.

Further, while contextual factors are essential for subsidiaries learning activities, we would like to verify what kind of relationship climates could enhance learning more. Could both cooperative and competitive climates work for stimulating learning? Thus, in this study we aim to explore how cooperation and competition revealed in subsidiaries' local and intra-firm environments affect subsidiaries' exploitation and exploration capabilities building.

LITERATURE REVIEW

Dynamic capability can be defined as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environment (Teece, Pisano, and Shuen, 1997). It requires the capability to extract economic benefits from current resources and to develop new capabilities. Focusing on the international setting, Luo (2002) and Tallman and Fladmoe-Lindquist (2002) conceptualize dynamic capability as consisting of two dimensions: Capability exploitation and capability upgrading. Capability exploitation concerns the extent to which a firm exploits rent-generating resources that are firm-specific, difficult to imitate, and able to generate abnormal returns which capability upgrading involves the extent to which a firm commits to building new capabilities through learning from organizations, creating new skills, or revitalizing existing skills in new situations. Capability exploitation is critical for gaining competitive advantages and determining strategies for exploiting such advantages while capability upgrading ensures the growth of sustainable competitive advantage and generates new bundles of resources (Zhan & Luo, 2008).

Similarly, Yang et al. (2008) distinguish two subsidiary roles in terms of the subsidiary mandates: competence creation versus competence exploitation. Competence-exploiting subsidiaries are expected to transfer and adapt knowledge from their parent to local markets. These subsidiaries are engaged in implementing established home-based knowledge effectively in local environments (Cantwell & Piscitello, 2000). These processes require continual knowledge transfers from parent firms (Cantwell & Mudambi, 2005). On the other hand, competence-creating subsidiaries are expected to develop knowledge assets that are new to the MNC network, like new products, technologies, practices, and skills (McDonald et

al., 2005). Competence-creating subsidiaries are expected to diffuse knowledge to other units to the MNC network. A greater volume of distinctive and valuable knowledge is likely to be available in competence-creating subsidiaries than in competence-exploiting subsidiaries, simply by virtue of their organizational role.

Thus, according to Yang et al. (2008), it is expected that competence-exploiting subsidiaries are associated with significantly higher conventional knowledge transfers. Conversely, competence-creating subsidiaries are expected to be associated with significantly higher levels of reverse knowledge transfers.

HYPOTHESES DEVELOPMENT

The Impact of Local Cooperative Environments on Subsidiary Dynamic Capabilities

The literature on multinational corporations frequently emphasizes the point that a subsidiary unit faces competing pressures: for responsiveness to host country demands, and for conformity to corporate norms (Bartlett & Ghoshal, 1989; Prahalad & Doz, 1987). This means that subsidiary dynamic capabilities are shaped by the local environmental context as well as by elements of the organizational context.

In their everyday work, subsidiary employees will typically interact for more with customers and other firms in their local market than with corporate managers, so it seems likely that such interactions will be the stimuli for their dynamic capabilities building. According to the recent studies of economic geography, subsidiaries innovation, capability upgrading, and competitiveness can be related to the presence of industry clusters (Porter, 1990; Solvell & Zander, 1995). Based on these studies, it is argued that subsidiary's exploration capability will be promoted by the local cooperative environments. Thus,
Hypothesis 1: A high level of local cooperative environments will promote subsidiary's exploration capability.

The Impact of Local Competitive Environments on Subsidiary Dynamic Capabilities

It is argued the exploration capability is essential for subsidiary's survival especially under dynamic environments. Because increasingly competitive environments make building and sustaining firm owned competitive advantage increasingly difficult. Building new resources and capabilities could facilitate the responsiveness to meet the local needs.

Thus, it is expected that changing business environments, dynamic competitive forces and institutions, and unique and changing customer needs all imply that subsidiaries should pay more efforts on building exploration capabilities to create new subsidiary-specific advantage to replace subsidiaries' ownership advantage which may erode over time.

However, according to Birkinshaw (1999), the initiative was promoted in cases where there was weak local market competition. It seems that in very competitive local markets, many subsidiaries found themselves crowded out, they have no opportunities to build relationships with important local customers and suppliers. Thus,

Hypothesis 2: An appropriate level of local competitive environments will promote subsidiary's exploration capability.

The Impact of Intra-firm Cooperative Environments on Subsidiary Dynamic Capabilities

In the setting of a subsidiary, capability exploitation focuses on combining, integrating and reconfiguring parents' and local partners' resources so that these resources are best blended and utilized to create value-adding products and/ or services. Since resources of subsidiaries are originally derived from parent company and other subsidiaries, it is critical for subsidiaries to cooperate closely with parent and other subsidiaries to ensure resources acquisition and integrating. In addition, since subsidiaries involve repeated inter-organizational exchange that become socially embedded over time, cooperation is an important safeguard that can mitigate both external and internal hazards and a comprehensive and efficient form of governance for subsidiaries learning from parent company and other subsidiaries. Since cooperation plays an important role in tacit knowledge transferring, it is expected that cooperation with parent and other subsidiaries will enhance subsidiaries' exploitation capabilities.

Hypothesis 3: A high level of intra-firm cooperative environments will promote subsidiary's exploitation capability.

The Impact of Intra-firm Competitive Environments on Subsidiary Dynamic Capabilities

Though the MNCs have more integration pressure today to coordinate their dispersed subsidiaries, it seems that there is increasing internal competition between subsidiary units. According to Birkinshaw and Lingbland (2005), two major types of internal competition can be identified. The first one is internal competition for a charter, or the responsibility to perform certain activities for the corporation as a whole. Another one is internal competition for a customer in the next stage of the value chain. Under the coopetition scheme, Luo (2005) indicates that subunits compete for parent resources and support, system position, and market expansion. First, they compete for parent resources to reduce their dependence on indigenous resources and to strengthen their competitive strengths in a local market. Second, subunits generally compete for four interrelated types of position: (a) the value-chain position, (b) the knowledge flow position, (c) the competence excellence position, and (d) the influencing power position. Finally, competition arises when subunits are interested or active in some common markets and offer the same category of products or services to shared consumers.

Regarding the impact of intra-firm competition on firm performance, it is possible that a negative effect may occur. First, competitive rent-seeking behavior may encourage firms either to erect barriers around their distinctive competencies or to behave opportunistically toward others. Second, competitive rent-seeking behavior may fail to take into account the dense web of social relations in which firms are deeply embedded (Lado et at., 1997). Thus, it is expected that this intra-firm rivalry will decreases the level of trust in information sharing and knowledge transferring. It will hurdle internal efficiencies and sharing of best practice for successful deployment and exploitation of knowledge. However, many previous researches

assert that a combination of cross-functional cooperative ability and competition may nurture productive interactions (Tsai, 2002; Luo et al., 2006) that can facilitate internal efficiencies and sharing of best practice for successful deployment and exploitation of knowledge. In particular, cooperation among competitors can foster greater knowledge seeking and result in syncretic rents. Thus,

Hypothesis 4: An appropriate level of intra-firm competitive environments will promote subsidiary's exploitation capability.

The proposed framework is shown in Figure 1.

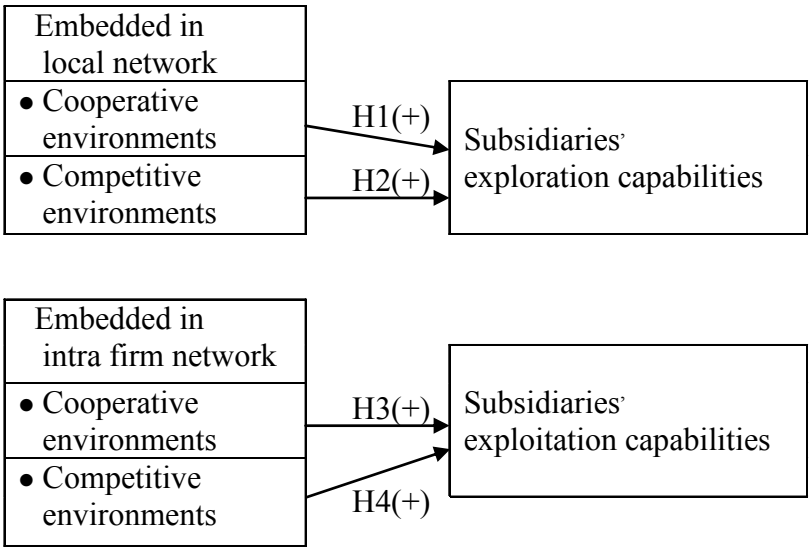

Figure 1 The Framework of Proposed Research Model

SAMPLE AND DATA COLLECTION

Data for this study were collected through structured questionnaire survey with top managers of Taiwan's subsidiaries of foreigner-owned MNCs. We assessed all constructs as multi-item measures. In addition, we scored each item on a seven-point scale, ranging from "strongly disagree" (1) to "strongly agree" (7). The questionnaire was then pretested with 3 Taiwanese managers in a pilot study. Reponses from the pretests ensured the relevance of the final measures. Then, the data collection started by calling to some foreigner-owned subsidiaries whose contact information were listed on name list of foreigner direct investment issued by Ministry of Economic Affairs of Taiwan government to invite them to join this project, resulting in a sample of two hundred subsidiaries agreeing to participate in the study. Then we sent questionnaires to them, and finally get 81 useful responses, including 47 Japan-owned, 19 US-owned, European-owned, and HK-owned units. They had been part of their parent corporations for an average of 21 years, had a mean of 265 employees, and average capital of 0.9 billion NT $. There are 41 respondents coming from the head of marketing departments and 40 respondents coming from manufacturing and R&D departments with average 10 years working experience who are supposed to have good enough knowledge to be in the best position to provide data on the full range of questions needed for this research.

Dependent Variables--Subsidiary Competence Building

In this study, exploitation and exploration are acted as two major roads for subsidiary's competence building. Following Bierly and Daly (2001) and Katila and Ahuja (2002), we regard exploration and exploitation as two distinct dimensions of learning behavior, rather than as two ends of a unidimensional scale. Drawing upon He and Wong (2004), we developed eight Likert-scale items to measure how firms divide attention and resources between innovation activities with explorative versus exploitative objectives. These items were designed to measure how important it is for a firm to carry out innovation projects to enter new product-market domains or to improve existing product-market efficiency (e.g., introduce new generation of products versus improve existing product quality; open up new markets versus reduce production cost).

Independent Variables

Subsidiary local embeddedness

Since subsidiaries are embedded in local environments, we divide local environments into cooperative environments and competitive environments. The former emphasizes the cooperative activities with local suppliers, customers, governments, and universities or other institutions, while the latter emphasizes the competition level of subsidiary of which his industry structure reveals. Following Lane & Lubatkin (1998), cooperation is defined as similar to embeddedness between two parties in a relationship which is usually measured as frequency of interaction and/or degree of mutual adaptation of resources/activities (Lane & Lubatkin, 1998). Drawing upon Andersson et al. (2002), six questions were used to measure subsidiary local cooperative activities. On Likert-type scales ranging from 1 "very little" to 7 "very much", the respondents were asked to indicate to what extent their subsidiaries had caused adaptations concerning (a) product technology, (b) production technology, (c) standard operating procedures, and (d) business practice with their major suppliers and customers.

Concerning the competitive environments faced by subsidiaries, based on previous literatures, a three-item scale was used for environmental competitiveness that measured the extent to which a unit's external environment is characterized by intense completion that is reflected in the number of competitors and the level of oversupply, and competing through only price (Jansen, et al., 2006). In addition, much research on competition derives from neo-classical economic theory, in which competition is analyzed as different structures within an industry, and structural entry barriers are often used to demarcate the industry. Thus, drawing from Porter (2000), a three-item scale was used for entry barriers that indicated the extent to which a subsidiary can earn positive economic profits via entry barriers while making it unprofitable for newcomers to enter an industry.

Subsidiary embedded in intra-firm network

In this study, we divide intra-firm network environments into intra-firm cooperation, and intra-firm competition. Drawing upon Luo et al. (2006), we measured *cross-functional cooperative intensity* with three items that we constructed to assess the degree to which the lateral cross-subsidiary interactions are frequent and close. Further, five-item scale was used to measure cross-subsidiary cooperative ability, which means the ability to assimilate and

deploy market knowledge in lateral interactions among subsidiaries. Concerning the intra-firm competition, there are 7 items to identify the degree to which departments compete both for limited tangible and intangible resources and for strategic importance, power, and department charter.

RESULTS

The four hypotheses may be summarized in two basic models as follows:

$$ER=\beta 11+\beta 12BE+\beta 13TE+\beta 14EB+\beta 15CI$$

Where ER: exploration capability; BE: business embeddedness; TE: Technology embeddedness; EB: entry barriers; CI: competition intensity;

$$ET=\beta 21+\beta 22CII+\beta 23CA+\beta 24RC+\beta 25MC$$

Where ET: exploitation capability; CII: cooperation intensity; CA: cooperation intensity; RC: compete for resource; MC: compete for market

Hypotheses 1 and 2 are reflected in model 1, while Hypotheses 3 and 4 are expressed in model 2. The results of these two models are reported in Table 1. Model 1 is highly significant. Hypothesis 1 examined the relationship between the local embeddedness (external cooperation) and the level of subsidiary exploration capability building. The result shows that the more technology embeddedness in local environments will highly enhance subsidiary exploration capability building. Thus, hypothesis 1 is supported. Further, a striking result is the clear impact of the level of competition intensity in local environments. When the competition intensity is heavy, it will stimulate subsidiary to pursue exploration capability building. Thus, hypothesis 2 is strongly supported, with a t value significant at the 0.5% level.

Concerning the impacts of intra-firm environments on subsidiaries' exploitation capabilities building, the results show that the intra-firm cooperation ability is the most relevant factor. The results indicate that the more the cross subsidiaries cooperation ability, the more easily to learn from other subsidiaries, thus enhances the ability to build exploitation capabilities for local subsidiary. Thus, the hypothesis 3 was supported. On the other hand, hypothesis 4 was not supported. In fact, the results indicate a negative but not significant relationship between intra-firm competition and exploitation capability building of subsidiary rather than the proposed positive relationship. This rather surprising result can have different explanations. First, our basic assumption behind hypothesis 4 may be wrong: too much emphasis on competition climate maybe impede knowledge transfer between subsidiaries, rather than encourage knowledge transfer. Second, maybe there exists an inverse U type relationship between intra-firm competition climate and subsidiaries' exploitation capabilities building. However, it needs to be verified in future study.

Table 1 Regression Analysis for the Relationship between Environmental aspects and capabilities building of subsidiaries

Independent Variable	Dependent Variable					
	Exploration capability			Exploitation capability		
	Beta	t value	VIF	Beta	t value	VIF
BE: business embeddedness	0.071	0.397	3.894			
TE: Technology embeddedness	0.437***	2.525	3.679			
EB: entry barriers	0.101	1.026	1.181			
CI: competition intensity	0.268***	2.927	1.030			
CII: cooperation intensity				0.016	0.137	1.264
CA: cooperation intensity				0.383***	2.957	1.485
RC: compete for resource				-0.012	-0.109	1.098
MC: compete for market				-0.045	-0.373	1.306
R^2	0.380			0.140		
Adjusted R^2	0.348			0.095		
F-Value	11.669			3.097		
P-Value	0.000			0.020		

* : P<0.1 ; ** : P<0.05 ; *** : P<0.01*

CONCLUSION

This study has shifted the focus from the knowledge transfer to the exploitation and exploration capability of subsidiaries. Theoretically, this study may contribute to research on subsidiaries' dynamic capabilities. It is argued that for subsidiaries' evolution and success, possessing resources transferred from parent is not enough. How to effectively exploit parent-contributed resources and continuously explore new capabilities in local market may be more important. Especially, this study explains what type of antecedents in terms of internal environment (cooperate vs. competitive) and external environment (cooperate vs. competitive) may shape exploitation capabilities and exploration capabilities. It is verified that when subsidiaries operate in a more local embedded business environments, subsidiaries will more depend on exploration capability to offset the severer competitive condition. In addition, while subsidiaries face more intra-firm embedded environments, subsidiaries will more depend on exploitation capability to fully utilize the current resources contributed by

parent. These results shed lights on how different contextual conditions may lead subsidiaries to pursue exploitation capability or exploration capability to successfully respond to multiple environmental needs. Through this empirical study, we contribute to a greater clarity and better understanding of how multiple environmental conditions, namely local embeddedness, local competition intensity, intra-firm cooperation, as well as intra-firm competition impact subsidiaries' exploitation and exploration capabilities building, which are relevant to MNCs' sustainable competitive advantages.

References are available from the author.

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INFORMATION USE AND ORGANIZATIONAL CULTURE OF MALAYSIAN EXPORTERS

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ABSTRACT

Export information is a critical determinant for the competitive advantage and the success of an export venture. However, the ability to acquire information may not be sufficient enough to ensure effective decision-making by the exporting firms. The correct use of that information may result in better planning and actions, which may lead to enhanced performance. At the same time, the organizational culture may influence the use of information by organizations. Organizations with strong culture were able to gain sustained competitive advantages and superior performance [2]. As organization culture governs the behavior of its members, it is fair to say that the activities of the organization may be different with different prevailing culture within. Thus, this study will assess the relationship between information use and organizational culture, as well as looking at the patterns of information use and organizational culture among Malaysian exporters. A questionnaire-based survey is carried out among Malaysian exporters and the analysis of the results shows significant relationship between information use and organizational culture.

Keywords: Information use, organizational culture, export

INTRODUCTION

There has been a growing interest on the area of market information use [e.g.,28,42] with a realization of its importance to organizations [1]. The success or failure of a firm depends on the market information that it possesses [18,23,34]. According to Koh [22], information use results in improved plans and organizational responses, which, in turn, enhance performance.

Organizational culture guides the attitude of managers thus their strategic orientation [46]. Therefore, organizations with strong culture were able to gain sustained competitive advantages and superior performance [2]. As organizational culture governs the behavior of its members, it is fair to say that the activities of the organization may be different with different prevailing culture within. For example, firms with an adaptable, risk-taking orientation may find that international expansion is the next logical step, thus more likely to

make export decisions to diversify their market. As the risk is higher at the strategic level if the wrong decision is made [42], effective information use is necessary to reduce such risk [6].

In Malaysia, exporting is a major economic activity contributing to a major percentage of the country's gross domestic product (GDP). Malaysian exporters are relied upon to stimulate economic expansion and generate domestic-led investments as they contribute to 47.3% to the GDP/total value [7]. In view of this, it is important to determine whether organizational culture influences the export decision making through their information processing activities. Thus, this study will examine the relationship between information use and organizational culture within the context of Malaysian exporters.

LITERATURE REVIEW

Information use is defined as the extent to which research influences user's decision making [31]. There are three types of use distinguished in the literature: instrumental, conceptual, and symbolic. Instrumental use occurs when information is directly applied to the problems at hand, whereas conceptual use is for general enlightenment, and not gathered to be directly applied to a specific problem [5]. Diamantopoulos and Souchon [13] found that instrumental and conceptual use constituted two aspects of a single dimension, thus are taken together as one variable. Symbolic use, on the other hand, "involves the use of partial or distorted information for essentially political purposes, such as justifying actions already taken on the basis of instinct or intuition, or legitimizing views already held" [51, p.47].

A major factor that may influence organization's information use is its organizational culture. Deshpande and Webster [10] defined organizational culture as the pattern of shared values and beliefs that allows organization's members to understand the functions of an organization and also what governs the behavior of individuals within the organization. In understanding organizational culture in the perspective of information processing, Deshpande and Webster [10] reviewed five theoretical paradigms for studying culture originally proposed by Smircich [41]. One of the paradigms is organizational cognition which is based on the cognitive organization theory [48]. Organizational cognition views organizations as knowledge systems and focuses on managerial information processing. In their subsequent work, Webster and Deshpande [47] discussed how organizational information processing perspective can be applied to understand culture and subsequently its relationship to marketing strategy.

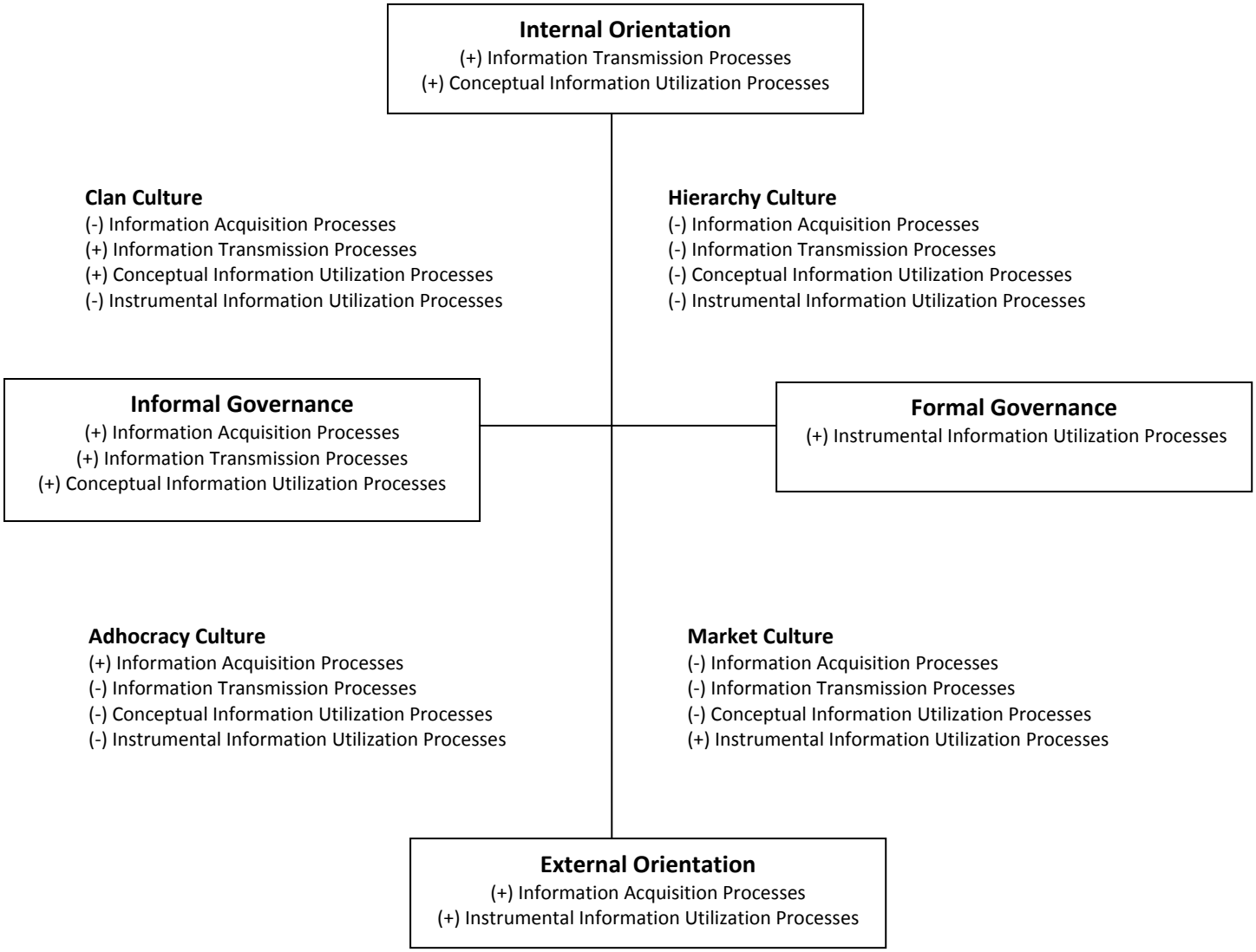
Webster and Deshpande [47] quoted the seminal work of Quinn and his colleagues [37,38,39], who have proposed the "competing values" model of organizational effectiveness. Quinn and Rohrbaugh [39] based their empirical study on the works of Jung [20] and Campbell [4]. Quinn and Rohrbaugh [39] used the organizational effectiveness criteria developed by Campbell [4] to reproduce clusters of values that matched the dimensions of psychological archetypes developed by Jung [20]. The study confirmed that individuals interpret the cultural information that they receive from within the organization according to the values that they hold [29].

Moorman [30] used the competing values model to show the impact of culture on organizational information processes, which include information acquisition, information

transmission, conceptual utilization and instrumental utilization processes. She proposed two predominant dimensions by which cultural values vary, which are the informal-formal dimensions and the internal-external dimensions. The informal-formal dimensions follow the organic to mechanistic processes continuum in the competing values model. The four cultures, clan, hierarchy, adhocracy and market, result from the intersection of the two dimensions. Culture is said to influence the various organizational market information processes in the organization [30]. Figure 1 depicts the proposed view.

Externally-focused cultures will have far developed information acquisition and instrumental utilization as both of these processes require interaction with the external environment. On the other hand, internally-focused cultures have better information transmission and conceptual utilization processes since both functions completely internal to the organization [30]. Generally, information utilization in firms has been found to be lower with formalization [8,11]. In the beginning stage of an adoption process, a formalized organization may hinder the process of adoption such as acquisition, understanding, and commitment to an innovation [52]. However, a formalized organization may facilitate the implementation stages of the adoption processes. Also, formalized cultures may facilitate instrumental utilization processes which involve direct use of information for marketing decisions. This would infer that informal cultures reduce instrumental utilization processes.

Figure 1 Cultural Antecedents of Organizational Market Information Processes*



*(+) denotes that the culture emphasizes the information process.
(-) denotes that the culture de-emphasises the information process.

Adapted from Moorman (1995)

The empirical findings of the study by Moorman [30] show that not all of the suggested hypotheses based on the model are supported. For example, none of the cultures are found to be significantly related to information acquisition even though it is predicted that adhocracy culture would encourage information acquisition processes more than the other cultures. However, the hypotheses that clan culture has the strongest positive effect on transmission processes and conceptual use processes are supported.

It is suggested that adhocracies may improvise decision making and implementation approaches and not follow the traditional information process [31,49,50]. In the past, managers in the adhocracy culture have a style of "play[ing] a best hunch and then learn[ing] and adapt[ing] as you go" [47, p.11].

In the clan culture, information intensity may be due to the internal orientation and informal structure which requires participation, teamwork, and cohesiveness among its members [30]. Cultures that are high in trust and mutual supportiveness will result in better communications and higher levels of commitment, and cooperation among members [33].

The inconclusive findings regarding the relationship between organization culture and information use lead us to ponder whether the result would be the same in the context of Malaysian exporters. To the best knowledge of the researcher, it is not known what the predominantly effective culture is as far as use of export information is concerned. As a result, this paper attempts to test the following non-directional hypothesis:

H1: There is a significant association between organizational culture and information use.

METHODOLOGY

Research Instrument

A survey questionnaire is developed for the purpose of data collection using several constructs adopted from the literature to measure the variables. The instrument elicits data on the organizations use of export information, their organizational culture as well as demographic information for the organization. The questionnaire is sent for face validity through a process of qualitative review by five subject-matter experts. Necessary modifications are made to the questionnaire based on the inputs given by the experts. After adjusting the questionnaire based on their comments, a pilot study is carried out using 30 exporting companies. To measure the consistency and reliability of the measures used, the Cronbach Alpha coefficient is utilized. In the analysis on the pilot study data, the alpha coefficient for all measures exceeded the minimum alpha of 0.6 [17,35]. Thus the constructs measured are deemed reliable and can be used for the main data collection.

Measures

Information use

Information use is the way that information is used in the organization. The measurement is adopted from the work of Diamantopoulos and Souchon [13]. The construct is further divided

into two dimensions namely instrumental/conceptual use and symbolic use. Twelve items for instrumental/conceptual use and nine items for symbolic use are measured by a 5-point Likert scale ranging from 1(strongly disagree) to 5(strongly agree). The respondents are asked about their perception on how information is used in the organization.

The instrumental/conceptual use and symbolic use variables have been used in their aggregate forms in previous studies. However, the literature has indicated that symbolic use may be manifested as, among others, distorted use [15], using information not for its intended purpose [28], or to justify a decision already made [21]. The studies of these different dimensions, nevertheless, have been mainly conceptual. The factor analysis may reveal the different sub-dimensions of symbolic use which will be used to study the relationships between the various symbolic use dimensions and organizational culture. Principal component factor analysis with varimax rotation is used to extract the factors of the independent variable, symbolic use.

Table 1: Varimax Rotated Factor Loading for Independent Variable: Symbolic Information Use

	Items	Factors		
		1	**2**	**3**
1	Information is sometimes taken into account to justify the cost of having acquired it	**.856**		
2	Information is often collected to justify a decision already made	**.846**		
3	Information is often gathered to maintain good relationship with information suppliers	**.691**		
4	Information is sometimes manipulated in order to justify company decisions made on the basis of instinct	**.562**		
5	Instinct/intuition is often combined with information when making decisions		**.858**	
6	If information is difficult to obtain, guesses are made instead		**.797**	
7	Information frequently supports decisions made for other reasons		**.372**	
8	Information is often not considered in the making of decisions for which it was originally requested.			**.883**
9	Key executives often distort information in passing it on			**.717**
	Eigenvalue	2.384	1.596	1.556
	Variance (Cumulative %)	26.491	44.219	61.503
	Coefficient alpha	0.751	0.655	0.623

In Table 1, the analysis identified three factors having eigenvalues of greater than 1, with 61.503 percent of the variance explained. Item 7 is dropped from Factor 2 due to the low factor loading. Factor loading of 0.50 is used for selection of items in the factor based on the recommendation of Stevens [43]. Subsequently, reliability analysis is performed on these variables. The alpha coefficients are 0.751, 0.655, and 0.623 for Factor 1, 2, and 3, respectively. The variables derived from the analysis are named legitimating use, intuitive use and distorted use, respectively. Legitimating use is defined as the use of export information to

justify decisions already made on the basis of cost, good relationship, and instinct [45]. Intuitive use is the use of information with intuition or making guesses and distorted use is the conscious modification and non-use of export information [45].

Organizational culture

The measurement of organizational culture is adopted from Deshpande, Farley and Webster's [12] study. The measure has 16 items capturing the four elements of organizational culture, which are clan, adhocracy, hierarchy and market. Each organizational culture construct consists of four items representing four organizational dimensions; 1) kind of organization, 2) leadership, 3) cohesiveness, and 4) the importance placed by the organization. The respondents are asked to rate their level of agreement or disagreement with the items in terms of how similar the description fits their organizations. A five-point scale, ranging from 1 (strongly disagree) to 5 (strongly agree), is used to measure the variables.

Data Collection

Data for this study is collected via a self-administered mail survey among export managers within the Malaysian exporting organizations. The database of exporting firms is acquired from the Malaysia External Development Corporation (MATRADE). The questionnaire is mailed with a self-addressed reply envelope and a letter to the designated contact person in the database with a request that they forwarded it, if necessary, to the export managers of the organization or the person in charge of making the exporting decisions. An internet-based random number generator is used to generate 2,500 numbers and company names are then extracted from the MATRADE database A total of 137 completed questionnaires are returned with 131 usable responses. The unusable responses are due to too many missing items and one inappropriate respondent being the personal assistant of the General Manager. This is following the recommendations that low missing data that is less than 10% is less likely to produce biased results, regardless of the methods used to treat the missing data [3,36]. 121 unopened envelopes are returned by the postal service due to change of address or termination of operation. The usable response rate represents a 5.5% response rate. Local researchers in the Southeast Asian countries have informally indicated that businesses in this region generally distrust mail surveys and are too busy to entertain academic research which is seen as competitive intelligence, thus resulting in low response rate [19]. Analyses done on the usable data are descriptive analysis and correlation.

Sample

The highest number of organizations in this study has less than 51 employees (43.1%), the next highest is having 51-150 employees (27.7%) and the third highest with 151-200 employees (17.7%). In terms age of company, 37.7% of the companies have been in operations for 10-19 years, 28.5% have been in operations for 20-49 years, and 20.8% in 5-9 years. The highest number of companies in this study comes from the food industry (14.8%), 10.2% are in the electrical and electronics parts and components industry and also the furniture and parts industry. The organizations' profile is presented in Table 2.

Table 2: Organizations' Profile

		*n**	percent
Size	Less than 51	56	43.1
	51-150	36	27.7
	151-250	23	17.7
	251-500	8	6.2
	501-1000	5	3.8
	More than 1000	2	1.5
Age of company	Less than 5 years	15	11.5
	5-9 years	27	20.8
	10-19 years	49	37.7
	20-49 years	37	28.5
	50 years or more	2	1.5
Industry	Food	19	14.8
	Electrical & electronic parts and components	13	10.2
	Furniture and parts	13	10.2
	Manufacturers of metal	12	9.4
	Chemical and chemical products	10	7.8
	Rubber products	8	6.3
	Wood products	6	4.7
	Textile, clothing and footwear	4	3.1
	Petroleum products	3	2.3
	Beverages and tobacco	3	2.3
	Toy and sporting goods	2	1.6
	Transport equipment and parts	2	1.6
	Others	32	25

(Difference in n is due to item non-response)*

Table 3: Information use

Type of Use	Mean	SD
Instrumental/Conceptual Use We actively seek out information for specific decisions.	4.05	.680
Our confidence in making export decisions is increased as a result of information.	3.89	.856
We store information so that it can be used by others at a later date.	3.81	.795
Without information, the decisions we make would be very different.	3.76	.858
Information is translated into significant practical action in this company.	3.70	.772
Decisions based on information are more accurate than wholly intuitive ones.	3.67	.827
Information is often used specifically to make a particular export decision.	3.66	.810
The majority of information acquired by the company is used.	3.62	.728
The same piece of information is often used for more than one decision.	3.61	.750
Export decision would not be taken without detailed information	3.56	.887
Information often has relevance to our decisions.	3.55	.888
Our uncertainty associated with export activity is greatly reduced by information.	3.45	.896
Aggregate mean:	**3.69**	**.431**
Symbolic Use		
Information frequently supports decisions made for other reasons.	3.56	.728
Information is sometimes taken into account to justify the cost of having acquired it.	3.52	.925
Instinct/intuition is often combined with information when making decisions.	3.52	.844
Information is often gathered to maintain good relationship with information suppliers.	3.23	1.064
Information is often collected to justify a decision already made.	3.06	.959
Information is sometimes manipulated in order to justify company decisions made on the basis of instinct.	2.95	.905
If information is difficult to obtain, guesses are made instead.	2.76	1.087
Key executives often distort information in passing it on.	2.80	.845
Information is often not considered in the making of decisions for which it was originally requested.	2.57	.823
Aggregate mean:	**3.11**	**.485**

RESULT AND DISCUSSION

Patterns of information use and organizational culture

In order to identify the patterns of information use and organizational culture among the exporters in the study, means are calculated for all items under each constructs. Table 3 presents the mean and standard deviation (SD) for information use while Table 4 presents the organizational culture.

From Table 3, on average the respondents in this study agree that most of the information collected by their companies are used instrumentally/conceptually which is using the information for its intended purpose. The results show that the item with the highest mean in the instrumental/conceptual use dimension is "We actively seek out information for specific purpose" with a mean of 4.05. This implies that the type of information that the exporting companies needed is specific and tailored to certain targets and purpose. As such, any export assistance extended to the companies by government agencies, for example, should first identify what is needed by the companies before dispensing any 'one-size-fits-all' kind of assistance. In addition, the value of information to the companies is that it increases their confidence in making decisions, is vital towards decision making, and increases the accuracy of the decisions. This implies that information will add value if they are problem-solving oriented. It is important, therefore, to know the types of problems faced by exporters so that the information is packaged accordingly. The aggregate mean for symbolic use of 3.11 indicates a lower usage compared to instrumental/conceptual use. Even though information may be used to support decisions made for other reasons, for example, exporters use information for decision making purposes to a higher degree. Nevertheless, the exporters do take into account the cost of acquiring the information. Certain information acquisition process is expensive, such as conducting in-house research or commissioning a research agency to gather information. As such, the information is used mainly because of its cost rather than its usefulness. Information may also be used together with intuition especially when a fast decision is required, and used to maintain good relationship with the supplier of the information.

For organizational culture in Table 4, in terms of the kind of organization (see all items no.1), the mean for market culture is the highest (mean = 3.56). The lowest mean is for hierarchy culture (mean = 3.32). For leadership practices (see all items no.2), adhocracy culture has the highest mean (mean = 3.95), with the lowest mean being for market culture (mean = 3.30). As for cohesiveness (see all items no. 3), the highest mean is for market culture (mean = 3.84), with the lowest for hierarchy culture (mean = 3.56). In terms of emphasizing what is important in the organization (see all items no. 4), hierarchy culture has the highest mean (mean = 4.06), while the lowest is for clan culture (mean = 3.78). Overall, the predominant culture among the companies in the study is adhocracy culture, followed by hierarchy, market and clan culture, although there is not much difference in the means.

Table 4: Organizational culture

	CLAN CULTURE	MEAN	SD
1	My organization is a very personal place. It is like an extended family. People seem to share a lot of themselves.	3.47	1.033
2	The head of my organization is generally considered to be a mentor, sage or a father or mother figure.	3.52	.917
3	The glue that holds my organization together is loyalty and tradition. Commitment to this firm runs high.	3.79	.811
4	My organization emphasizes human resources. High cohesion and morale in the firm are important.	3.78	.874
	Clan Culture Aggregate Mean	**3.64**	**.610**
	ADHOCRACY CULTURE	**MEAN**	**SD**
1	My organization is a very dynamic and entrepreneurial place. People are willing to take risks.	3.45	.905
2	The head of my organization is generally considered to be an entrepreneur, an innovator, or a risk taker.	3.95	.879
3	The glue that holds my organization together is a commitment to innovation and development. There is an emphasis on being first.	3.65	.944
4	My organization emphasizes growth and acquisition of new resources. Readiness to meet new challenges is important.	4.04	.782
	Adhocracy culture aggregate mean	**3.77**	**.703**
	HIERARCHY CULTURE	**MEAN**	**SD**
1	My organization is a very formalized and structured place. Established procedures generally govern what people do.	3.32	.939
2	The head of my organization is generally considered to be a coordinator, an organizer, or an administrator.	3.82	.840
3	The glue that holds my organization together is formal rules and policies. Maintaining a smooth-running institution is important here.	3.56	.807
4	My organization emphasizes permanence and stability. Efficient, smooth operations are important.	4.06	.668
	Hierarchy culture aggregate mean	**3.69**	**.593**
	MARKET CULTURE	**MEAN**	**SD**
1	My organization is very production oriented. A major concern is with getting the job done, without much personal involvement.	3.56	.912
2	The head of my organization is generally considered to be a producer, a technician, or a hard-driver.	3.30	.954
3	The glue that holds my organization together is the emphasis on tasks and goal accomplishment. A production orientation is commonly shared.	3.84	.677
4	My organization emphasizes competitive actions and achievement. Measurable goals are important.	3.97	.670
	Market culture aggregate mean	**3.67**	**.561**

The results imply that more than one culture may exist within an organization, but there may be one predominant culture that mainly determines the way that the organizations do things. In the case of exporters, the dominant culture determines how the organization would tackle internationalization. Adhocracy culture is characterized by entrepreneurial leadership, emphasizing growth, innovation, and risk taking and considered to have an external orientation and informal structure. An adaptable and externally oriented culture such as adhocracy culture has the greatest potential to become successful exporters [14]. Hierarchy culture is more bureaucratic, characterised by a formalized, structured place, held together by formal rules and policies. It may appear that this culture may not be conducive to be successful exporters. However, it was found that in stable industries, firms can compete effectively by adhering to orders and rules [16,27]. Market culture is characterized by its emphasis on competitive advantage, which is necessary for international ventures. However, clan culture focuses on internal maintenance such as employee satisfaction, morale, and cohesiveness. Because of the greater emphasis on internal orientation and less on financial goals, they have lower potential to become successful exporters [14].

Table 5: Correlation among Information Use and Organizational Culture (n=131)

Pearson correlation	Instrumental/ Conceptual use	Legitimating use	Intuitive use	Distorted use
Clan	.239**	.241*	-.022	-.004
Hierarchy	.168	.114	.048	.072
Adhocracy	.360**	.243**	-.033	-.014
Market	.260**	.290**	.010	.072

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

The relationship between information use and organizational culture

Pearson correlation is used to test the relationship between information use and organizational culture. The result is presented in Table 5.

Five out of sixteen correlations are statistically significant at below 0.30 level, with one correlation above 0.35. Instrumental/conceptual and legitimating uses are significantly correlated with three dimensions of culture (i.e. clan, adhocracy, and market) except with hierarchy culture. Instrumental/conceptual use is significantly correlated with clan, adhocracy, and market culture at 0.01 significance level. This result is somewhat similar to the study by Moorman [30] which found significant relationship between conceptual use of information and hierarchy culture, and between instrumental use and clan culture. On the other hand, legitimating use is significantly correlated with adhocracy and market culture at 0.01 level, but significantly correlated with clan culture at 0.05 level. Hierarchy culture is found to have no significant correlation with any of the information use dimensions.

Instrumental and conceptual uses refer to rational and straightforward utilization of information in making decisions [5]. Legitimating use, a dimension of symbolic use, pertains to the employment of information to justify decisions already made, justify the cost of

acquiring the information and for maintaining good relations with information providers. Instrumental/conceptual and legitimating uses are found to have significant association with three dimensions of culture which are clan, adhocracy, and market culture. Internally focused culture such as the clan culture would use information positively to increase their confidence, get acceptance among members of the organization, and also for economic purposes. The legitimate use of information by clan culture indicates that the managers within this culture are confident enough to use information in a symbolic way because they have the support and trust of their own people to make any decision necessary for the improvement of the organization's performance. Adhocracy culture which is more externally focused would have the support of an entrepreneurial leadership and use information for the company's strategic and economic performance. Another externally focused culture is the market culture which may use information to maintain growth and market competitiveness.

On the other hand, intuitive use and distorted use are found to have no relationship with organizational culture. Although companies may behave differently when looking for and processing information [44], companies in this study may not agree to use information that may be detrimental to their well-being. Such use, if any at all, seems to be non-discriminating among cultures. In addition, hierarchy culture is found to have no significant correlation with any of the information use dimensions. This finding provide further support for previous studies that found hierarchy culture to have the lowest levels for all pattern of information processing [e.g., 44].

CONCLUSION

The four types of cultures are not mutually exclusive within an organization, rather they coexist, with one may be more dominant than the others [25]. For exporters, the dominant culture may determine how the organization approaches its international ventures and also its commitment towards exporting.

Past studies in the area of organizational culture and information processing have focused on the formal-informal continuum of the competing values model. This study extends the body of knowledge by looking at the competing values model through the internal-external continuum, providing empirical evidence of a relationship between externally oriented cultures (i.e. adhocracy and market culture) with instrumental/conceptual use and legitimating use of information.

However, there is no evidence of intuitive and distortive use based on culture. The organizations know well enough the negative implications of using information in that manner to avoid them. One interesting finding is that hierarchical culture is not related to any of the acquisition and use variables. Being more bureaucratic, formal, and structured, organizations with this culture may not be too adventurous in obtaining information. Hierarchy culture is found to maintain a high degree of formality in planning [44].

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DETERMINING THE IMPACT OF LOGISTICS FACTORS ON THE BUSINESS SUCCESS OF THE ELECTRICAL AND ELECTRONICS INDUSTRY IN THAILAND BASED ON DIFFERENT SIZES OF THE FIRMS

ABSTRACT

An empirical analysis of internal and external logistics factors to the business performance of the firms of the Electrical and Electronics Industry in Thailand is presented. This study used data collected from the high level logistics executives in the Electrical and Electronics Industry. The analysis was divided into two scenarios based on the firm's capital investment (less than or higher than 100 million baht). Questionnaires were used as a tool to collect data and Structural Equation Modeling (SEM) was used to analyze relationships among these factors. This study attempted to examine a structural model of internal and external logistics factors on firm's business performance. Seven hypothesized relationships were tested on five factors which consisted of human resource management, logistics infrastructure, internal operational activities, external operational activities and business performance. The outcomes can recommend important logistics factors to the firms in each scenario so they can focus more on these factors with their limited resources and budgets.

Keywords: Electrical and Electronic Industry, Internal and External Logistics Factors, Structural Equation Modeling, Performance Evaluation, Supply Chain Performance.

1. INTRODUCTION

Fierce competition in today's global markets, the introduction of products with shorter life cycles, and the heightened expectations of customers have forced business enterprises to invest in, and focus attention on, their supply chains. This, together with continuing advances in communications and transportation technologies (e.g., mobile communication, internet, and overnight delivery), has motivated the continuous evolution of the supply chain to manage it effectively. In a typical supply chain, raw materials are procured and items are produced at one or more factories, then shipped to warehouses for intermediate storage, and subsequently shipped to retailers or customers. Consequently, to reduce cost and improve service levels, effective supply chain strategies must take into account the interactions at the various levels in the supply chain.

This study investigates internal and external logistics factors in the supply chain of the Electrical and Electronics Industry in Thailand. This is to evaluate their impact on the firms' business performance based on their different sizes of investment. Questionnaires are used as a tool to collect data from the firms and Structure Equation Modeling (SEM) is employed as a tool to analyze the proposed relationship among these factors.

2. THEORECTICAL FRAMEWORK AND HYPOTHESES

There are three groups of main factors in the questionnaire, which are tested to find their impacts towards the firm's competitive capabilities and business performance. As seen in Figure 1, the first group is related to the external logistics factors while the second group evaluates the internal logistics factors. Finally, the last group evaluates the firm's business performance.

Internal Logistics Factors: These factors include Human Resource Management (HRM) and Internal Operational Activities of the firms (IO). These activities represent the firms' internal operations relating to manpower, human resource planning, and employee recruitment, as well as the day to day internal operations management of the firms.
External Logistics Factors: These factors include the fundamental Logistic Infrastructure (LI) and External Operational Activities of the firms (EO). Both factors are mainly linked to activities beyond the firms' internal operations. They represent fundamental logistic infrastructure, transportation and supplier linkages.

Business Performance: This includes the firm's operating performance such as return on investment, profits as a percentage of sales, net income before taxes, and present value of the firm. These performances are considered to be the main criteria for evaluating the business performance of the firms.

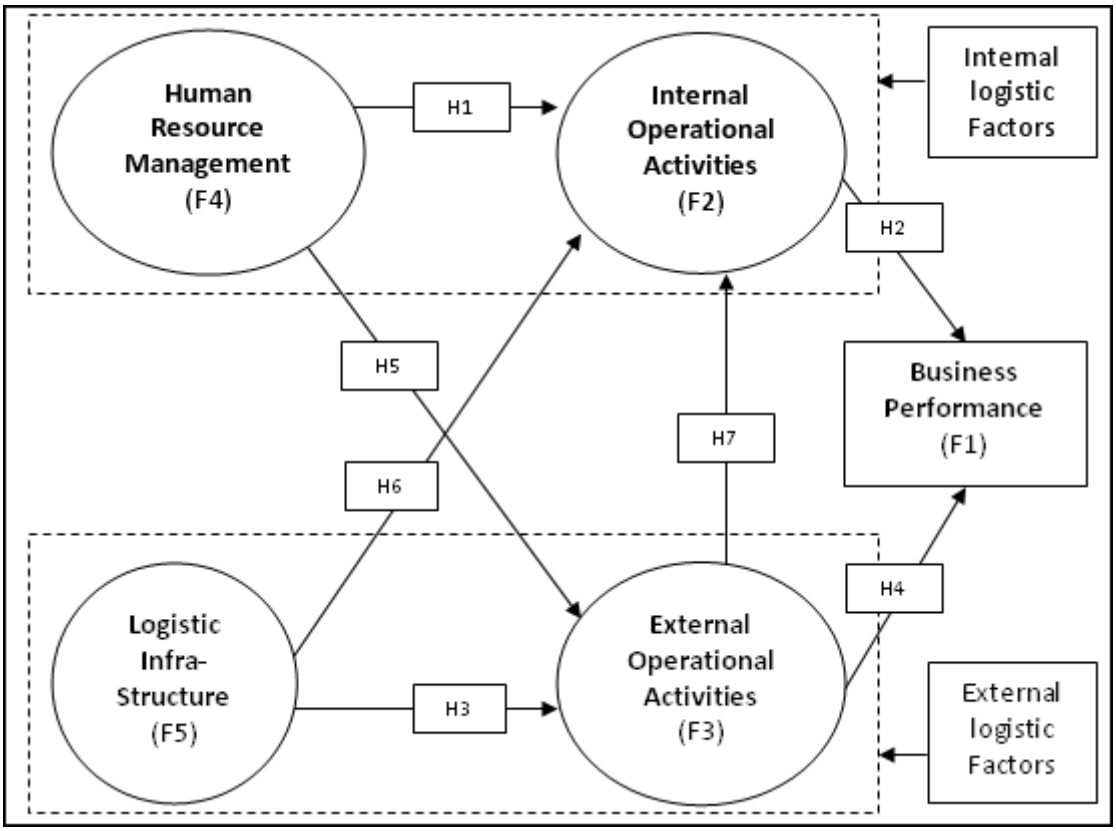

Figure 1: Research hypothesis

2.1 Relationships of External Operational Activities (EO) in relation to Internal Operational Activities (IO)

Hypotheses 1 and 5 propose that strategic Human Resource Management (HRM) has a positive impact on Internal Operational Activities (IO) and External Operational Activities (EO). As a result, the following hypotheses are proposed:
H1: Human Resource Management (HRM) has a positive impact on Internal Operational Activities (IO).
H5: Human Resource Management (HRM) has a positive impact on External Operational Activities (EO).

2.2 Relationships of Logistic Infrastructure (LI) in relation to External Operational Activities (EO) and Internal Operational Activities (IO)

Hypotheses 3 and 6 propose that the Logistic Infrastructure (LI) has a positive impact on External Operational Activities (EO) and Internal Operational Activities (IO). As a result, the following hypotheses are proposed:
H3: Logistic Infrastructure (LI) has a positive impact on External Operational Activities (EO).
H6: Logistic Infrastructure (LI) has a positive impact on Internal Operational Activities (IO).

2.3 Relationships of External Operational Activities (EO) in relation to Internal Operational Activities (IO)

Hypothesis 7 suggests that positive relationships between the External Operational Activities (EO) have an impact on Internal Operational Activities (IO). As a result, the following hypothesis is proposed:
H7: External Operational Activities (EO) has a positive impact on Internal Operational Activities (IO).

2.4 Relationships of Internal Operational Activities (IO) and External Operational Activities (EO) in relation to Business Performance (BP)

Hypotheses 2 and 4 support that positive relationship between the Internal Operational Activities (IO) and External Operational Activities (EO) have an impact on Business Performance (BP). Therefore, the following hypotheses are proposed:
H2: Internal Operational Activities (IO) has a positive impact on Business Performance (BP).
H4: External Operational Activities (EO) has a positive impact on Business Performance (BP).

3. RESEARCH METHODOLOGY

A survey was undertaken to gather data for testing the research hypotheses. The surveys include multiple scale items for each of the factors. The respondents responded from a variety of firms in the Electrical and Electronics Industry that are listed by Electrical and Electronics Institution. From the 1,100 surveys in the target samples, 336 responses were received. Thirty three surveys were excluded from the analysis because of incomplete information. Thus, the response rate was about 30.54%. The questionnaire's questions were pre-tested by a few respondents from an Electronic Manufacturing firm, Delta Electronics (Thailand) Plc. This is

to ensure readability, eliminate ambiguity and make sure that close-ended questions have a complete array of possible responses and so on. The analysis was also separated into two scenarios based on the firm's capital investment. Small-size firms are the group of firms that has their capital investments less than 100 million baht while large-size firms are the group of firms that has their investments at least 100 million baht. This is to find the impact of logistics factors based on the different sizes of the firms towards their business performance. From the 303 surveys, 117 samples are classified as the large-size firms and 186 samples are the small-size firms. The responses samples were comprised of high ranking plant or production managers as well as logistics managers. The responses were recorded using a 5-point Likert-type scale (1 = strongly disagree to 5 = strongly agree) for each group of factors.

The study uses Structural Equation Modeling (SEM) with SAS to analyze the research hypotheses. SEM is performed by using a two-step procedure. First the measurement model is developed. Then, it is followed by development of the structural model (Anderson and Gerbing, 1988). The structural model differs from the measurement model because it includes causal paths based on hypothesize relationships between specific factors in the model.

4. RESULTS

Confirmatory Factor analysis (CFA) was used to validate measures of constructs for developing the measurement. CFA is a more effective method for assessing unidimensionality than exploratory factor analysis, coefficient alpha, and item-to-total correlation. The purpose is to ensure unidimensionality of the multiple-item constructs or low item-to-constructs and to eliminate unreliable items (Bollen, 1989). Items that loaded on multiple constructs were deleted from the model prior to testing. The measures underlying the constructs are given in Table 1. The measurement model was analyzed using the SAS program and CALIS procedure. An adequate fit was achieved for the measurement model.

For the large-size firms' scenario, the chi-square to *df* freedom ratio = 1.39, the Bentler's Comparative Fit Index (CFI) = 0.9222, Bentler and Bonett's Non-normed Fit Index (NNFI) = 0.9076, all of the *t*-statistics for the indicator variables were greater than 2.576, significant at $p<0.01$, and no standard errors were near zero. The confirmatory factor analysis resulted in the elimination of several individual items (V6, V7, V12, V15, V19, V22, and V26) because of low factor loadings or high residuals. This result was not surprising because many of the survey items had been developed specifically for the study, and other items had been adapted from other literature streams.

For the small-size firms' scenario, the chi-square to *df* freedom ratio = 1.45, the Bentler's Comparative Fit Index (CFI) = 0.9326, Bentler and Bonett's Non-normed Fit Index (NNFI) = 0.9232, all of the *t*-statistics for the indicator variables were greater than 2.576, significant at $p<0.01$, and no standard errors were near zero. Similarly, the confirmatory factor analysis also resulted in the elimination of a few individual items (V9, V10 and V11).

Table 1: Measures underlying the constructs

Construct and measurement items
Business Performance (BP)
V1: Market share of the firms V2: Return on investment V3: Profits as a percentage of sales V4: Increasing the capacity of production recently V5: The present value of the firm
Internal Operational Activities (IO)
V6: The firm is currently using effective production planning ,and inventory management software, such as MRP, ERP, SAP, etc. V7: Demand forecasting of the firms is quite accurate and has a high potential to be used for its production planning. V8: The firm has managed its inventory control system effectively so that its level of inventory is suitably set and managed. V9: The firm has an ability to respond to the customer's order quickly and promptly. V10: The firm can always produce its product with high quality and conform to the required standard.
External Operational Activities (EO)
V11: The firm always exchanges important information such as production and inventory level with key suppliers. V12: The firm has never experienced late order delivery to customers in recent time. V13: The firm can manage its transportation vehicles or outsource firms to deliver its products promptly. V14: The firm has suitable transportation methods to deliver its products effectively. V15: The firm has an effective system to find the right materials from the right suppliers.
Human Resource Management (HRM)
V16: The firm can recruit new employees to fill its requirement perfectly. V17: The firm always provides good and effective training programs for its employees. V18: The firm always provides good return and appropriate welfare for its employees. V19: The firm has maintained and kept good employees with the firm for a long period of time. V20: The firm has an opened mind to receive recommendation from employees and respond to them. V21: Every department in the firm is willing to participate and mutually join activities to strengthen their relationships.
Logistic Infrastructure (IL)
V22: Road network coverage is sufficient and appropriate. V23: Multimode transportation such as land, water or air can be done to reduce the transportation cost. V24: Ports for importing and exporting materials and products are sufficient and can offer good and quick service. V25: Information technology network is reliable and provides good coverage throughout the country. V26: Import and export tax systems for collecting and redemption are effective and well facilitated. V27: Electrical and water infrastructures are reliable and can provide good coverage throughout the country.

Table 2: Measurement model for large-size firms

Individual items, their respective factors and coefficient alpha for each factor. (All scales were 5-point Likert scales where 1 = Strongly disagree - 5 = Strongly agree)	Unstandardized coefficient	Standard error	*t*-value	Standardized coefficient
Business Performance (BP) (α = 0.7919)				
V1: Market share of the firms	0.5084	0.0679	7.4826	0.6836
V2: Return on investment	0.7017	0.0654	10.7367	0.8784
V3: Profits as a percentage of sales	0.6886	0.0673	10.2375	0.8519
V4: Increasing the capacity of production recently	0.6183	0.0806	7.6744	0.6967
V5: The present value of the firm	0.6100	0.0747	8.1649	0.7292
Internal Operational Activities (IO) (α = 0.7335)				
V8: The firm has managed its inventory control system effectively so that its level of inventory is suitably set and managed.	0.6100	0.0747	8.1649	0.6223
V9: The firm has an ability to respond to the customer's order quickly and promptly.	0.6851	0.0752	9.1052	0.8014
V10: The firm can always produce its product with high quality and conform to the required standard.	0.5225	0.0646	8.0865	0.7334
External Operational Activities (EO) (α = 0.7126)				
V11: The firm always exchanges important information such as production and inventory level with key suppliers.	0.4804	0.0817	5.8810	0.5629
V13: The firm can manage its transportation vehicles or outsource firms to deliver its product promptly.	0.6804	0.0673	10.1097	0.8468
V14: The firm has suitable transportation methods to deliver its products effectively.	0.6561	0.0574	11.4369	0.9187
Human Resource Management (HRM) (α = 0.7684)				
V16: The firm can recruit new employees to fill its requirement perfectly.	0.4924	0.0847	5.8133	0.5876
V17: The firm always provides good and effective training programs for its employees.	0.5709	0.0780	7.3194	0.7088
V18: The firm always provides a good return and appropriate welfare for its employees.	0.4347	0.0830	5.2373	0.5379

V20: The firm has an open mind to receive recommendations from employees and respond to them.	0.5221	0.0844	6.1891	0.6189
V21: Every department in the firm is willing to participate and mutually join activities for strengthening their relationships.	0.4717	0.0929	5.0750	0.5235
Logistic Infrastructure (IL) (α = 0.7607)				
V23: Multimode transportation such as land, water or air can be done to reduce the transportation cost.	0.6687	0.1038	6.4428	0.6583
V24: Ports for importing and exporting materials and products are sufficient and can offer good and quick service.	0.6410	0.0841	7.6215	0.7643
V25: Information technology network is reliable and provides good coverage throughout the country.	0.5189	0.0915	5.6719	0.5895
V27: Electrical and water infrastructures are stable, reliable and can provide good coverage throughout the country.	0.2781	0.1023	2.7173	0.3012
Note that V6, V7, V12, V15, V19, V22, V26 were eliminated				

Table 3: Measurement model for small-size firms

Individual items, their respective factors and coefficient alpha for each factor. (All scales were 5-point Likert scales where 1 = Strongly disagree - 5 = Strongly agree)	Unstandardized coefficient	Standard error	*t*-value	Standardized coefficient
Business Performance (BP) (α = 0.8853)				
V1: Market share of the firms	0.6281	0.0581	10.8138	0.7493
V2: Return on investment	0.6466	0.0473	13.6713	0.8773
V3: Profits as a percentage of sales	0.7024	0.0580	12.1141	0.8106
V4: Increasing the capacity of production recently	0.7092	0.0638	11.1092	0.7637
V5: The present value of the firm	0.6308	0.0657	9.5987	0.6867
Internal Operational Activities (IO) (α = 0.7689)				
V6: The firm is currently using effective production planning ,and inventory management software, such as MRP, ERP, SAP, etc.	0.6308	0.0657	9.5987	0.5598
V7: Demand Forecasting of the firms is quite accurate and has a high potential to be used for its production planning.	0.7265	0.0637	11.4051	0.8184
V8: The firm has managed its inventory control system effectively so that its level of inventory is suitably set and managed.	0.6483	0.0601	10.7920	0.7831
External Operational Activities (EO) (α = 0.8597)				
V12: The firm has never experienced late order delivery to customers in recent time.	0.5041	0.0579	8.7089	0.6365
V13: The firm can manage its transportation vehicles or outsource firms to deliver its product promptly.	0.6770	0.0513	13.2044	0.8606
V14: The firm has suitable transportation methods to deliver its products effectively.	0.6828	0.0483	14.1384	0.8998
V15: The firm has an effective system to find the right materials from the right suppliers.	0.5242	0.0536	9.7739	0.6956
Human Resource Management (HRM) (α = 0.8655)				
V16: The firm can recruit new employees to fill its requirement perfectly.	0.4001	0.0700	5.7138	0.4533
V17: The firm always provides good and effective training programs for its employees.	0.6221	0.0635	9.7930	0.7071
V18: The firm always provides a good return and appropriate welfare for its employees.	0.5617	0.0710	7.9102	0.5986

V19: The firm has maintained and kept good employees with the firm for a long period of time.	0.6171	0.0646	9.5456	0.6963
V20: The firm has an open mind to receive recommendations from employees and respond to them.	0.6745	0.0618	10.9107	0.7650
V21: Every department in the firm is willing to participate and mutually join activities for strengthening their relationships.	0.7641	0.0666	11.4696	0.7925
Logistic Infrastructure (IL) (α = 0.7786)				
V22: Road network coverage is sufficient and appropriate.	0.5909	0.0746	7.9236	0.6248
V23: Multimode transportation such as land, water or air can be done to reduce the transportation cost.	0.6603	0.0808	8.1684	0.6406
V24: Ports for importing and exporting materials and products are sufficient and can offer good and quick service.	0.6372	0.0705	9.0418	0.6955
V25: Information technology network is reliable and provides good coverage throughout the country.	0.5150	0.0739	6.9647	0.5609
V26: Import and export tax systems for collecting and redemption are effective and well facilitated.	0.5650	0.0785	7.2006	0.5769
V27: Electrical and water infrastructures are stable, reliable and can provide good coverage throughout the country.	0.5238	0.0779	6.7242	0.5443
Note that V9, V10, V11 were eliminated				

Table 2 and 3 provides unstandardized coefficients, standard errors, and *t*-values for each individual item for the large and small-size firms consecutively. These numbers provide information about the local fit, that is, how well each individual item is related to its respective factor. Each of the coefficients is large and significant at the $p<0.01$ level. They also provide coefficient alphas for each factor after the measure purification process. The coefficient alphas are ranged from 0.7126 to 0.7919 (for large-size firms' scenario) and 0.8853 to 0.7689 (for small-size firms' scenario). De Vellis (2003) noted that alpha levels below 0.6 are unacceptable. Goodness of fit is determined by comparing the structural model (full maintained model) to alternative models. One tests alternative models by sequentially deleting or adding paths. The measures of goodness-of-fit are shown in Table 4 and Table 5. After deleting 3 paths representing Hypothesis 3, 4 and 6 (for the large-size firms' scenario) and deleting 1 path representing Hypothesis 4 (for the small-size firms' scenario), the results of the test of the overall fit of the model can be shown in Figure 2 and 3 and are provided below. The chi-square statistic is significant. Other goodness-of-fit indices indicate an acceptable fit of the structural model to the data, especially given the exploratory nature of the study. Bentler's Comparative Fit indices (CFI) and Bentler and Bonett's Non-normed Index (NNFI) are above the desired 0.90 level (Byrne, 2006; Hair *et al*., 1995) and thus indicate good fit. The ratio of chi-square to degrees of freedom is 1.42 and 1.48 respectively, which is below the recommended 3.0 threshold (Hartwick and Barki, 1994; Hair *et al*., 1995), which also indicates a good fit. The adjusted goodness of fit index is above the desired 0.80 threshold (Hartwick and Barki, 1994; Wheaton *et al*., 1977; Segars and Grover, 1993), although below the conservative 0.90 thershold recommended by Bagozzi and Yi (1988).

Table 4: Measures of goodness of fit for the structural model for large-size firms

Model	χ^2	*df*	χ^2/*df* ratio*	CFI**	NNFI***
Null model	1007.3	190	-	-	-
Uncorrelated factors	392.2136	170	-	0.7281	0.6961
Full maintained model	224.1593	162	1.38	0.9239	0.9108
H 6 path deleted	224.2866	163	1.37	0.9250	0.9126
H 3 path deleted	227.5769	164	1.38	0.9222	0.9099
H 4 path deleted	234.8728	165	1.42	0.9145	0.9016
Measurement model	223.5983	160	1.39	0.9222	0.9076

* χ^2/*df* ratio < 3 (Hartwick and Barki, 1994; Hair *et al*., 1995) ** CFI > 0.9 indicates a good fit of the data to the model (Bentler and Bonet, 1980) *** NNFI > 0.8 indicates an acceptable fit (Wheaton *et al*.,1977; Segars and Grover, 1993; Bagozzi and Yi, 1988)

Table 5: Measures of goodness of fit for the structural model for small-size firms

Model	χ^2	*df*	χ^2/*df* ratio*	CFI**	NNFI***
Null model	1890.4	276	-	-	-
Uncorrelated factors	508.0703	250	-	0.8435	0.8272
Full maintained model	359.9145	244	1.47	0.9282	0.9188
H 4 path deleted	362.2389	245	1.47	0.9274	0.9182
Measurement model	353.0948	242	1.45	0.9326	0.9232

* χ^2/*df* ratio < 3 (Hartwick and Barki, 1994; Hair *et al*., 1995) ** CFI > 0.9 indicates a good fit of the data to the model (Bentler and Bonet, 1980) *** NNFI > 0.8 indicates an acceptable fit (Wheaton *et al*.,1977; Segars and Grover, 1993; Bagozzi and Yi, 1988)

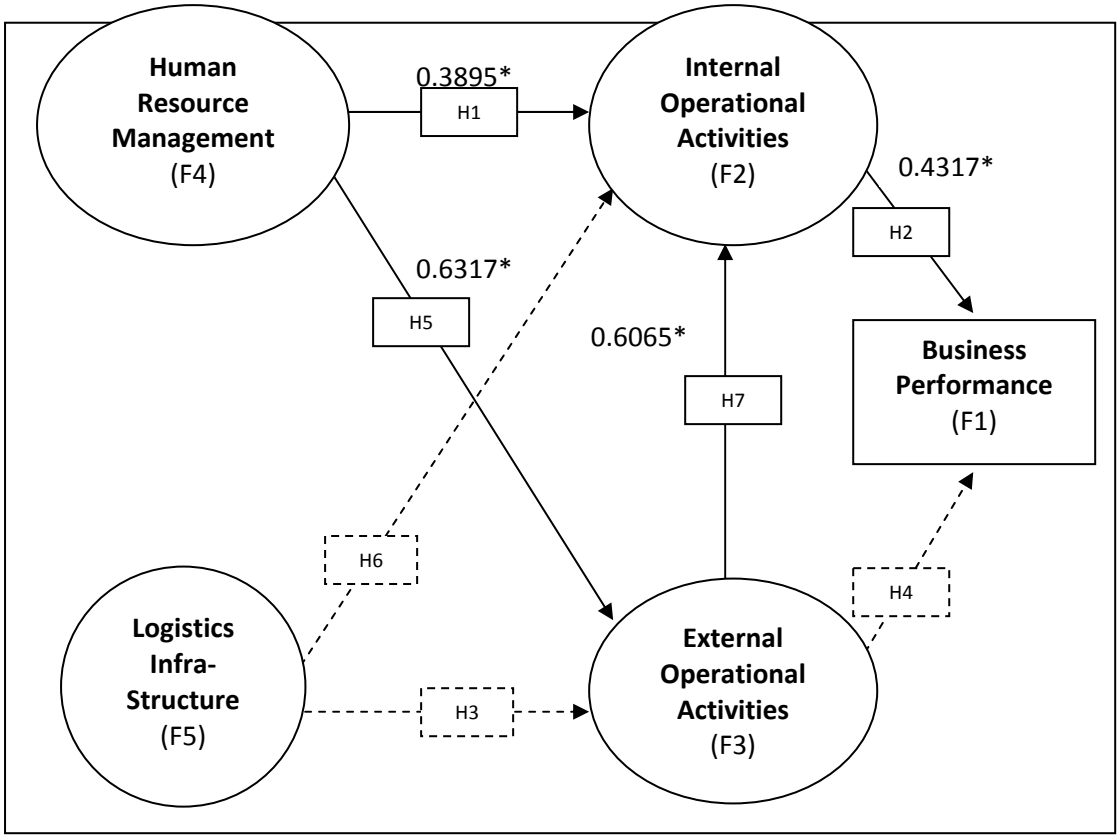

Figure 2: Structural model for large-size firms

----▶ Denotes non-significant paths ——▶ Denotes significant paths

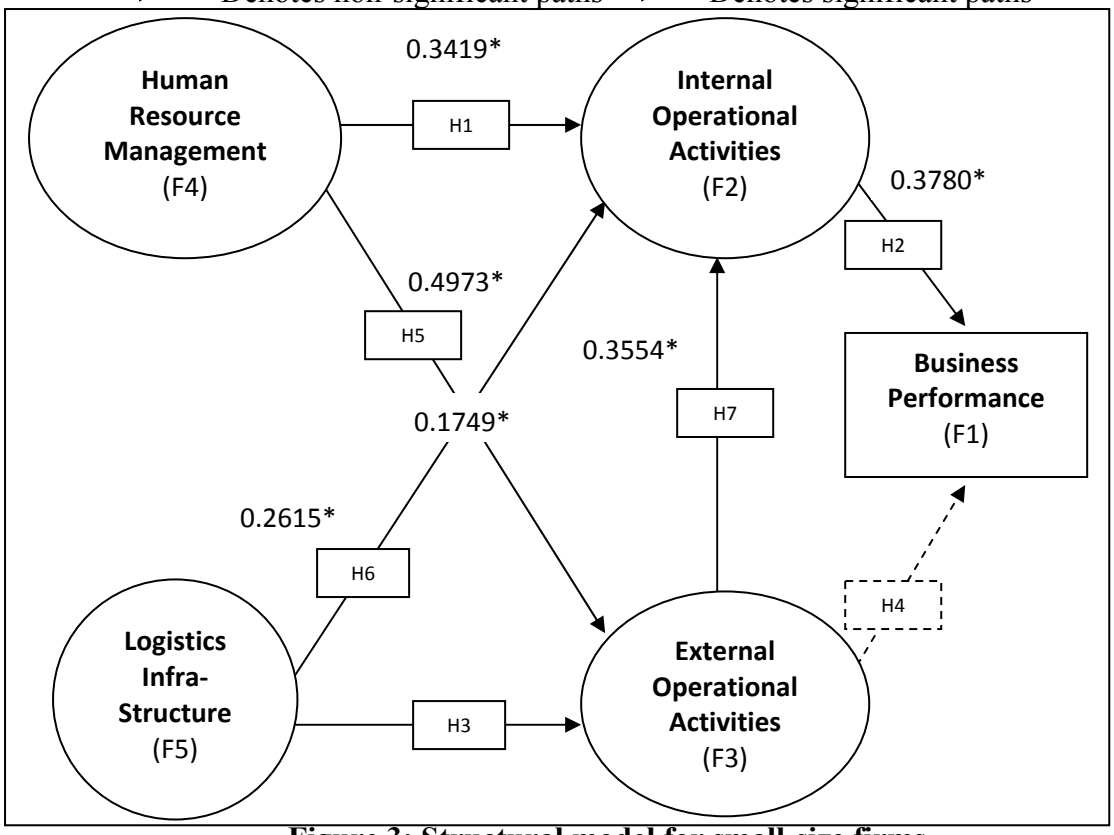

Figure 3: Structural model for small-size firms

These results are indicative of an acceptable fit of the model to the data, especially given that many of the measures used in this study were either developed for the study, or adapted from other studies. The R^2 values for the three structural equations, which represent the variance explained by the endogenous factors of BP, IO, and EO, are 0.19, 0.82, and 0.40, respectively (for the large-size firms' scenario) and 0.14, 0.56, 0.32, respectively (for the small-size firms' scenario).

5. DISCUSSION AND MANAGERIAL IMPLICATIONS

5.1 Large-size firms

5.1.1 Significant paths

Four paths tested positive and significant ($p<0.01$). These paths consist of H1 representing the path from HRM to IO; H2, testing the effect of the IO factor on factor of BP; H5, representing the path from HRM to EO, and Finally H7, representing the path from EO to IO

5.1.1.1 The effects of Human Resource Management (HRM), on both Internal Operational Activities (IO) and External Operational Activities (EO), were positive (H1 and H5)
The paths from HRM to both IO and EO were positive and significant ($p<0.01$). HRM refers to the personnel related practices and policies an organization needs to develop its current employees. Developing the human resources of a firm has shown to be a key to improving both internal and external operational functions. The business in this industry that has made training, education, and development of HRM a priority have seen it pay off through more efficient operations. Bridle (2010) reported the strategic role of HRM that could help to ensure organizational success by warning managers against abdicating responsibility for leading their people. HRM can help an organization to succeed, provided that all employees understand their role, work together and take responsibility for their contribution. As a result, an improvement in HRM is critical for building fundamental supports to all operational activities.

5.1.1.2 The effects of External Operational Activities (EO), on Internal Operational Activities (IO) towards Business Performance (BP), were positive (H2 and H7)
The path from EO to IO was positive and significant ($p<0.01$). This supports the fact that external operational activities have shown to contribute to the success of firms' internal management. As the firms try to improve their internal operations, their external operational activities must be in a good shape to support the internal activities. One setback would impede the effectiveness of another. External operations refer to all logistic activities relating to the flows of goods outside the company boundary, and usually involve transportation or freight management in various transportation modes. Gimenez and Ventura (2005) also reported that the internal and external operations integration could influence each other. The integration in the logistics-marketing interface does not lead to reductions in costs, stock-outs and lead-times, while the integration achieved in the logistics-production interface does improve these performance measures.

As the path from IO to BP was positive and significant ($p<0.01$), this provides an empirical evidence of IO that can help firms to achieve business success. As, it is imperative for the

firms to excel in their internal operations on which the efficient and effective flow of goods and information in supply chains depend, this becomes the direct impact on the firms' business performance. Law and Pujawan (2009) reported that the internal operation including various factors within a firm such as production planning, human factors, and the system scheduling, could affect the firms' system performance in terms of stability, cost, service level and a better internal operation would eventually lead to a better operational performance.

5.1.2 Non-significant paths

There are 3 paths which were not significant and are recommended to be dropped during the Wald test. These paths included H3, representing the path from LI factor to EO and H4, testing the effect of the EO on BP and finally H6, representing the path from LI factor to IO.

The propose hypotheses H3 and H6 were rejected because LI has shown no direct influence on both EO and IO. This may be due to the fact that the large-size firms do not regard much of the effect of LI**.** The large-size firms with their better financial abilities could manage and place themselves in a better logistics location where electrical, water and transportation infrastructure have been established more completely. From our collected surveys, 77 firms (65.8% from the total of 117 large-size firms) are located in the main towns or industrial estates whereas 40 firms (34.2%) are located outside the main towns. As a result, the implication of the logistics infrastructure on their normal operations may not be as much when compared to the small-size firms who have limited accessibility and financial abilities. Referring the rejection of the proposed hypothesis H4, where EO has shown no impact on BP, it seems that an improvement in external operational activities without improving on its internal management would lead to little impact on the firms' performance. Therefore, emphasizing on building good infrastructure and external operational activities without strengthening its own HRM and internal management does not significantly help the business performance of the firm. Hence, competitive advantage for many manufacturing firms now lies in their ability to effectively implement superior manufacturing, continual improvement of reliability of existing production processes, and developing a continual stream of quality products.

5.2 Small-size firms

5.2.1 Significant path

In general, overall results for the small-size firms' scenario are also quite similar to the large-size firms' scenario. However, there are two different significant paths in this scenario which are H3, representing the path from LI to EO and H6, representing the path from LI to IO that are now significant and need further investigation.

5.2.1.1 The effects of Logistics Infrastructure (LI), on both Internal Operational Activities (IO) and External Operational Activities (EO) were positive (H3 and H6)

The paths from LI to IO and EO were both positive and significant ($p<0.01$). Internal operational activities refer to all flows of goods, people and information, within the firm boundary. It is responsible for input of product, storage of raw materials, internal transportation, and storage of partly finished and finished products, preparation of orders and

return of packaging to suppliers while the external operational activities refer to the exchange of information and material transportation outside the firms. Again from our collected surveys, only 56 firms (30% from the total of 186 small-size firms) are located in the main towns or industrial estates where the basic logistics infrastructures are sufficient and more completed whereas up to 130 firms (70%) are located in the rural areas outside the main towns. With weaker financial ability of the small-size firms, their internal and external operations still need to rely very much on the logistics infrastructure. This finding is different to the case of the large-size firms in which they could depend more on themselves. Vastag *et al.* (1994) reviewed current manufacturing trends with a new type of logistical infrastructures supporting agility and quick response to global markets. They showed how these new logistical infrastructures were being put in place and created logistical environment to improve manufacturing competitiveness. They must be the linkages within the organization and throughout the entire organizational network.

5.2.2 Non-significant paths

There is only one path which was not significant and is recommended to be dropped during the Wald test for the small-size firms' scenario. This path represented the proposed hypothesis H4, where EO has proven to show no impact on BP. This is similar to the case of the large-size firms, which can be concluded that an improvement in external activities without improving on its internal management would not eventually improve the business performance of the firms.

6. CONCLUSION

The research outcomes indicate that there are relationships among internal logistics factors, external logistics factors as well as the firm's business performance. The results show some supports for some of the hypotheses which have been formulated in our theoretical framework. For the large-size firms, it shows that the logistic infrastructure does not have any impact on the internal and external operation activities as well as those external operational activities do not have a direct impact on business performance. On the other hand, for the small-size firms, it shows an impact of logistics infrastructure on the internal operational activities.

Human resource management shows its significant impact on both internal operational and external operational activities for both scenarios and it is the key factor for successful integration between external and internal logistics as well as the business performance. The firms must be able to develop their human resources by using an appropriate strategy for attracting quality workforces involving good human resource planning and effective employee recruitment and developing them through a proper training and development, and a fair performance appraisal to maintain quality workforces with the firms.

External operational activities have been shown to contribute to the effectiveness of the firm's internal management for all firms' sizes. Even though, the external operational activities do not have a direct impact on the firm's business performance, they can indirectly impact via improving the internal operations management. As a result, without a good and sound support from the external operational activities (such as sufficient and reliable

transportation vehicles or good logistics methods to deliver products to the customers) the firms would not be able to manage their internal logistics and operations effectively. This would eventually impede the success of their business performances.

Comparing between the results of the firms in both groups, two links are different, which are H3 and H6, where the logistics infrastructure does not show the impact on both internal operational activities and external operational activities of the large-size firms but show this impact for the small-size firms. Although, the Logistics infrastructure is important for the firms' operations management, the result from the large-size firms reported no significant impact. This is due to the fact that they are more ready to facilitate themselves and have already put themselves in the place and the position where they can rely more on themselves while the small firms are more valuable and sensitive to the good or bad condition of these infrastructures.

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ROLE OF HIGHER EDUCATIONAL CLASSIFICATION AND STANDARDIZATION ENHANCING GLOBAL COMPETITIVENESS

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ABSTRACT

According to the most recently Global Competitiveness Report, it ranked the economic competitiveness 133 nominated countries worldwide during 2009-2010, indicating two key factors that have been taken into consideration for economic growth, including higher education and training which has produced well-educated workers as key for efficiency-driven economics. One of the most important factors for long-term economic development is innovation which is only factor that brings forth better standard of living. A consequence of crucial key for innovation-driven economics results from the emergence of Research University. Therefore, the classification becomes important tool to determine which higher educational institute has been classified as Research University. Meanwhile, to determine if Research University is qualified, it can be achieved by using educational quality assurance; for instances, accreditation, ranking and rating, educational performance, and so on. In addition, the National Qualifications Framework (NQF) contributes the confidence in the graduated's quality and qualification standard. So, the purpose of this paper was to point out the link of the role of higher educational classification and standardization enhancing the global competitiveness under scope of three questions. Firstly, "Is it alright saying that enhancing the university to Research University boosts the economic competitiveness?" Secondly, "how do you know which university is a Research University?" And lastly, what ensures the quality of the university that has been classified as Research University?

Keywords: The Global Competitiveness Report, Classification and Ranking, Higher Education, Research University, National Qualifications Framework

INTRODUCTION

Many countries are becoming aware of the urgent leveraging the economic competitiveness to keep pace with the current of globalization. The report for the national competitiveness assessment, or so-called "The Global Competition Report" proposed by the World Economic Forum, until now has been widely accepted for over three decades as ranking tool for global competitiveness (Schwab, 2009). It is cited that the Global Competition Report reflects the country's overall economic environment, and makes us acknowledge the existing competition in each country under the indicator of the economic prosperity, and enables individual countries understand what advantages and disadvantages in competition of the respective country are they. Consequently, the Global Competition Report becomes a crucial instrument

for policymakers and business leaders worldwide to formulate the appropriate policy and institutional reform and eventually lead to global competitiveness enhancement.

In addition, the paper demonstrated two important factors for competitiveness enhancement; firstly, higher education and training, which is a crucial key for efficiency-driven economics. Many literatures showed that higher education and training is important for countries to add the value chain beyond simple production process and products. In particular, the current economics have leveraged the competitiveness in manpower. Many industries need for well-trained workers who are potential adapt themselves to the ever-changing environment. Secondly, the most important factor is an innovation. It is a key for driving the economics and it is considered as the single factor for better standard of living in long run.

The evolution of Globalisation and the evolution of the knowledge-based economy have led to changes dramatically. In many countries, the higher education has to adapt itself in term of character and function to meet the society's complex demand and expectation (Burbules and Torres, 2000; Mok and Welch, 2003). The need for enhancing the university into Research University and World-Class University has been something challenging desirable. Since the universities have been eager to become the quality Research University as a key economic driver, three questions raised; 1) "Is it alright saying that enhancing the university to Research University boosts the economic competitiveness?", 2) "how do you know which university is a Research University?", and lastly 3) what ensures the quality of the university that has been classified as Research University? So, this paper was aim to demonstrate three major purposes. Firstly, there were relationship between the quality of higher education, innovation, and competitiveness enhancement. Secondly, classification became a crucial tool to determine which university has been characterized of Research University. Lastly, higher education standardization was a tool reflecting which of Research University was qualified.

QUESTION 1: IS IT ALRIGHT SAYING THAT ENHANCING THE UNIVERSITY TO RESEARCH UNIVERSITY BOOSTS THE ECONOMIC COMPETITIVENESS?

Recently, the World Economic Forum has completed presenting the ranking for economic competitiveness at international level. The latest volume of the report year 2009-2010 described the objective of the national competitiveness assessment that furthers the people to the high level of prosperity. This depends on how country employs the resources and how productively it has been. The Global Competitiveness Index (GCI) was used to evaluate the competition capacity. It included twelve pillars which were divided into three different areas; basic requirement (pillar 1-4), efficiency enhancer (pillar 5-10), and innovation and sophisticated factor (pillar 11-12).

At the latest ranking for competitiveness, there included 133 countries. Each country was selected among five regions; Europe, Latin America and the Caribbean, Asia and Pacific, Middle East and North Africa, and sub-Saharan Africa. The information used for ranking included 2 major parts; quantitative and qualitative data. Quantitative data was derived from the international organizations such as the International Monetary Fund (IMF), the World Bank, and other United Nations agencies, and so on. The qualitative data was derived from the exclusive opinion survey which consisted of more than 13,000 samples from 133 countries. Of overall samples, 12,614 samples (95% responds per country) returned the

completely filled-out questionnaires. The most items met the GCI structure and 7-point scale was used (1 = mostly severe, 7= mostly positive) (Schwab, 2009).

The ranking results have shown that Top 10 countries with highest score of competitiveness were Switzerland (5.60), the United States (5.59), Singapore (5.55), Sweden (5.51), Denmark (5.46), Finland (5.43), Germany (5.37), Japan (5.37), Canada (5.33) and Netherland (5.32). When compared to the Global Competitiveness Report 2008-2009, it revealed that Top 10 countries were the same countries, only rank was changed (see Table 1). In addition, the report confirmed that the innovation factor was mostly important competitiveness in twelve pillars as appeared in the Top 10 countries with highest overall GCI. The Top 10 countries were in the development stage of innovation-driven economics. To bring for the innovation development, it is necessary for countries to be supported in different ways, especially the pillar 5; higher education and training.

Table 1 The Overall GCI 2009-2010 ranking, 5th pillar and12th pillar 2009-2010, and Overall GCI 2008-2009 comparisons

Country/Economy	Overall GCI 2008-2009	Overall GCI 2009-2010		5th pillar Higher education and training index 2009-2010		12th pillar Innovation index 2009-2010	
	Rank	Rank	Score	Rank	Score	Rank	Score
Switzerland	2	1	5.60	6	5.60	2	5.56
United States	1	2	5.59	7	5.57	1	5.77
Singapore	5	3	5.55	5	5.62	8	5.09
Sweden	4	4	5.51	3	5.76	5	5.39
Denmark	3	5	5.46	2	5.90	10	5.04
Finland	6	6	5.45	1	5.97	3	5.53
Germany	7	7	5.37	22	5.07	7	5.11
Japan	9	8	5.37	23	5.06	4	5.51
Canada	10	9	5.33	9	5.50	12	4.80
Netherlands	8	10	5.32	10	5.49	13	4.79

Source: Schwab (2009)

To respond the question if quality of higher education, innovation, and interrelation competitiveness are associated or not, and how much. This paper examined relationship the pillar 5 as a factor reflecting the higher educational quality, the pillar 12 reflecting the innovation, and the overall GCI reflecting the competitiveness. The higher educational quality and innovation were highlighted as revealed by the advantages of Top 10 countries in related indexes. The Pearson's Correlation was used to test the relationship while advantages comparison was based on the Global Competitiveness Report 2009-2010. The results have shown as follow;

1.1 Index tendency comparison for pillar 5, 12, and overall GCI, and determining the relationship among three indexes.

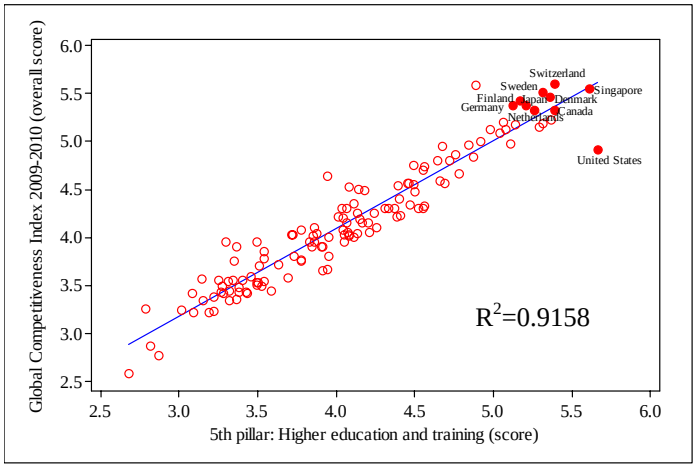
Table 1 showed the directional tendency comparison for overall GCI and the pillar 5 (education and training), and the pillar 12 (innovation), it indicated the same direction with overall GCI for pillar 5 and 12. Eight of Top ten countries with high overall GCI reported high index for pillar 5 (5.49-5.97), except for only two of Top ten countries; German and Japan whose scores were ranked 22 and 23 respectively. However, German and Japan showed scores higher than average score (mean = 4.08) was 5.06 and 5.07 respectively. The Figure 1a implied the relationship between overall GCI and the 5th pillar scores, the very strong linear relationship was found and significantly positive correlation among them (Pearson's Correlation Coefficient; 0.957; P<0.01) (Hinkle, 1998). Next, among Top 10 countries with high overall GCI, eight of them showed high innovation (12th pillar) scores ranged 5.04-5.77, except for Canada and Netherland whose scores were ranked 12 and 13 respectively. However, both Canada and Netherland showed high innovation scores of 4.80 and 4.79 respectively which were scores higher than average score (mean =3.37) obviously (see Table 1). The Figure 1d signified the relationship between overall GCI and the 12th pillar, it found positive strong linear relationship (Pearson's Correlation Coefficient; 0.880; P<0.01). Similarly, The Figure 1g showed high relationship between scores of the pillar 5th and 12th it found positive strong linear relationship (Pearson's Correlation Coefficient; 0.894; P<0.01) (Hinkle, 1998).

1.2 Advantages and Disadvantages Analysis of Variables/Relationship Analysis of Variables.

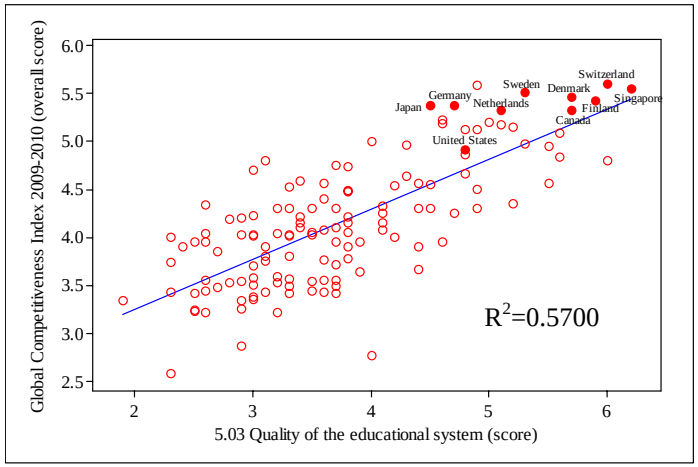
According to the Global Competitiveness Report 2009-2010, the advantages and disadvantages analysis was performed based comparing overall GCI raking and individual variables for top ten countries. If individual variables ranged from 1 to 10, indicating the advantageous variables, in turn, if less than 10 (11, 12, 13… 133), it indicated disadvantageous variables. Therefore, in order to point out that higher education and innovation were two factors enhancing the competitiveness, four variables were analyzed, including quality of educational system (section 5.03), quality of Math and Sciences education (section. 5.04), quality of scientific research institutions (section 12.02), and university-industry collaboration in R&D (section 12.04). This revealed the quality of higher education, innovation, and competitiveness relationship. On the other words, the higher educational institutions emphasized the quality of educational system, particularly in Math and Sciences. Enhancing the university into Research University by concentrating the R&D and industrial collaboration was an important mechanism for economic development. Table 2 showed the advantages and disadvantages comparison for four variables, it indicated that the Top ten countries had advantages on such four variables, just a few had disadvantages. However, the countries with disadvantageous variables still had higher scores than mean. Most importantly, it was obvious that eight of Top ten countries had advantages on university-industry collaboration in R&D (section 12.04), reflecting the emphasis of R&D by institutes, and the industrial collaboration was conductive to increase the national competition potential. In addition, the Figure 1b scores on overall GCI and: quality of educational system (section 5.03), the Figure 1c scores on overall GCI and quality of Math and Sciences education (section 5.04), the Figure 1e scores on overall GCI and quality of quality of

scientific research institutions (section 12.02), the Figure 1f scores on overall GCI and university-industry collaboration in R&D (section 12.04), found the strong linear relationship for overall pairs of relationship with positive coefficient value (Hinkle, 1998).

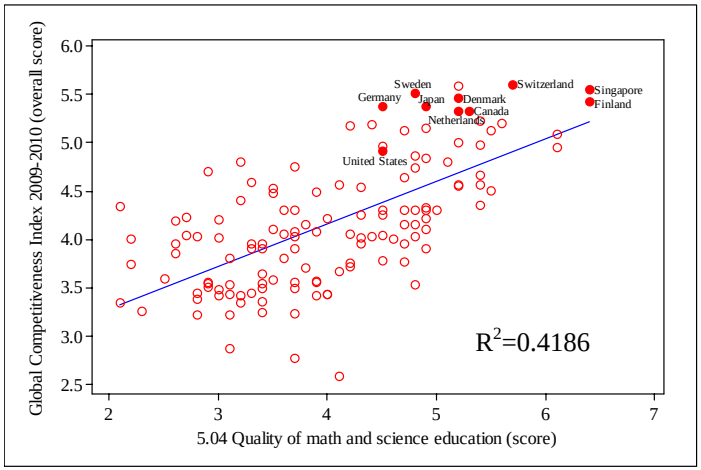
In conclusion, the relationship test showed the interrelation among quality of higher education, innovation, and competitiveness. This also reflected the quality of higher education and innovation that lead to enhance the competitiveness, consistently with Yusuf and Nabeshima (2007), saying that tertiary education institutions have played a vital role on local and regional economics. World Bank (2002) added that "within the tertiary educational system, the Research University also plays important role in training professionals, high-level specialists, scientists, and researchers, consistently with the economic demand and bringing forth new knowledge components contributing the national innovation system.



Note: Pearson's correlation (coef: 0.957; sig 0.01)
(a) Relationship between overall GCI 2009 -2010 and 5th pillar (score)

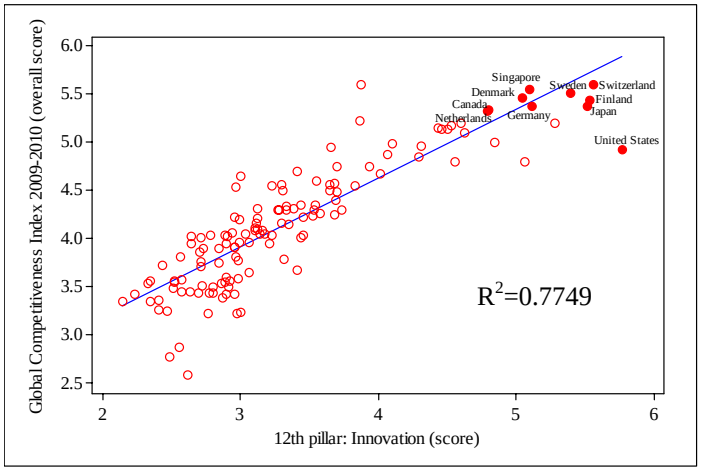


Note: Pearson's correlation (coef: 0.755; sig 0.01)
(b) Relationship between overall GCI 2009 -2010 and 5.03 (score)

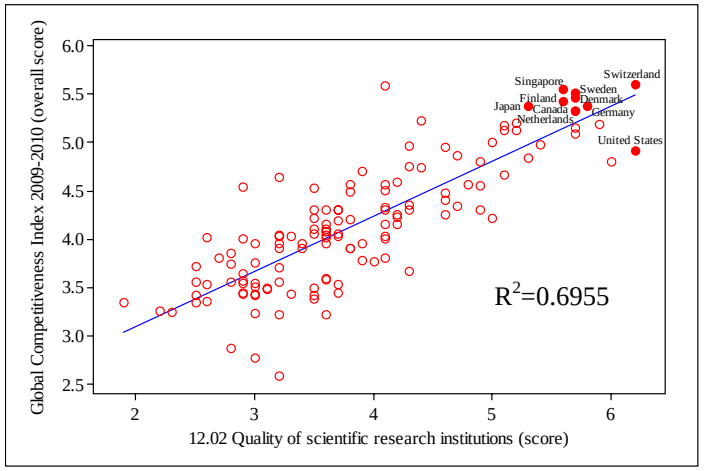


Note: Pearson's correlation (coef: 0.647; sig 0.01)
(c) Relationship between overall GCI 2009 -2010 and 5.04 (score)

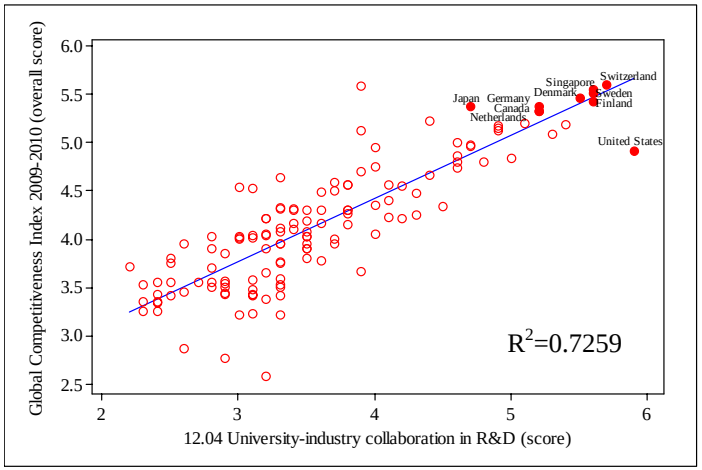
Figure 1 Relationship analysis of variables



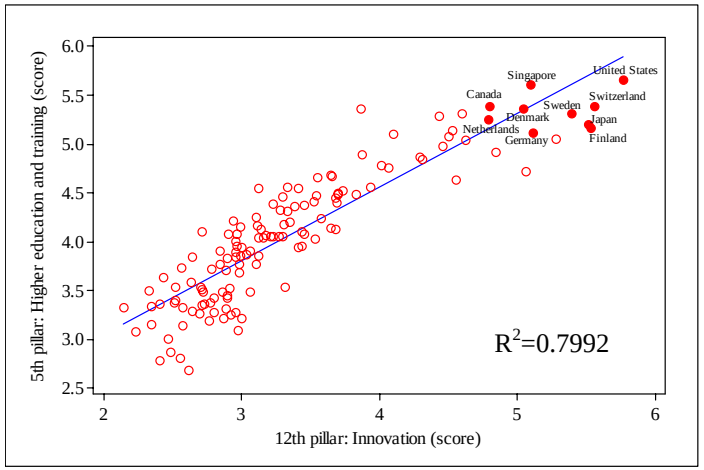
Note: Pearson's correlation (coef: 0.880; sig 0.01)
(d) Relationship between overall GCI 2009 -2010 and 12th pillar (score)



Note: Pearson's correlation (coef: 0.834; sig 0.01)
(e) Relationship between overall GCI 2009 -2010 and 12.02 (score)



Note: Pearson's correlation (coef: 0.852; sig 0.01)
(f) Relationship between overall GCI 2009 -2010 and 12.04 (score)



Note: Pearson's correlation (coef: 0.894; sig 0.01)
(g) Relationship between 5th pillar and 12th pillar (score)

Figure 1 Relationship analysis of variables

Table 2 The advantages and disadvantages comparison for four variables

Country	Over all GCI 2009-2010		5th pillar: Higher education and training						12th pillar: Innovation					
			5.03 Mean = 3.8			5.04 Mean = 4.0			12.02 Mean = 3.9			12.04 Mean = 3.6		
	rank	Score	rank	Score	Variable status	rank	Score	Variable status	rank	Score	Variable status	rank	Score	Variable status
Switzerland	1	5.60	2	6	Advantage	5	5.7	advantage	1	6.2	advantage	2	5.7	Advantage
United States	2	5.59	22	4.8	Disadvantage	48	4.5	disadvantage	2	6.2	advantage	1	5.9	Advantage
Singapore	3	5.55	1	6.2	Advantage	1	6.4	advantage	12	5.6	disadvantage	4	5.6	Advantage
Sweden	4	5.51	12	5.3	Disadvantage	36	4.8	disadvantage	6	5.7	advantage	5	5.6	Advantage
Denmark	5	5.46	6	5.7	Advantage	15	5.2	disadvantage	9	5.7	advantage	6	5.5	Advantage
Finland	6	5.45	4	5.9	Advantage	2	6.4	advantage	13	5.6	disadvantage	3	5.6	Advantage
Germany	7	5.37	27	4.7	Disadvantage	45	4.5	disadvantage	5	5.8	advantage	10	5.2	Advantage
Japan	8	5.37	31	4,5	Disadvantage	25	4.9	disadvantage	15	5.3	disadvantage	20	4.7	Disadvantage
Canada	9	5.33	5	5.7	Advantage	14	5.3	advantage	11	5.7	disadvantage	9	5.2	Advantage
Netherlands	10	5.32	15	5.2	Disadvantage	16	5.2	disadvantage	7	5.7	advantage	11	5.2	Disadvantage

Source: Schwab (2009)

QUESTION 2: HOW DO YOU KNOW WHICH UNIVERSITY IS A RESEARCH UNIVERSITY?

Over the past 30 years, the educational reform policy has been transformed into practice in all educational systems (Carnoy, 1999). The phenomenon has been expanded significantly, especially in promoting the university to the National Research University. In many countries, the government has formulated its policy and triggered the concerned agencies to put the policy into practice seriously and urgently. As realized by government that the Research University is fundamental to leverage the competitiveness and sustainability, consistently with literatures citing that human capital is important to investment on knowledge and skill that leads to an improved productivity and key thrusting the promising economics in the future (Bils and Klenow, 2000; Hanushek and Kimko, 2000; Krueger and Lindahl, 2000; Cohen and Soto, 2001).

In several countries, the government policy has stimulated the higher education to become a Research University. One important issue included diversity and complex which such a situation causes an important issues inevitably ; namely, under the diversity and complex, how do the Educational Higher Commission recognise which university is classified as the Research University. Therefore, the classification was becoming an important tool to identify which university is qualified as a Research University. This tool was very useful to stakeholders (student, higher educational institution, business and industry, researchers and policymakers) as it provided useful information about the differences of the educational intuition groups broadly (McCormick and Zhao, 2005). As we have seen, the classification is a crucial tool to the Higher Education Commission as it enables them to understand the characteristics of educational groups (e.g. Research University, Master's University, Baccalaureate Colleges, and others) as importantly fundamental information to design the development guidelines that suits the individual educational institute and lead to enhance the higher educational standardization and economic competitiveness at international level. Moreover, McCormick (2008) added "classification is more likely to be used to identify the similarity than ordering the institutes. This could be a reason why classification has not reflected the quality of the higher education, but simply used to identify the higher educational institute criteria or parameters which have been developed in agreement with the background of the objectives of classification. The question's sample background that lead to create the classification instrument (see Table 3).

Advantageously, higher education classification has been popular worldwide, especially the Carnegie Classification of Institutions of Higher Education[1], a well-established classified system, has been famous in the United States universities and colleges. Over the past 30 years, it was first developed in 1973 by classifying the educational institutes into five major groups; doctoral-granting institutions, comprehensive universities and colleges, liberal art colleges, 2-year colleges, and institutes and professional school, and other specialized institutions, respectively. As a proxy for research activity, the doctoral-granting institution was divided into four subcategories; Research I, Research II, Doctoral I, and Doctoral II. The higher educational institute's role on research has been highly valued. In the United States higher educational system, research activity varies from institute to institute, which attract considerable attention in developing the higher educational institutes into Research University (McCormick, 2008).

Table 3: Examples of classification bases

Background	Classification bases
What do you offer?	**Degrees or disciplines offered/awarded**
What do you produce?	**Student profile such as enrolment –Institute of Higher Education, Mode of delivery such as part time, full time and distance learning**
What do you teach?	**Instructional program – Classification of Instructional program (CIP)**
Why do you exist?	**Purpose of establishment (*e.g.*, land grant, research, innovation, doctoral universities *etc*)**
Who are you?	**Sources of funding (*e.g.*, public, private, religious, etc.*)*, size (*e.g.*, large, medium, small, *etc*), variety (*e.g.*, comprehensive or specialized fields, etc.)**
Where do you setting?	**Geographical location (*e.g.*, urban, rural, community, *etc*.)**
How do you admit students?	**Admission method (*e.g.*, competitive or open admission, *etc*.)**

Source: Adapted from Phusavat and Chansa-ngavej (2007)

Later, the Carnegie Classification of Institutions of Higher Education was revised for many times since, 1976, 1987, 1994, 2000, and latest 2005-2006 while core classification remained the same. The notable points of changes included 1) variation on label used, definition, and technical part, 2) the Research University appeared grew up by 25% as resulted from the 1994 classification (Evangelauf, 1994). Following 1994, 3) the Roman numbers were omitted for Research University I & II, Doctoral University I & II, aiming to avoid latent mistakes pertaining to difference in the institute quality. In addition, 4) the position of the institute was analyzed in 1976, 1987, and 1994, and summarized the indicator of prestige which is a key driver to move the institutional direction and decision-making on its policy (Aldersley, 1995). Apparently, the higher educational institutes have attempted to upward and move toward the reputed Research University. In 2000, 5) the Research University I was integrated into the Doctoral University I while Research University II was integrated into the Doctoral University II. More recently, during 2005-2006, there occurred a great change in classification; the classification system was overhauled comprehensively. The overall pictures of change included; firstly, changing from single classification into a set of multiple parallel classifications under three major questions; “What is taught?”, “Who are students?”, and “What is the setting?” With these questions, the five following categories were included; undergraduate instructional program, graduate instructional program, enrollment profile, undergraduate profile, and size and setting in addition to update of the existing original classification. Secondly, the web-based tool was developed where users are able to combine the classification schemes and generate subset in which they are interested. Lastly, the elective classification or so-called “community engagement” was developed subject to the voluntary participation of the institutes. In this case, data was obtained from institutions directly, opposite to empirical data of previous time. Broadly speaking, the “elective classification” facilities the institutional classification in viewpoint of mission and action, which were grouped into three followings; 1) Curricular Engagement, 2) Outreach & Partnership and 3) Curriculum Engagement & Outreach & Partnership (McCormick and Zhao, 2005).

In addition, the Carnegie Classification of Institutions of Higher Education becomes an exemplar tool for classification development by researchers in many countries. For examples, the Japanese Classification composed of five major groups; Research University, Doctorate-granting University I, Doctorate-granting University II, Master's Degree-granting University, and Colleges (Amano and Chen, 2004). Similarly, the Chinese Classification included five major groups, Research University, Doctorate University, Master' University, Baccalaureate College, and Associated Colleges (Liu and Liu, 2005). Thailand Classification contains five areas in classifying the university position; including university characteristics, teaching, research, student body, and management (Phusavat, 2008). European Classification composes of five main categories with 14 dimensions; education (4 dimensions: degree level, subject mix, orientation of programmes, and involvement in lifelong learning), research and innovation (2 dimensions: research intensiveness and innovation intensiveness), international orientation (2 dimensions: teaching and research), size and setting (3 dimensions: mode of delivery, public/private character and legal status) and community engagement (2 dimensions: cultural engagement and regional engagement) (Bartelse and van Vught, 2009).

Most obviously, the higher education classification by researchers or institutes over countries required that the Research University has always been classified. In addition, the common indicators as proxy for research activities are used.

- Number of Research staffs
- Number of peer reviewed publications per FTE academic staff
- Aggregate level of federal funding
- Receive amount of government research funding in fifty rank of first priority
- Number of doctoral degrees award annually
- Number of doctoral degrees more than the average number of doctoral degrees from universities focuses on doctoral degrees
- Ratio between doctoral and baccalaureate degrees

Source: Amano and Chen (2004), McCormick and Zhao (2005), Liu and Liu (2005), Liu (2007), Phusavat (2008) and Bartelse and van Vught (2009)

In brief, the classification was an important tool determining which university is quailed as Research University. It provided the policymakers to design the appropriate direction for higher educational development.

QUESTION 3: WHAT ENSURES THE QUALITY OF THE UNIVERSITY AS A RESEARCH UNIVERSITY?

In 1990s, it is known as the "decade of quality" which term "quality" became commonly used in the industries, commerce, and government sector. In context of higher education, the quality is widely used and played important role for higher educational system in many countries. Though the universities have been classified as Research University, for examples, the Ivy League has been classified as Research University in the United States, G13 (Group of Thirteen) in Canada, the Russell Group in the Unite Kingdom, the League of European Research University (LERU) in Europe continent, G08 (Group of Eight) in Australia, China's Research Universities I in the mainland China, and other research universities worldwide.

Most people perceived these universities as a leading research university with important components, for examples, top-quality academic staffs and students, adequate funding for R&D, facilities for academic works, and other qualities. Nonetheless, the universities have been questioned about the quality among the stakeholders (students, instructors, institutional executives, policymaker, industrial operators, and so on). One most frequently asked question was "how do they ensure the quality of university as a Research University?"
The literature survey revealed that the quality assurance in higher education by means of evaluation can ensure of its quality. Bogue (1998) proposed the evaluation approaches. Firstly, the peer reviews evaluation (e.g. educational institutes per se, external professionals, or external body). This approaches included the educational accreditation, and University Ranking/Rating. Next, the Total Quality Management (TQM) has been employed for educational evaluation. Thirdly, the assessment of outcomes is a way of quality assurance that emphasized the accomplishment of the curriculum. Fourthly, it included the accountability indicator and performance indicators, etc. Barnett (1987) and Church (1988) added that quality assurance for higher educational evaluation should be characterized of comprehensive viewpoint in respect with input, processes, and outcomes. However, that the quality of the Research University has been emphasized results in the global competitiveness. The instruments have been widely used and most institutes perceive as appropriate for quality assessment of the Research University included (1) ranking as quality measure that could be used to compare the quality of research activity at national and international level (Salmi and Saroyan, 2007), and (2) "NQF" is an instrument for quality assurance corresponding the need of the industrial stakeholders, and could be used to compare the qualified graduated at national and international level (Coles, 2006; Tuck, 2007). Therefore, to point out that those two instruments mentioned are conductive to higher educational quality standard, this paper included the detailed information about the tool to ensure of the quality of the Research University below;

3.1 Ranking systems in higher education

The phenomenon of the ranking university or higher educational institutions has grown rapidly worldwide. The national ranking has emerged since 1980 s while the international ranking has happened recently (Högskoleverket, 2009). Bowden (2000) and McCormick (2008) stated that "ranking" is a rating tool based on the criteria set up. The process of ranking consisted of sequences ordered as follows; collecting data, selecting category and quality of the variables, standardizing and weighting the indicators from selected variables, and last step; calculation and comparison (Hogskoleverket, 2009). In addition, the literature such as Usher and Savino (2006) and Cunningham (2008) contained criticism about biases of ranking systems. However, the ranking systems have been commonly used domestically and internationally, and be used for continuous improvement and development for weaken areas. The ranking system provides many advantages. It provides a mechanism to indicate which university should be classified as a leading Research University, especially in research activities. It also composes of ranking system providing the student, government, HE leaders, employers, and policymakers with useful information supporting the decision-making. For examples, the students make good use of information to support their decision in choosing the educational institutes. The government applies the information to formulate the educational policy and budgeting. The HE leaders apply the information to enhance the management. The employers use the information for recruitment purpose. The policymaker

uses the information for policy planning. Next, the ranking system is a tool facilitating the quality improvement. For examples, it is potential to protect the students and stakeholders from low quality provision, and encouraging the institutes to move toward the number one leader, accelerating the academic community to improve the quality, and influence the competition and productivity. Finally, the ranking system brings about the transparency and serves as an effective instrument for public accountability (Usher and Savino, 2007; Salmi and Saroyan, 2007). With various advantages of the ranking system, the institutes worldwide, especially the Research University, make an effort to improve the quality based on the criteria set forth and eager to become a World-Class university. The International Ranking System that has been interested included the Shanghai Jiao Tong University Global Ranking (SJTU), and the Times Higher Education QS World Universities Ranking (THE-QS)

3.1.1 Shanghai Jiao Tong University Global Ranking (SJTU)

The International Ranking System was initiated in 2003 by the Shanghai Jiao Tong University Global Ranking (SJTU)[2]. Its primary aim was to develop the Academic Ranking of World Universities (ARWU). Liu (2006) cited that the ARWU was put on the internet in 2003. There were more than 2,000,000 visitors accessing into the site, averaging 2,000 visitors daily. Liu and Cheng (2005) added that over 2,000 educational institutes were taking into account, and over 1,000 institutes had been ranked. However, only 500 institutes were presented on the internet. International Ranking System by SJTU occurs every year with the intent to focus the quality of research only. The Jiao Tong Group said it is hardly possible to rank other qualities like teaching and learning for reasons that there are great differences among universities and the much more differences at national level. In addition, there included the technical problems in collecting data at international level. In addition, they did not desire to use the subjective measures of opinion from informative sources of the universities. They needed for the non-subjective measurable indicator and comparison could be done at international level, which data could be checked. Consequently, the International Ranking System by SJTU employed four criteria with several research performance indicators, including 1) alumni and staff wining the Nobel Prize and Fields Medals, 2) highly cited researchers, 3) publicized paper in Nature and Sciences, articles in Science Citation Index-expanded (SCIE), and Social Science Citation Index (SSCI), 4) academic performance with respect to the size of an institution. The weight for each indicator was detailed in Table 4. In general, the International Ranking System by SJTU was criticized in two broad areas. Firstly, it only focused research while ranking could not cover all areas of higher education quality. Secondly, certain quality indicators, especially in the scientific prizes index which was extremely criticized due to 1) the variation was very low, quite simply there were very few Nobel and field awarded, 2) only Nobel Prize winners from a given institutions said about the quality of the institution. As a result, this was considered to be a far too superficial attribute which could bee manipulated by the Nobel Prize winners who have not actually participated in the institutional activities (Marginson and van der Wende, 2006) The International Ranking System by SJTU was also criticized considerably in relation to the bibliometrically based citation indicator for it caused the bias. The indicators matched with the Medical and Natural Sciences, but not some disciplines like Humanities and Social Sciences. The indicators had the limitation in term of the preference of the use of English as major language as they were familiar with presentation in English (Usher and Savino, 2006;

Cunningham, 2008). Thus, the work results other than English were inclined to be less presented (Marginson, 2007).

3.1.2 Times Higher Education QS World Universities Ranking (THE-QS)

Times Higher Education QS World Universities Ranking (THE-QS)[3] was first proposed in 2004 with the aim to compare the achievement of universities which are attempting to enter into the world-class university. To contemplate and be regarded as the world-class university, THE-QS described four pillars; research quality, teaching quality, student employability, and international outlook, all these have brought forth six indicators derived from various sources such as the Higher Educational Statistics Agency (HESA), the Higher Educational Funding Council, the Quality Assurance Agency, the Office for Standard in Education and Individual University Survey (Stella and Woodhouse, 2006). The research quality was measured by two indicators; academic "peer review", and number of research citation per head of academic faculty. Teaching quality was measured in term of student-teacher ratio. The student employability and the international outlook were measured by two indicators; international teacher and researcher ratio, and the proportion of the international students. (Weight for each indicator detailed in Table 4). However, the THE-QS Ranking was criticized in the following areas; 1) academic peer review which was used to measure the quality of research, as it was so subjective, it is weighted by 40%, 2) data derived from questionnaires surveyed with the academics and employers was not transparent, reflecting the reputation, but not quality, 3) Internationalization was criticized in term of the difficulty on international comparison. The indicators were likely to prefer the university using English (Anglo-Saxon universities), and 4) citation indicator was criticized in term of biases like the SJTU Ranking.

Table 4 Comparison of the methodologies for International ranking systems

	SJTU		THE-QS	
Universities analyzed	**1000+**		**500+**	
Universities ranked	**500**		**200**	
Criteria	**Indicator**	**Weight**	**Indicator**	**Weight**
Quality of education	**Alumni of institution winning Nobel Prize and Fields medals**	**10%**	**Staff-student ratio (proxy for 'teaching quality')**	**20%**
Internationalization	**-**	**-**	**International students**	**5%**
			International staff	**5%**
Research Output	**Papers indexed in Nature and Science***	**20%**	**-**	**-**
	Papers indexed in SCIE & SSCI	**20%**		
Prestige	**Staff of an institution winning Nobel Prize and Fields medals**	**20%**	**Academics Peer review**	**40%**
			Reputation: employers	**10%**
Impact	**Highly Cited researchers in 21 broad subject categories**	**20%**	**Research citation per head of academic faculty**	**20%**
Per capita performance	**Per capita academic performance of an institution**	**10%**	**-**	**-**
Total		**100%**		**100%**

Source: SJTU (2009) and THE-QS (2009)
*For institutions specialized in humanities and social sciences such as London School of Economics, N&S in not considered, and the weight of N&S is relocated to other indicators

In summary, the Ranking system is a tool reflecting the quality of the university. It was developed many times at national and international level under the ranking criteria. However, it has been widely criticized in term of biases, and leading to continuous development. The literature review on ranking system revealed the following common indicators that have been used by most universities; citation, publications, research awards and patents, and research budget (see Table 5).

Table 5 Indicators used in ranking of research activities

Type	Common of Indicators
Citation	**Bibliometrics (counting of publications and citations)**
	Highly cited publications
	Citations in engineering publications
	Citations in social science oriented indices
Publications	**Publications in science-oriented indices**
	Publications in Science and Nature
	Publications in social science oriented indices
	Publications in other indices
Research awards and patents issued	**National research awards**
	International research awards
	Number of patents issued
Research Budgets	**Financial indicators of research**
	Total amount of research expenditure
	Total number of research-based grants and projects
	Public-source grants
	Number of research-based chairs per institution.
	Research-based/affiliated research institutions or centers for studies

Source: Bowden (2000), Dill and Soo (2004), van Dyke (2005) and Williams and van Dyke (2005)

3.2 National Qualifications Framework (NQF)

Many countries worldwide are now aware of the national qualification framework (NQF) and the NQF implementation status which could be divided into three generations; first generation framework (the late-1980 – the mid-1990s) consisting of Australia, England, Wales, Northern Ireland, New Zealand, Scotland, and South Africa. Second-generation (the late-1990s to the early-2000s) consisting of Ireland and Mexico, etc. Third generation has been currently under consideration consisting of Albania and Brazil, etc. (DEEWR, 2008). The NQF has been applied worldwide due to the global economic growth where competition is stiff and severe, the opening of free trade, the movement of the international students, and migrant workers. These circumstances result that educational institutes worldwide demand for the academic accreditation as quality assurance of students, and international comparison can be done. At the same time, the industry stakeholders over countries call for the well-educated and multi-skillful employees whose qualification meet the company's need. Such qualities included flexibility, well-adaptation, and able to work overseas. The industry stakeholders also need for comparison the workers' qualification in countries as information supporting the recruitment process.

To bring forth the efficiency and fairness, the countries have to assign the qualification or skill possessed by students or the graduated that can be acceptable in accordance with the criteria for admission or job applications. The NQF has defined the qualifications framework as a classifier for qualification set in accordance with the level of learning outcomes achieved. The NQF varies in detail from country to country, for examples scope of framework, levels, learning measurement, teaching unit, responsible agencies for development and control, etc. However, all qualification frameworks have been established under the common objectives; quality improvement, accessibility, linkages, public and labor market recognition of qualification in local and international level (Coles, 2006; Tuck, 2007). So, to distinct the NQF attributes, the Australia Qualifications Framework (AQF) was used for comparison with the Thailand Qualification Framework (TQF).The AQF was regarded as the first-generation framework which was implemented since 1990 while the TQF is currently under the implementation process. Both Australia and Thailand are members of the APEC. Table 6 showed the comparison features of qualification framework in four different areas; scope of frameworks, level of qualification, domains of learning, and control unit.

Table 6 Features of national qualification framework in Australia and Thailand

Features	Australia	Thailand
Scope of frameworks	**AQF covers post-compulsory education in Australia, schools, vocational education and training, and higher education sector.**	**TQF covers higher education only.**
A number of levels	**Level is not specified in the framework.**	**Six levels: diploma, bachelor degree, graduate diploma, master degree, advanced graduate diploma and doctor degree.**
Domains of learning	**Implicit but descriptors for each qualification refer e.g. to knowledge, skill, performance and responsibility.**	**Five elements: ethics and morals, knowledge, cognitive skills, interpersonal skills and responsibility, and numerical, communication technology skills.**
Control unit	**Managed by AQF Council under legal with state and national legislation**	**Managed by Commission on Higher Education under legal**

Source: Burke (2009)

In addition, the literature review, for examples, Coles (2006, 2008), Raffe et al. (2008) and Young (2008) proposed four ways on how to achieve the implementation of NQF. Firstly, it is needed to demonstrate that the NQF is a developed tool to secure the stakeholders' confidence. Secondly, it has to indicate the national education and training as requirement limits to attract the international innovation directly. And lastly, it should avoid the over-engineering qualification system and NQF, specifically in low-economic countries.

An appropriate implementation of the NQF, especially in along with the contribution of effective system of quality assurance, the benefits result, for examples, the NQF is conductive to development on worker's skill, facilitate the education and labor market mobility, improve individuals' access to education and training at higher and different level.

Conclusively, the national qualification framework (NQF) is a tool for university quality enhancement which it produces the qualified graduated that meet the current market need and contribute the assurance of graduated's quality and accreditation standard.

CONCLUSION

A way to increase the competitiveness for university quality in any country is to move the university development into the National Research University and World-Class University. The powerful Research Universities are potential to produce the well-educated workers and innovation which both factors are vital keys to boost the competiveness. The "Classification" is an effective tool to identify which university is qualified and should be classified as Research University. Meanwhile, the "Ranking" is a tool determining the quality of the Research University which research activities are emphasized. Another important one is "NQF" which is an efficient tool to frame the quality assurance for graduated and production of the well-qualified workers consistently with the economic demand (see Figure 2).

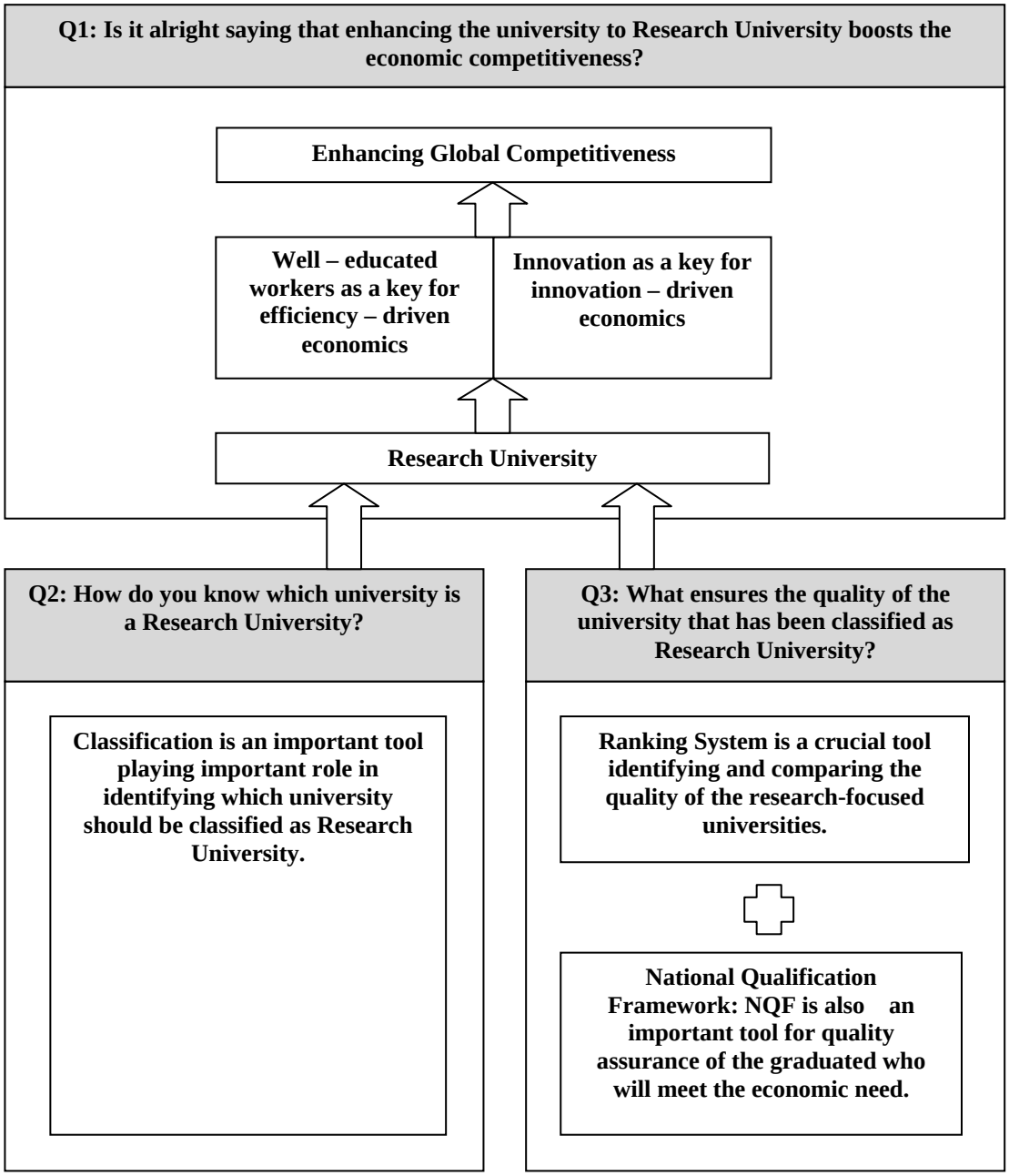


Figure 2 The Relationship of higher educational classification and standardization enhancing global competitiveness under scope of three questions

FUTURE STUDIES

The instruments derived from the vast literature review have been combined to develop the "Classification" and "Ranking" corresponding to Thailand educational system that meets the policy on leveraging the competition capacity.

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EXPORT MULTIPLIERS AND THE DEFENCE SECTOR SUPPLY IN RETURN EXPORT MANAGEMENT

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ABSTRACT

The statistical 60 sectors symmetric input-output matrix and the in-depth unique evidence of the Slovenian defence industry enterprises focusing on the defence industry supply in return export activities are analyzed using the input-output modelling approach. The input-output modelling approach using the 60 sectors symmetric input-output matrix is used to estimate direct, indirect, and total effects of the exports from the fore-ward defence industry supply in return activities on the Slovenian economy during the years 2004-2008. The indirect effects are three-to-four times greater than the direct effects. The empirical results confirm that the defence system of supply in return activities can be in a greater extent used for implementation of the economic development objectives in building up and development of the industrial technological base and for a niche approach in setting up, maintaining and catching up of the high-technological base activities of the domestic suppliers and sub-suppliers with largely high technological exports of particularly civilian goods and services.

Keywords: supply chain management, defence sector, supply in return, input-output modeling, export multiplier, Slovenia

INTRODUCTION

The analysis of the fore-ward supply defence industry market chain linkages is a rare in literature. 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, Bojnec and Fošner 2009). These inter-sector, multiplicative economic effects are potential factor for economic growth in the economy as a whole (e.g. Davis 2008). However, so far there is almost no study to investigate the size of this multiplicative effect and its spread over the different sectors in the economy.

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-side multiplicative effects on the 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 in the economies, particularly in production, supply and supply in return activities, 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). Our specific focus is on the size and spread of the export multiplier pertained to the defence sector export supply in return activities with Slovenia. It is selected as a case study due to the available information on both the 60 sectors symmetric input-output table and particularly due to the available enterprise-level evidence on the exports that is linked to the defence sector export supply in return activities.

The first contribution of this paper is the analyses of the direct and total multiplicative linkages of the defence industrial and technological base sector activities in the supply in return export activities on the rest of the economy. More specifically, we analyse the impact of the country's defence industry supply in return export flows, which are directly and indirectly spead from the defence industrial and technological base supply in return export activities to different sectors of the economy, which are directly and indirectly linked to these 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 linked significantly with the rest of the economy that are transmited from the export flows. This implies policies that are less purely defence sector policies, but market driven with the rest of the economy in an open and global international trade environment with goods, services and their outsourcings (e.g. Heather 2002, Allen 2005).

The second significant contribution of this paper is the calculated size and the spread across diffferent sectors of the export multiplier for the defence sector supply in return export activities. To do this, we combine two data sets: first, the statistical 60 sectors symmetric input-output matrix, which was used for the calculation of direct coefficients and multipliers from the inverse statistical 60 sectors symmetric input-ouput matrix. Second, the enterprise-level data on the supply in return export activities. On these bases we estimated direct, indirect and total multiplicative effects, which are caused and linked by the size of the export multiplier for the defence sector supply in return export activities.

The third 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. The advantage of our research is to combine both publicly available data on the statistical symmetric input-output table and the unique in-depth defence sector enterprise data set, which has been obtained by both the conducted in-depth surveys in the Slovenian defence sector enterprises that are engaged in different business activities with the defence technological and industrial base activities, and from Ministry of Defence.

The rest of the paper is structured as follows. In the next section we explain the methodology on application of 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 supply in return export flows (e.g. Kenen and Lubitz 1971). The focus is on the export multiplier. The section after then describes the empirical results on the direct fore-ward linkages on the basis of the unique in-depth empirical evidence obtained from the surveys in the Slovenian defence sector industry enterprises. The special focus is on the export multiplier in the defence industry supply in return export activities. After this, we provide managerial and policy implications for the defence industry supply in return export management and for data management systems in the defence sector with issues for future research, whereas the final section derives main conclusions.

METHODOLOGY AND DATA USED

The application of input-output modelling in the industry cross-sector data management is used focusing on the defence industry sector supply in return export activities. The input-output modelling provides 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 supply in return export activities with the rest of the economy, we apply matrix theory, which is a base for an input-output modeling in the data management. The compailed statistic symmeteric input-ouput matrix is a starting point of our analysis of the direct, indirect and total fore-ward supply-side cross-sector linkages, which are pertained to the defence technological and industrial base supply in return export activities. We employ the statistical 60 sectors symmetric input-output matrix of the Slovenian economy in the combination of the enterprise-level data on the defence industry supply in return export activities. In this way, we analys the cross-sectoral flows between the defence techological and industrial base supply in return export activities with the different parts of the economy, which are directly and indirectly engaged in the conduction of these supply in return export activities.

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 defence industry fore-ward supply in return export activities. They are causing subcontracting, middelmen, traders and similar activities within the national economy and in international trade.

The relation between production and consumption in the economy can be analysed by use of the statistical input-output table. The symmetric 60 sectors input-output table is based on tables of supply and consumption in the economy. The symmetric input-output table presents process of domestic production and transactions of products and services in the economy at the level of products or adjusted at the branch level (SORS 2008). At the aggregate economy level, symmetric input-output table is a matrix with row and columns at the level of product/branch with the sum by row or columns, which gives the total value of production. The input-output model assumes that inputs are associated with outputs with linear production function with fixed coefficient at least on short-term.

The input-output modelling is based on linear algebra (Iwankowicz 2008, Lam, Chan, Ip and Lau 2008). The column *j* in the input-output table shows how much in production of the sector *j* (X_j) are spent inputs from all other sectors *i* in the economy for the intermediary consumption (X_{ij}) and what is the structure of the value-added (for wages, different other incomes, and business surplus) in the sector *j*. The X_j depends and causes on X_{ij} through technical coefficients, A_{ij}:

$$X_j = A_{ij} X_{ij} + Y_j ,$$

where Y_j is final supplies or final consumption.

Technical coefficient, a_{ij}, indicates how much of inputs of the sector *i* is needed for a unit of production of the sector *j*:

$$a_{ij} = \frac{X_{ij}}{X_j} .$$

The indicator of total (direct and indirect) intermediary reproduction links between the symmetric 60 sectors in input-output matrix (*i*=*j*=60) is the matrix multiplier of the individual sector, which we can obtain by resolving structural form of the symmetric input-output model:

$X_j = A_{ij} X_j + Y_j$

$X_j - A_{ij} X_j = Y_j$ and, taking care to ensure conformability, we can write:

$I_{ij} X_j - A_{ij} X_j = Y_j$, where I_{ij} is a unit matrix (n,n) and

$(I_{ij} - A_{ij}) X_j = Y_j$, where $(I_{ij} - A_{ij}) X_j$ is non conformable. After pre-multiply both side by the inverse $(I_{ij} - A_{ij})^{-1}$, we obtain:

$(I_{ij} - A_{ij})^{-1} (I_{ij} - A_{ij}) X_j = (I_{ij} - A_{ij})^{-1} Y_j$, which follows:

$X_j = (I_{ij} - A_{ij})^{-1} Y_j$, since $(I_{ij} - A_{ij})^{-1} (I_{ij} - A_{ij}) = I_{ij}$.

where X_j is vector-column for production, Y_j is vector-column of final supplies or final consumption, A_{ij} is matrix of technical coefficients for total production for the 60 symmetric sectors in the input-output system, I_{ij} is a unit matrix and $(I_{ij} - A_{ij})^{-1}$ is the inverse matrix or matrix of sectors multipliers (r_{ij}) (Leontief 1966)

Our special interest in to estimate the export coefficients and export multiplier by investigation the sector's *j* fore-ward export sells or delivery structures. This is presented in the rows of the symmetric 60 sectors input-output matrix. The row *j* in the symmetric input-output table shows how the final supplies or final consumption of the sector *j* (Y_j) is used in the intermediary consumption of the all sectors in the economy (X_{ij}) and in the final household consumption C_j, gross investments I_j, government consumption G_j, and exports E_j: $Y_j = X_{ij} + C_j + I_j + G_j + E_j$.

The direct export coefficient of sector *j* e_j shows the exports of the sector *j* in the unit of final consumption in the sector *j*:

$$e_j = \frac{E_j}{Y_j},$$

where E_j is the value of exports of sector *j*. The export multiplier $\hat{e}_j$ for the sector *j* is:

$$\hat{e}_j = \sum_{j=1}^{n} e_i r_{ij}, \text{ where } \hat{e} = e\,(I - A)^{-1}, \hat{e} = (\hat{e}_1\ \hat{e}_2\ \ldots\ \hat{e}_{60}).$$

The export multiplier $\hat{e}_j$ for sector *j* shows total (direct and indirect) effect of exports of sector *j* on the economy as a whole.

To estimate the export multiplier for the defence sector supply in return export activities for the period 2004-2008, we use the 60 sectors symmetric input-output matrix for 2005 valued at basic prices, which are compiled every five years (SORS, 2008) and the enterprise data on the supply in return export activities by the years 2005-2008. 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. 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. The input-output model assumes linear production function with fixed coefficient at least on short-term. The input-output table total economy flows are distinguished separately by domestic flows and international export/import 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 enterprises and their role in the defence supply in return export chain management of the defence technological and industrial base activities.

EMPIRICAL RESULTS

The input-output analysis, particularly on measuring direct and indirect multiplicative effects can provide wider application opportunities of these methodological approaches in the industry data management. In the Slovenian statistical 60 sectors symmetric input-output matrix, the defence sector belongs to the public administration and defence services; compulsory social security services. Bojnec and Fošner (2009) on the basis of the empirical results obtained from the 30 sectors symmetric input-output table for domestic output at basic prices for Slovenia in 2005 confirmed that in the domestic matrix as well as for the total sell

matrix, the final consumption expenditure by government are the most important. The export flows in the export part of symmetric input-output table are less concentrated, but still there are three market outlets, which are the most important: first, intermediary consumption in transport, storage and communication services; second, final consumption expenditure by households; and third, intermediary consumption within public administration and defence services; compulsory social security services.

We first present our unique in-depth enterprise survey evidence for the defence industrial and technological base activities. 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 to define the enterprise level starting point for the defence supply in return export multiplier. 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 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 operated 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.

Table 1. Frequency Distribution of the Enterprises with Their Market Outlets for the Needs of the Defence Industrial and Technological Base Activities (in per cent)

Frequency distribution of enterprises (%) for primary production	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
for supply in return or subcontracting activities			
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
for middlemen (trade) activities for the defence chains			
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.

The frequency distribution of the defence industry enterprises in Slovenia by the structure of their market outlets for the needs of the defence industrial and technological base activities is presented 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 1). For several defence industry enterprises in our sample, the national Slovenian 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 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 for around two-thirds of the enterprises in the sample that 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 around two-thirds of the enterprises are not engaged in these EU business activities. Moreover, 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.

The share of the enterprises that are not engaged in the supply in return or subcontracting activities for the needs of the defence industrial and technological base activities on the domestic Slovenian market is relatively high, but it is even much higher for similar activities towards the EU-26 markets (more than three-quarters) and even more at the other markets in the rest of the world. The relatively high share of the Slovenian defence sector enterprises 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 as there are only few enterprises in Slovenia that specialize in the defence supply in return or subcontracting activities on the domestic Slovenian market, much less for similar activities in the EU-26 markets, and a very rare for the other markets in the rest of the world.

The distribution of the enterprises in the defence chains as the middlemen (traders) on the national 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) neither on the domestic Slovenian market nor on the enlarged EU-26 markets nor on the markets in the rest of the world. On the other hand, there are less than one-third of enterprises, 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 (8 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 2. 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.

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. As can be clearly seen from Table 2, the large share of the Slovenian defence sector enterprises in the sample is not engaged in the supply in return activities for the EU-26 markets and in the supply in return activities 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. 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 activities on the EU-26 markets and around 4 percent of the supply in return activities 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 activities 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).

So far there is no study to investigate the export multiplier concerning the defence sector export supply in return activities. To do this, we have estimated direct export coefficients e_j and production multipliers r_{ij} to obtain the export multipliers $\hat{e}_j$ by the 60 sectors of the symmetric input-output matrix for Slovenia. On the basis of the calculated sectoral multipliers and direct defence export supply in return activities of the Slovenian enterprises, we have calculated direct, indirect, and total effects of the defence export supply in return activities on the Slovenian economy. We have found that the defence supply in return export multiplier is equal 3.69 (Table 3). This implies that, if these activities are properly conducted

and managed, they can have an important impact on the other, non defence sectors activities. In this way, they can significantly contribute to the exports of the defence and civilian products and services, and thus contributing to growth, employment and economic development in the rest of the economy. This requires advanced organizational and supply chain management arrangements.

Table 3. Export multipliers by sectors and the export multiplier for the defence supply in return export activities

60 input-output sectors engaged in supply in return export activities	export multipliers
Other mining and quarrying products	1.91
Textiles	5.64
Leather and leather products	1.86
Wood and products of wood and cork (except furniture), articles of straw and plaiting materials	2.03
Pulp, paper and paper products	2.17
Chemicals, chemical products and man-made fibres	3.54
Rubber and plastic products	2.72
Other non-metallic mineral products	1.64
Basic metals	6.01
Fabricated metal products, except machinery and equipment	3.62
Machinery and equipment n.e.c.	1.68
Office machinery and computers	3.13
Electrical machinery and apparatus n.e.c.	1.83
Radio, television and communication equipment and apparatus	2.54
Medical, precision and optical instruments, watches and clocks	1.30
Motor vehicles, trailers and semi-trailers	1.63
Construction work	19.95
Trade, maintenance and repair services of motor vehicles and motorcycles; retail trade services of automotive fuel	11.37
Wholesale trade and commission trade services, except of motor vehicles and motorcycles	16.07
Land transport and transport via pipeline services	2.37
Air transport services	1.13
Computer and related services	2.50
Other business services	17.12
Defence export supply in return	3.69

Source: Own calculations.

MANAGERIAL AND POLICY IMPLICATIONS

Globalization and internationalization of supply chain management has taken different forms. In the defence sector, it has taken a special form of barter trade supply in return organization, where military imports can be covered by supply in return export activities of defence and civilian products. While in general, the competition for capital and similar equipment sales and supports has intensified globally, for example in Europe, there have been achieved notable sales successes for aircraft, locomotives and ships (Quayle 1999). These activities have also been pertained to the defence technological and industrial base activities in the economy with different suppliers and sub-suppliers arrangements and a joint project management within and between the countries. The important reason for such cooperation arrangements are in use of economies of scale, which are necessary for greater and complex capital equipments and their considerable investment costs. In additional to high-

technological requirements, this requires extensive management procedures for production of capital equipments and support strategies on project management performance and dealing with subcontractors to gain and remain successful in the global market competition.

The concept of vertical and horizontal enterprise integration into supply chain and supply-chain management often requires contractual and other arrangement about managing coordinated information, flows of products and services, plant operations, and logistics. The crucial premise is synchronization and coordination within and between various autonomous supply-chain members to increase economies of scale, reduce fixed and other operational costs and provide flexibility and agility in responding to consumer demand shifts. Chandra and Kumar (2001) illustrated a supply-chain model based on a collaborative system approach utilizing the example of the textile industry. The appropriate structure, compliance with defined qualitative and quantitative requirements, proper control and incentive mechanisms, alignment of interdependent decision-making processes and implementation principles of optimization to synchronize the supply chain are critical success factors in improvement in the overall performance of each participating member and the supply chain management as a whole. The concepts of vertical and horizontal enterprise integration into the defence industry supply chain and supply-chain management are still underdeveloped in the Slovenian economy. The Slovenian defence industry enterprises demands an institution to monitor and support the Slovenian defence industry and associated business sectors (Bojnec, 2009). The contractor risk in the Slovenian defence industry is currently practiced by the involved enterprises. Unlike to some developed countries, such as in the United States of America, in Slovenia is not developed a legislative requirement of “Buy Slovenia First” to ensure the sustainability of the defence industry supply chains.

In addition to enterprise resource planning to streamline and integrate operation processes and information flows within a company, for the barter supply in return defence industry activities is a crucial collaborative system implementation in production, inventory, procurement, suppliers and logistics companies inside and outside a certain country in response to the need for resource optimization and the global competition and logistics management and worldwide market distribution. An interesting question regarding western exporting manufacturers was raised by Li (2002): should they use independent resident distributors or employee sales force when they enter emerging markets? This is also a challenging issue in the Slovenian supply in return export management, but theories provide mixed and contradict answers. Different channel structures and channel management are associated with advantages and disadvantages, and hence the choices of channel structure depend on market entry stages and market conditions. For a relatively small countries such as Slovenia (two million of population), where economies of scale for most of products can be achieved on wider export markets, the defence industry export supply in return can provide opportunities for exports, growth and economic development for engaged enterprises, activities, and regions.

The 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, which is illustrated in the case of the Slovenian defence industry supply in return export activities. These are the challenging research and policy issues in the changing world, industrial management and data systems. 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, but with the increasing role of the economic efficiency criteria in their marketing and supply in return export activities. This also holds for Slovenia as a small open economy, which is the member of the enlarged EU and NATO as well as in cooperaton with the other countries in Europe and in the rest of the world. The extensive overseas participations by Slovenian armed forces have contributed to goodwill and credibility from other countries, but so far this has to a lesser extent been utilised in the defence industry supply in return export management activities as an issue for future research.

CONCLUSIONS

This paper presents unique empirical results of the defence industrial and technological base supply-chain activity structures and marketing flows. 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 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, and the rest of the world markets).

The input-output modelling approach is used to study export supply chain management in the defence technological and industrial base activities. Our focus has been on those enterprises and activities, which are engaged into the defence industry supply in returns export activities. It has been found that the size of the export multiplier provides a significant multiplicative effects from the defence industry supply in return export activities on the rest, particularly on the civilian activities in the Slovenian economy. A greater attention should be given to products and services in activities and services in higher productive value-added activities in

middle-high and high-technological intensive activities to achieve greater positive synergies and multiplicative effects for the rest of the economy. The defence technological and industrial base supply in return export activities are found as an important factor for strengthening of export supply-side management, internationalization of the enterprises and the economy to increase international competitiveness.

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CHALLENGES OF COLLABORATIVE PRODUCT DEVELOPMENT IN HIGH-TECH COMPANY ENVIRONMENT

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ABSTRACT

The purpose of this paper is to identify challenges in collaborative product development in the high-tech enterprises. The research approach is a multiple case study realized in Finland and Thailand. There are twenty-three challenges that have found to be critical for effective collaborative product development. These include negotiation strategies, mutual trust, generating new ideas and rapid pace of new product introduction. In addition to the theoretical study, the practical definition of challenges is made by the experts in the high-tech enterprises.

Keywords: Challenges, Collaborative Product Development, High-Tech Company

INTRODUCTION

The amount of partnerships in research and development has grown significantly during the past decades, especially in the high-tech industries. Globalization and current economical situation are increasing the competitive forces in all fields of industry and the pace of new product development has reached new levels. Technologies, products and services are more complicated than before. Therefore companies are facing increasing challenges in keeping up with the pace of development and new innovations systems. The enterprises are introduced to the challenges of more modern collaborative product development that combines agile methods of new product development to more complex partner and supplier co-operation interfaces (Schwaber, 2004). Improving firm's innovation performance has become an important concern of today. This is the reason, why firms are continuously improving their innovation processes, combining internal R&D and external knowledge acquisition activities (Cassiman and Veugelers, 2006). Firms must be able to draw on a variety of internal and

external technologies in order to introduce new products and services to the market at the right time. Thus, the acquisition of external information and technology becomes a vital factor and strategic variable for organization's success. (Kurokawa, 1997; Rigby and Zook, 2002; Squicciarini and Loikkanen, 2008). Therefore acquiring product development know-how by means of collaborating is occurring to be much more challenging than what we are traditionally used to. These are the reasons, why this is an important topic to study.
The aim of this research is to investigate the challenges hidden in the collaborative product development process and to better understand the relationship between a high tech company who is a buyer of the knowledge for its new product development (NPD) process and with a supplier of the needed knowledge. The focus of the study is in knowledge transfer process during or in sourcing process of product development process. This research not only contributes to a better understanding about the modern product development process, but also gives the insight of what the most important aspects of the collaborative R&D of special know-how are in high-tech field of business. In order to meet the objectives of this study, the following research questions need to be answered:

RQ1: What are the challenges of collaborative product development according to literature?
RQ2: How these challenges are defined in high-tech product development?

This study addresses the research questions in a qualitative approach both through literature as well as analysis of high-tech enterprise interviews. The first research question will be answered on according to literature review, and then the second research question is based on qualitative interviews.

RESEARCH PROCESS

This study bases its theoretical foundation on buyer-supplier relationship and product development (Figure 1). Selected theories are applied to an extent as required for the purpose of understanding the challenges of collaborative product development.

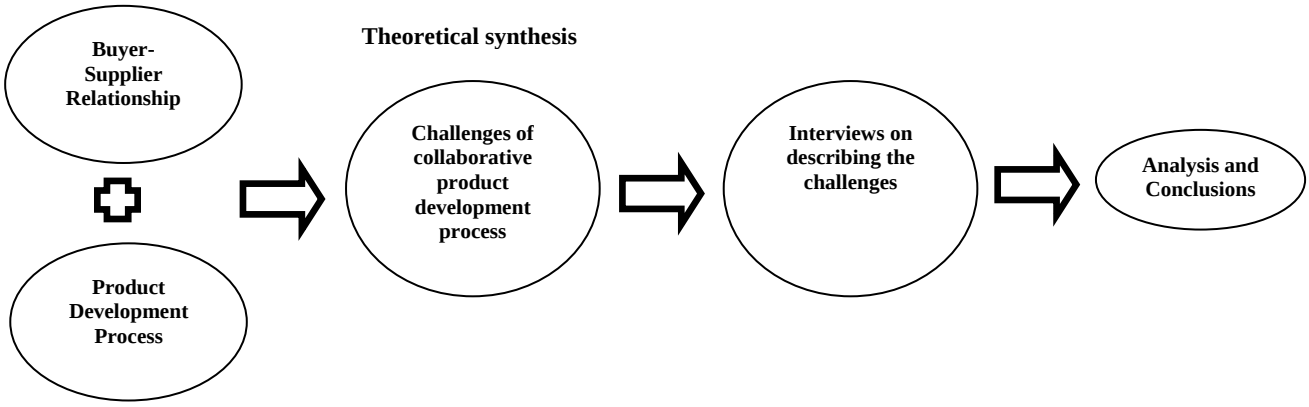

Fig. 1 Research process

The research process had two phases. The first phase is literature survey built up in order to define the challenges of product development related purchasing, contracting activities and

collaborative R&D as seen in previous studies. The second phase is an empirical investigation of high-tech case companies. The empirical study was conducted to better understand the main challenges of collaborative product development by exploring the common definition of the challenges in practical way. The study consisted of 7 interviews with people who are expert in collaborative product development. Each interview session was based on the same questionnaire. The interviews were allowed the interviewees to explain and clarify the challenges. All the interviewed companies are the high tech enterprise and have long traditions of continuous R&D and NPD process, 4 companies are operating in Finland and one in Thailand. Most of them are a large-size high-tech enterprise.
The participants interviewed were selected carefully on the basic of their professional background and expertise. Selected participants hold responsible positions in the interviewed companies. The experience and the current interests ensured the high motivation among the participants and up-to-date knowledge with respect to the discussed topics. The total work experience of those interviewed was typically between 10 and 20 years.

Table 1: Brief characteristic of the interviewed companies

Company	Number of interviews	The job title of respondents	Company size	Type of products	Area
Company A	2	1) Director of Sales and Marketing Development 2) Director of Technological Assets	Mid-sized	Software and services	Finland
Company B	1	Head of R&D	Large	Consumer electrics, converging internet and communications	Finland
Company C	1	Collaboration Manager	Large	Telecommunications equipment and services	Finland
Company D	1	Software Project Manager	Large	Network protocol analyzers and simulators	Finland
Company E	2	1) Senior Manager of Design Engineering Department 2) Specialist of Design Engineering	Large	Electrical products	Thailand

COLLABORATIVE PRODUCT DEVELOPMENT PROCESS

Buyer-supplier relationship

In recent years, there are many scholars concentrate on the relationship between buyer and supplier. Gules and Burgess (1996) has emphasized, the buyer and supplier relationships are often characterized by reference to two major types: adversarial and collaborative (Lamming, 1986; Lyon, Krachenberg and Henk, 1990; Imrie and Morris, 1992).
The traditional relationship or adversarial relationship is referred to as the antagonistic model, which has the characteristics of tough negotiation, focus on price, short-term contracts and multiple sourcing (Matthyssens and Van den Bulte, 1994). The competition for suppliers was defined by the buyer. The buyer would ask many suppliers to bid for business and use the enquiry and post-bid negotiation process to reduce the piece price. The supplier with the

lowest bid would be awarded the contract. This type of relationship sees the buyer-supplier relationships in terms of both parties completing with each other for profit margin. In this atmosphere, the sharing and transfer of data and information were very limited and this relation tended to discourage innovation in the supplier. Therefore with the ineffectiveness of such relationship and also the globalization of markets combined with a restructuring of many firms that a focus towards costs, quality, flexibility and technology, a new relationship between buyer-supplier has emerged by moving towards a more collaborative approach: partnership relationship (Macbeth and Ferguson, 1994; Herbig and O'Hara, 1995).

Partnership relationship requires trust and commitment for long-term cooperation along with a willingness to share risks (Humphreys et al., 2001). Buyer and supplier achieve lower costs through working together to lower both buyer's and seller's operating costs (Wilson, 1995). In the partnership model, suppliers become involved in the new product development process very much earlier than before. Lamming (1993) showed the results of involvement of suppliers in development of a new vehicle gives the Japanese a major advantage and also he assert that earlier involvement, a key aspects of participation in new product development, is a feature of the collaborative relationships. Many manufacturers now recognize that their ability to become world-class competitors is based to a great level on their ability to establish high levels of trust and cooperation with their suppliers since they believe that their supplier are able to help them achieve a stronger competitive position (Humphreys et al., 2001). Many researchers (e.g., Ellram, 1990; Lamming, 1986; Wilson, 1995) studied the key success factors for the collaborative relationships. The common key success factors that affect the relationships between partners are commitment, trust, cooperation, shared knowledge/technology and social bonds.

Product Development

Organizations face bigger challenges to stay competitive and are forced to exploit knowledge from the environment in order to sustain growth. (Cooper, 2001; Squicciarini and Loikkanen, 2008; Audretsch DB, 2008) Product development process - the most strategically sensitive business function - is accelerating in global environment. Characteristics that make product development challenging for the project team are trade-offs, dynamic nature of environment, used level of details, pressure of time, required investments, creation, satisfaction of customer needs, team spirit and diversity. Dimension used to assess the performance of product development effort are: product quality, product cost, development time, development cost and development capability (Ulrich and Eppinger, 2008; Cooper 2001). Speaking of modern product development, firms are seeking new ways to grow and diversify through technological innovation and development (Kurokawa, 1997). However, globalization, rapid pace technological change and increasing amount of information flows has made the modern product development more versatile and complex, than traditional product development processes let us perceive. Today even the largest innovation-active organizations cannot rely only on the internal sourcing – they also require knowledge from beyond their boundaries when developing new products and technologies. Therefore increasing amount of innovations employed within a firm is not induced by firm's own product development process, let alone product development process is no longer merely an in house operation (Kurokawa, 1997; Rigby and Zook, 2002).

Innovative activity is essential for economic growth and development, therefore greater openness to knowledge sharing and trade increases the local technological development (Squicciarini and Loikkanen, 2008). Firms are experimenting in their innovation process, combining internal knowledge and external knowledge-acquisition activities (Cassiman and Veugelers, 2006). One challenge of modern product development is how organizations manage shared knowledge and internal and external information flows effectively. Many innovations in modern society are acquired through a variety of means, such as licensing, R&D contracts, collaborative product development projects, minority investments, joint ventures, or mergers (Kurokawa, 1997). Due to a rapid pace of modern society, technological change, and globalization, firms must be able to draw on a variety of internal and external technologies in order to introduce new products and services into to the market at the right time. Thus, the acquisition of external information and technology becomes a vital factor and strategic variable for organization's survival (Kurokawa, 1997; Rigby and Zook, 2002; Squicciarini and Loikkanen, 2008).

According to social network theory and the knowledge-based view of the firm, collaboration enhances competitive advantage through enabling efficient resource exchange and combination (Galunic and Rodan, 1998; Nahapiet and Ghoshal, 1998). In addition prior research has empirically demonstrated that inter-firm cooperation tends to increase the innovativeness (Mowery et al., 1996; Dutta and Weiss, 1997; Stuart, 2000). In the context of innovativeness, there is also evidence on that customers and suppliers are a particularly important source of innovation. Successful integration of suppliers in product development can result in improved quality, reduced product development duration, cost reductions, and improved access to needed technologies, markets etc. (Ragartz et al., 1997; Mikkola and Skjoett-Larsen, 2003; Handfield et al., 1999) Extensive supplier involvement in product design can cut the complexity of the project, which in turn creates a faster and more productive product-development process. Such involvement can also alert the project team of potential problems early on, at a stage where they are faster to eliminate (Brown and Eisenhardt, 1995). According to Ragartz et al. (2002) supplier involvement gravity may range in from simple consultation or information gathering to outsourcing design of components or systems entirely. Also supplier involvement schedule varies according to the purpose and need. Early involvement of suppliers is necessary when the product development process in question involves high complexity and uncertainty. In addition timing of supplier integration is relative when supplier holds critical items of technologies with regards to the development process (Ragartz et al., 2002; Handfield et al., 1999; Monczka et al., 2000).

Collaborative product development project can be successful only if the partners are able to enhance learning, re-evaluating and readjusting the initial conditions of their partnership (Doz, 1996). Conflicting pressures of simultaneous competition and cooperation may bring tensions in inter-firm collaboration. Therefore, combination of collaboration and competition are one the challenges product development projects face more or less in every organization. Moreover, the role of trust in creativity-oriented joint developments is very important. Bidault and Castello (2009) suggested that the role of trust has a positive effect on establishing the collaborative development, but has mixed effects on the innovativeness of the joint development as well as Simons and Peterson (2000) explored that mutual trust is conductive to an increase of joint creativity. Björkman and Lindell (1991) found that two-thirds of the sample ventures had the primary mission of leading the new product development to diversification into new product markets. Other expected benefits of entering

collaborative R&D are cross-fertilization of ideas, improvement of competitive position, R&D cost reduced, larger project / increased funds, early access to new technologies, better chance of project completion, access to larger potential market, risks reduced, etc. Also Tidd et al. (1997) suggest that there is usually more than one reason for an alliance and these reasons can be classified as strategic, in terms of opportunities for gaining market leadership and general learning or tactical, in terms of reducing cost, time and risk. However, some investigations into joint development observed that collaborative development often fail because it lacks coordination of activities and management. This suggests that consideration should be given to both contractual and procedural coordination mechanisms in collaborative relationships (Sobrero and Roberts, 2002). One aspect of the contracting in product development is the fact that results lead in a legal relationship, where partnership and mutual interest has to be created and clarified in order to avoid risking the collaboration (Fleming, 2003; Smith and Eppinger, 1997). Also contracting collaborative product development should create value to both parties i.e. should create a win-win situation for partners (Emden et al., 2006).

CHALLENGES FOR COLLABORATIVE PRODUCT DEVELOPMENT PROCESS

Theoretical synthesis

The challenges in collaborative product development have been summarized in Table2. This synthesis highlights the key findings from the review of literatures. The findings are classified into seven perspectives named: contract management, information management, collaboration management, resource management, NPD management, technology management, and globalization management. The goal of this summary was to list all the challenges faced by high-tech companies in collaborative product development.

Table 2: Challenges of collaborative product development (Cassiman and Veugelers, 2006; Cooper 2001; Fleming, 2003; Kurokawa, 1997; Lamming, 1993; Leavy 1994; Ragartz et al., 2002; Rigby and Zook, 2002; Simons and Peterson, 2000; Sobrero and Roberts, 2002; Squcciarini and Loikkanen, 2008; Ulrich and Eppinger 2008; Wilson 1995)

Category	Challenges
Contract Management	1. Negotiation strategies 2. Managing the win-win situation (combination of competition and collaboration) 3. Degree of supplier integration
Information management	4. Understanding the dynamics of information between network partners 5. Managing the transferred and shared information between network Partners 6. Managing communication between partners
Collaboration management	7. Mutual trust 8. Mutual goal 9. Lack of commitment 10.Understanding the role of competence flow between supplier- buyer 11. Increase communication and coordination costs 12. Managing the cross-functional interface
Resource management	13. Pressures of the continuous quality improvement and cost reduction
NPD management	14. Generating new ideas 15. Rapid pace of new product introduction 16. Finding the superior product 17. Finding the best partner candidate for R&D 18. Increased expectations of quality and reliability
Technology Management	19. The features of technology (technological change, complexity, and uncertainty) 20. Increase special know how of some technology 21. Finding the best technological solution
Globalization management	22. Need for cultural understanding 23. Increased competitive forces

Practical definitions

The practical definitions of all challenges have been summarized in Table3. This summary focuses on the key findings from the empirical study. The goal of this summary was to explore the common practical definition of challenges.

Table 3: Practical Definitions of Challenges in High-Tech Company Environment

Challenges	Practical definition	Comment
Contract Management		
1. Negotiation strategies	The economics of scale, the size of the company and the amount of the sales are the key factors in negotiation situation. The company can get the total price cheaper but it is good to gain profit for the company's providers as well.	Reviewing the literature, negotiation strategy is the specific technique (e.g., win-lose, win-win) that the parties use during the negotiation process. Negotiation strategy takes two parties to carve some outcomes based on mutual interests. A good negotiator is one who produces a win-win situation between both parties. However, companies try to win a bit more.
2. Managing the win-win situation (combination of competition and collaboration)	The company tries to have reasonable cost and offers long term contracts in order to give stability and creates the visibility and openness to the processes.	The aim of win-win negotiation is to find a solution that is acceptable to both parties, and leaves all involved feeling that they've won in some way. The negotiation itself is a careful exploration of company position and the partner's position, with the goal of finding a mutually acceptable compromise that gives both parties as much of what they want as possible.
3. Degree of supplier integration	There are many degree of supplier integration depending on the case and the partner. Sometimes just in-licensing and sometimes it is more integrated collaboration. The important thing is to define what the right level of details is for each part in the project in order to carry out the work and earn the share of the results.	According to the literature review, supplier involvement gravity may range in from simple consultation or information gathering to outsourcing design of components or systems entirely. The interaction degree of supplier involvement in product development process depends on several factors; project's size, scope and complexity, technological uncertainty and so on (Kamath and Liker, 1994; Ragartz et al., 2002).
Information management		
4. Understanding the dynamics of information between network partners	The company has to all the time validate and verify the information by frequent meeting and ordinary project work or using the constant information changing management.	Frequent communication and interaction have been considered a crucial way in efficient understanding and management of information flow between partners.
5. Managing the transferred and shared information between network partners	The information is shared by documents, a specific tool, and/or meeting. The crucial things are all the information is tried to be shared all the time and the level of trust and openness between partners has to be very high.	The transfer and sharing information between partners is somehow controversial. For the transferred and shared information between network partners, the company has to achieve the trust and openness, however the company has to be careful on what is shared and transferred.
6. Managing communication between partners	The communication is managed through many ways that are meeting, teleconference, emails, reports, working together, and unofficial face-to-face discussions.	In order to achieve the benefits of collaboration, effective communications between partners are essential. According to Cormican and O'Sullivan (2004), face to face interaction is the

Challenges	Practical definition	Comment
		most effective form of communication. The frequency of personal contacts is found to be positively related to project success (Heinz et al. 2006).
Collaboration management		
7. Mutual trust	The mutual trust is crucial for the success of the project however the level of trust usually depends on the personal level. The company tries to achieve mutual trust through team building, openly discussions and social activities. Moreover, the basic challenges of achieve mutual trust is to find the balance how to be fare enough to the partners and how to take into account business in the first place.	Most of researchers claimed that the role of mutual trust has a positive effect on establishing the joint development as well as it is conductive to an increase of joint creativity but some argued that mutual trust is not continuously positive because it seems peak at a certain value of trust.
8. Mutual goal	The important thing to achieve mutual goal is to sustain the win-win situation in order to balance between how to achieve fair prices without compromising too much of the company benefit and to keep the production costs and development costs low enough.	The existence of common goals between the suppliers is emphasized. The mutual goal is project completed on time and safely, without rework and extra coasts. To achieve the mutual goal, it is required to have a strong mutual trust among the parties to success both parties' interests (Gray & Larson 2006).
9. Lack of commitment	The ways to ensure the commitment are usually written in the agreement. However if there is a lack of commitment, the company has to mange this issue on a company level or change the partner.	Cullen et al. (2000) claimed that commitment is to give extra effort to make the work and a willingness to go beyond contractual obligations. The more committed partners will balance short-term problems with long-term goal achievement.
10. Understanding the role of competence flow between supplier-buyer	Company has to know what the partners can do and what their competencies area by defining the company competencies and the competencies the company need from the partners in order to take the partners to fill out the gaps in the company's resources and competence area.	Reviewing the literature, effective supplier starts with the selection of the most appropriate suppliers, using criteria such as providing high quality parts, aggressive pricing and reliable delivery. The competence supplier can take costs out of the supply chain.
11. Increased communication and coordination costs	The communication and coordination costs totally based on the virtual meeting and using free tools (e.g. Skype) in day-to-day communication but they are not remarkable costs for the company.	According to Lyons et al. (1990), they presented that the one of the disadvantages of collaborative between partners is increased communication and coordination costs. However, in the real operating, that costs are not significant costs for the company.
12. Manage the cross-functional interface	Company is becoming more flexible in operation and cross-functional. The partners work through project interface and company has to consider the maturity and the life cycle of the technology and adjust the functions and the stakeholders.	A cross-functional team is a group of people with different functional expertise working toward a common goal. The management of cross-functional interface relates to coordinating and synergizing the activities of multidisciplinary for achieving the mutual goal. To manage cross-functional interface is concerned

Challenges	Practical definition	Comment
		with building a better system for achieving such cross-functional goals as product innovation, quality, cost, and delivery.
Resource management		
13. Pressures of the continuous quality improvement and cost reduction	It is based on contracts and projects plan. However, it is not always easy to get enough resources or competence from the supplier or the partner because the capabilities do not fit.	The on-going improvements in product and process can enhance quality and reliability of product leading to the lower costs.
NPD management		
14. Generating new ideas	There are plenty of sources for ideas but the crucial issue is how to put the ideas into the practice. The ideas are not only generated on the base of market, customer needs or partners but also on follow-up new and future technologies, and find out what is happening around the world.	Generating new product ideas is a must for any companies. New products are what keep established business profitable and sustainable. Reviewing the literature, there are a number of ways to generate new product ideas, for example observe what's around and what's been done before, think creativity and do a technical and market research.
15. Rapid pace of new product introduction	Monitoring, evaluating and collecting new ideas all the time.	From the literature review, there are five phases to rapid pace of new product introduction (NPI): 1) analyze the resources and competences, 2) formation of partnership, 3) sharing knowledge, 4) evaluation and 5) conclusion (Farrukh et al, 2003).
16. Finding the superior product	Research activities and evaluation to measure which product should be superior product.	The superior product is the one of the fifteen critical factors that makes the difference between winning and losing (Cooper, 2001). A differentiated product delivers unique benefits and superior value to the customer. However, superior, unique, and benefit are defined from the customer's standpoint not in the eyes of the R&D, technical or design department.
17. Find the best partner candidate for R&D	Define what the company needs and expectations are and do a deep analysis of the competences and economical status of the partner candidate.	Ball (2005) presented that selection decisions of the partner/supplier are determined based on factors such as a supplier's new product development capabilities and capacity to share information; and ability for a supplier's component to differentiate the final product.
18. Increased expectations of quality and reliability	Focus on quality improvement in order to have a good process and high-level of process to develop the main process and the products and use key performance indicators for monitoring.	Reliability is defined as how long the device continues to meet the customers' expectations whereas quality is defined as meeting the customer's expectations and ensuring that the parts work when assembled in the final product. It can be said that reliability is quality over time. The increased expectations of quality and reliability from customers leads the

Challenges	Practical definition	Comment
		company recognize about the quality polity which is to consistently meet customer expectations by continual improvement of quality.
Technology Management		
19. The features of technology (technological change, complexity, and uncertainty)	Check the changes on the customers, markets, and competitors as fast as possible in order to able to change the on-going development work and define the features and contents and also develop processes to support specification work for allowing changes in short time.	The observation that the technology change continuously- incrementally and radically is now commonly accepted. It is complex and often unpredictable therefore it enables companies to develop process and monitor the change continuously as well as link together effectively collaborations to the partners for mutual advantage.
20. Increase special know how of some technology	The company must has system for handling information about technologies and the company must make a decision on which market, customer, and technology area the company focus.	
21. Finding the best technological solution	Evaluate and analysis tools, follow-up new and future technologies, and the requirements of the customers together with a good vision of the future.	The companies have to find the best technological solution for their need not a technological solution that will work.
Globalization management		
22. Need for cultural understanding	Learn more about different organizational cultures and what the working philosophy in different places is.	Culture is as significant and complex as it is difficult to understand and use in thoughtful way. Cultural learning help company understand generally act the way partners do and recognize that the role expectations and other social variable such as ethnicity and place of residence affect the way partners speak and behave.
23. Increased competitive forces	Focus on strategy and vision and try to increase expand markets with quality and competitive price and need to have flexible products that have all the needed features and that support the evolution of technologies. However sometimes there are some big changes the company has to re-shape the strategy or change the business model.	Every company has to deal with the same challenges in the field later or sooner therefore it is not only one company has to deal with the competitive forces. However, if the company has to re-shape the strategy or business model, there are some crucial things that should be considered “Is something that changes the user behaviors” or Is this something that makes the user experience better.

Table 2 presents the key points of the challenges taken out from the literature review and Table 3 elaborates the practical definition of these challenges from high-tech enterprises view point. These definitions were somewhat similar to the earlier literature but some were different.

According to the findings, there are 19 challenges which the practical definition are similar to the earlier literature such as managing the win-win situation, degree of supplier integration, understanding the dynamics of information between network partners, managing the transferred and shared information between network partners, managing communication

between partners and mutual goal. In the other hand, there are 4 challenges which the practical definition differs from the earlier literature definition:

- Negotiation strategies: the practical definition of negotiation strategies is quite the same as in the earlier literature in terms of its focuses on finding a mutually acceptable compromise that gives a win-win situation for both parties. In practical way however, the companies try to win a bit more than their partners.

- Mutual trust: in the practical meaning, the mutual trust is very significant for the success of project and lead to increasing the creativity. Some researchers (Bidault and Castello, 2009) argued that through the mutual trust has a positive effect on the collaborative project, it is not continuously positive, because the positive effect seems to peak at a certain value of trust.

- Increased communication and coordination costs challenge: the earlier literature claimed that this factor is the one of the disadvantage of collaborative product development but in a practical way, it is not a critical factor for the joint development.

- Rapid pace of new product introduction: the practical definition is mentioned in terms of idea management in order to success the rapid pace of new product introduction but not mentioned on the resources and competences analysis, formation of partnerships and sharing knowledge between partners as presented by the earlier literature.

CONCLUSIONS

This research has addressed the challenges faced by the high-tech companies in collaborative product development. The study deals with the main concern on the improvement of collaborative product development in the high-tech enterprises. This concern is very crucial considering the globalization and current economical situation which are increasing the competitive forces in high-tech company environment. The challenges that affect collaborative product development were identified by the literature which focused on answering to the first research question. The practical definition of those challenges was analyzed by the case company which concentrated on answering to the second research question. The 23 challenges in the 7 main categories are found from the literature concerning collaborative product development. The number of challenges and the number of types of challenges indicate that there are very many categories and challenges for collaborative product development.

By focusing on the categories and challenges, the majority of categories and challenges are somehow relative to the co-operation and nobody denies that the co-operation is very important and difficult issue which companies have to manage. Moreover the increase of the importance of communication, commitment, information sharing, collaboration is certainly really much more difficult than usual collaboration in buyer and supplier relationships, therefore knowing and understanding these challenges should help ensure that companies are able to deal with the increasing challenges in order to keep up with the pace of development and new innovation systems and prepare to solve many of the problems these companies are facing.

The results from the case companies that explain how the high-tech companies define challenges answered to the second research question. There are some challenges which are defined different to the earlier literature such as negotiation strategies, mutual trust, and increased communication and coordination costs therefore there are the important contributions coming out from the practical definition that helps to better understand the relationship between a high-tech company who is a buyer of the knowledge for its NPD process and with a supplier of the needed knowledge. Furthermore, the practical different in practical definition and theoretical review indicate that there is more develop practices in the future to be more success in collaborative product development. Therefore, the outcome of this research was new knowledge about the challenges of the collaborative product development both in theory and in practice.

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A DOUBLE SCREENING PROCEDURE FOR MELAMINE INSPECTION

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ABSTRACT

According to a report from the Chinese Ministry of Health, 294,000 infants have been affected by melamine-contaminated infant formula by the end of November 2008. After one year, however, melamine-contaminated foods are still entering market in Mainland. The Melamine found in contaminated milk products from Mainland had drawn worldwide attention. Screening model was first developed to solve the employee selection problem, and then was widely used in the area of quality management, credit scoring, medical problems, etc. The aim of this article is to propose an efficient procedure for melamine inspection by using the well-known screening model, in which with some melamine inspection methods appropriately arranged into the scheme of a double screening procedure we can lower down the probability of misjudgment, inspection cost, inspect error and improve inspection efficiency etc. The proposed double screening procedure could meet the needs of both consumer and company, as well as could be integrated into a preventive food safety management model for melamine.

Key words: Melamine, Screening Model, Food Safety Management, Inspect error

INTRODUCTION

According to Review of "WHO Expert consultation to the toxicological aspects of melamine and cyanuric acid" (WHO, 2008), 294,000 infants have been found to be affected by the melamine-contaminated infant formula as of the end of November 2008. The report went on to add that more than 50,000 infants have been hospitalized, and six deaths have been confirmed. World Health Organization and international food safety and health authorities strictly banned foods melamine contamination in 2009 (Freeonline library, 2009). However, Melamine-laced milk products have been found on sale in China, more than one year after the melamine scandal over contaminated dairy goods (Bangkok Post, 2010). Authorities in the southwestern province of Guizhou found that products made by three food companies contained illegally high levels of the toxic substance (Bangkok Post, 2010).

Melamine adulteration in Mainland had drawn worldwide attention (WHO, 2008b). Food safety and health authorities all around the world have been working to identify public health threshold levels for melamine (FDA, New Zealand Food Safety Authority, 2008). In the meeting organized by WHO at the end of 2008, international experts have established a tolerable daily intake (TDI) for melamine at a level of 0.2 mg/kg bodyweight. (i.e., for every kg a person weighs they can safely consume 0.2 mg every day; for a 50 kg child this is 10

mg; for a 70 kg adult the safe amount is 14 mg). The TDI is applicable to the whole population including infants. The TDI determines the level of melamine in food that will present negligible risks to public health(WHO, 2008b). The US Food and Drug Administration (FDA) has published an interim safety/risk assessment on melamine and structural analogues and has established for melamine a tolerable daily intake (TDI) of 0.63 mg per kg of body weight per day(WHO, 2008a). The European Food Safety Authority (EFSA) has published a provisional statement and recommended to apply a TDI of 0.5 mg per kg of body weight per day as tolerable intake value for the total of melamine and its analogues (ammeline, ammelide, cyanuric acid) (WHO, 2008a).

The TDI is an estimate of the maximum amount of an agent to which an individual can be exposed on a daily basis over the course of a lifetime without an appreciable health risk. Based on this figure, the US FDA set the legal limit of melamine and melamine-related compounds in food products other than infant formula below 2.5 parts per million (ppm) do not raise concerns. The US FDA announced a 1 ppm standard for safe levels of melamine in infant formula. The Hong Kong Food and Health Bureau (FHB) set the legal limit of melamine at 1mg/kg for milk, any food intended to be consumed principally by children under the age of 36 months and any food intended to be consumed principally by pregnant or lactating women; and 2.5mg/kg for other food(WHO, 2008c).

Taiwan suspended imports of all mainland Chinese milk products, and recall all the problem foods on Sep 22, 2008(Bloomberg, 2008). Sep 25, 2008 the DOH raised the legal standards for melamine in foods from zero ppm to 2.5ppm. DOH minister Lin Fang-yu resigned the next day under heavy criticism(Taiwan News, 2008). On Sep 27, Premier Liu Chao-shiuan and Lin's successor Yeh Ching-chuan both said that the authorities would use a "zero detection" method to replace the 2.5ppm standard(Taipei Times, 2008).

Milk powder, creamer, dairy products and vegetable protein concentrates were all banned from importing from Mainland on Sep 21, 2008. DOH lifted the import restrictions of dairy products and vegetable protein in June 2009, but remained inspection in batches and melamine should not be detected positive. Two groups of plant protein powder imported from Mainland were found to have melamine on Nov 19, 2009. According to Mainland Affairs Council's Report, Melamine adulteration in Mainland created panic among consumers and enormous losses for business operators in Taiwan (Mainland Affairs Council, 2008). In order to ease people's worries about tainted food, Taiwan's DOH needs to set up a food safety system to safeguard the people's health and welfare. The system should include setting food safety standards, establishing testing programs to ensure that those standards are met, conducting tests on milk and dairy products in the market; maintaining close liaison with the trade, overseas and Mainland authorities; monitoring any relevant findings and studies on melamine in food conducted locally or in overseas jurisdiction.

Considering the lower limits of detection, the DOH should go for the best available technology - the GC/MS or LC-MS/MS and not the HPLC. However, if people use extremely expensive testing methods, it would raise the price of products to a level that nobody could afford. How to utilize all kinds of resources to inspect thousands of dairy products efficiently is a critical issue. Therefore, it is an urgent problem to set up a reasonable inspection process which satisfies the needs of consumers, business operators and food manufacturers. The aim

of this article is to propose an efficient inspection procedure for melamine by using screening model which is well-known in solving quality problems.

LITERATURE REVIEW

1. Melamine and a Melamine-related Compound

Melamine (CAS No. 108-78-1), (Chemical Name: 1,3,5-Triazine-2,4,6-triamine**)**.

Melamine is used in the production of melamine resins, typically by reaction with formaldehyde. It has many industrial uses, including in the production of laminates, glues, adhesives, moulding compounds, coatings and flame retardants. Melamine was also found as a metabolite of the pesticide cyromazine in plants, goats, hens and rats. Melamine is also used in some fertilizers.

Outside the current food safety incident consumer exposure to melamine is considered to be low. Besides low levels of residues as consequence of cyromazine metabolism it may occur through the extraction of melamine from compression moulds by acidic foods, such as lemon or orange juice or curdled milk, at high temperature. Taking into account these sources the estimated oral uptake of melamine is around 0.007 mg melamine/kg body weight/day.

There are no approved uses for the direct addition of melamine to food (e.g. in the United States and Europe). Adulteration occurs, in part because commonly used methods for protein analysis cannot distinguish between nitrogen from protein sources and nitrogen from non-protein sources. This results in incorrectly high protein measurements for products containing non-protein nitrogen sources like melamine and provides an economic incentive for their (illegal) addition.

2. Methods for the Analysis of Melamine

There are several inspection methods available for the analysis of melamine and its analogues in food and feed, such as ELISA, HPLC, GC/MS, LC-MS/MS (WHO/HSE-FOS, 2008a, 2008b), they serve for different product inspections and have various detection and quantification limits, respectively.

2.1 ELISA is an enzyme-linked immunosorbent assay (ELISA) that determines a quantitative level of melamine and is intended for use in milk, milk powder, wheat gluten and pet food. Melamine is extracted from a sample by vortex or sonication, and the extract pipetted into the antibody-coated microwell. The quantity of melamine is determined via a colour reaction, and a microplate (or strip-) reader is required to measure the optical density. Test kits (i.e. coated microplates and reagents) are commercially available; they can prove very useful as screening tool. However care has to be taken with respect to sample preparation in order to avoid interferences. Also currently available test have reported detection limits that may not be sufficiently sensitive. Validated for various food matrices and sample preparation methods adapted to achieve lower detection and quantification limits are currently under development.

2.2 HPLC-UV can provide quantitative information (usually using UV at 240 nm). Samples are extracted with acetonitrile/water mix and analyzed by ion-pair HPLC. However, analyses of complex samples like candy and cookies will give a lot of interfering compounds that also will absorb UV at 240 nm. Therefore, development of an LC-UV requires intensive validation by a mass spectrometric based technique for each food matrix and may also require a selective sample preparation procedure. Often positive samples are validated by a second analysis. However, this is normally used to eliminate false positives, whereas false negatives will not be discovered. From the point of food safety it is more important to find the false negatives (thus samples that do contain melamine above the limit even though analyses show they are below).

2.3 GC-MS/MS is with LC-MS/MS amongst the most reliable methods for low level quantification of melamine in a variety of different sample matrices. It will deliver high sensitivity and selectivity for a broad range of different products. This approach is less sensible to matrix effect compared to LC-MS/MS. Samples are generally extracted with an acetonitrile/water mixture. The extract may then be cleaned up by liquid/liquid extraction followed when necessary by solid phase extraction SPE followed by a derivatization step. Isotope dilution approaches using isotopically labelled internal standards may provide more reliable quantification, but is not mandatory.

2.4 HPLC-MS/MS is with GC-MS/MS amongst the most reliable methods for low level quantification of melamine in a variety of different sample matrices. It will deliver high sensitivity and selectivity for a broad range of different products. Samples may be extracted with an acetonitrile/water mixture. The extract may then be cleaned up by liquid/liquid extraction followed when necessary by solid phase extraction SPE. Isotope dilution approach is strongly recommended to provide reliable quantification.

For HPLC-MS/MS, melamine is analyzed in the positive electrospray ionization mode; analogues are analyzed in the negative ionization mode. The different polarities required necessitate the use of polarity switching during one HPLC-MS/MS run and, thus, adequate analyze chromatographic separation or two different HPLC-MS/MS runs. Trimethylsilyl derivatives are produced for GC-MS/MS analysis of melamine and analogues. Analysis is performed in the electron impact ionization mode.

Table 1. Analytical techniques used for analysis of melamine and analogues in food and feed

Analytical technique	Selectivity	Sensitivity	Cost	Purpose	Remarks
ELISA	Low	Low	Low	Screening	Currently for detecting melamine only
HPLC-UV/DAD	Low	Low	Medium	Screening and confirmation	Preferred for screening of melamine and analogues; however, validation is required for confirmation
GC-MS /MS	High	High	Very high	Screening and confirmation at trace levels	Confirmatory method for melamine and analogues
LC-MS /MS	High	High	Very high	Screening and confirmation at trace levels	Confirmatory method for melamine and analogues

Note: DAD, diode array detection; ELISA, enzyme-linked immunosorbent assay; HPLC, high-performance liquid chromatography; LC, liquid chromatography; MS, mass spectrometry; MS/MS, tandem mass spectrometry; UV, ultraviolet.

3. Screening Model

Screening model was first developed to solve the employee selection problem (Taylor and Russell, 1939), and then was widely used in the area of quality management (Owen, McIntire, and Seymour, 1975; Tang, 1987; Moskowitz, Plante, and Tsai, 1991), credit scoring (Tsai and Yeh, 1999; Tsai, Thomas and Yeh, 2005), medical problems (Moskowitz, Plante, and Tsai, 1993) etc. Screening models with single-stage, double-stage, and multi-stage consider the inspection process, inspection error, inspection costs, selection rate, in order to achieve the best inspection determine baseline for optimizing the misclassification error, total costs, etc.

A double screening procedure was first established by Moskowitz and Tsai (1988). The scheme of a double screening procedure is as follow: two inspection stations are considered, a product is inspected at the first station by using an inspection method which is relatively easy to use, low cost, but may be less precise or accurate, and results in one decision out of accept, rejection, or undecided. The second station, by using a better but more expensive inspection method, is applied to those undecided products, and results in one decision out of accept or rejection.

The scheme of a double screening procedure can be stated in more details as follows: Suppose there are two screening variables X_1 and X_2 that can be used jointly to predict a performance variable Y which cannot be measured directly. Also assume that Y has a one-sided lower specification $-K_\gamma$. Thus, an item with a Y value above $-K_\gamma$ is conforming; Otherwise, it is nonconforming. Hence the individual nonconforming probability (INP) for an item with $X_1= x_1$ and $X_2=x_2$ is defined as INP=Prob $[Y<-K_\gamma|X_1= x_1, X_2=x_2]$. Note that if an item is accepted, then its INP can be interpreted as the individual misclassification probability (IME).

Furthermore, an average outgoing quality (AOQ) is defined as the proportion of nonconforming items among selected items, or as derived in Tsai and Moskowitz (1986), the average INP for those accepted items. A selection ratio (β) is defined as the proportion of selected (accepted) items. We also define emaxa and eminr to be the maximum INP for those accepted items and the minimum INP for those rejected items, respectively. Therefore, the INP for every accepted item is no more than emaxa at both inspection stations. Thus the overall AOQ will also be less than or equal to emaxa.

METHOD

Double Screening Procedure for Melamine Inspection

There are several inspection methods available for the screening and quantification of melamine in food such as ELISA, HPLC, GC/MS, LC-MS/MS (WHO/HSE-FOS, 2008a, 2008b), they are able to detect very low concentrations of melamine and its analogues in food products and have various inspection costs, inspection errors, detection limits, false positive and false-negative factors, easiness to use, respectively. In order to set up a double screening procedure for melamine inspection, two commonly used methods HPLC and LC-MS/MS are

adopted as first stage and second stage inspection methods, their detection limits are 2.5ppm and 0.05 ppm; inspection costs are R_1=NT1,500 and R_2=NT4,000, respectively.

Let Y denote the true value of melamine contained in food, since its measurement scale is based on ppm (10^{-6}), it is reasonable to assume that Y has a lognormal distribution, i.e., Z=lnY has a normal distribution. If Z=lnY~N(μ_z=0, σ_z^2=1.5), and the mean and variance of Y are $\mu_y = \exp(\mu_z + \sigma_z^2/2)$=3.08, $\sigma_y^2 = \exp(2\mu_z + \sigma_z^2)[\exp(\sigma_z^2) - 1]$=8.97, respectively. The measurement error model used in Moskowitz et al. (1993) is adopted here to develop our proposed double screening procedure for melamine inspection. Let's consider the following measurement error models: X_1=Z+e_1; X_2=Z+e_2, where
Y: the true value of melamine;
Z=lnY: the logarithm of true melamine value (Y) with lognormal distribution N(μ_z, σ_z^2);
e_1: the measurement error of HPLC with N̂(, σ_1^2);
X_1: the exponential value of observed melamine by HPLC with N(μ_z, σ_z^2 + σ_1^2);
e_2: the measurement error of LC-MS/MS N̂(, σ_2^2);
X_2: the exponential value of observed melamine by LC-MS/MS with N(μ_z, σ_z^2 + σ_2^2);
σ_1: the detection limit of HPLC, say ln(2.5ppm);
σ_2: the detection limit of LC-MS/MS, say ln(0.05ppm);
R_1: the inspection cost for HPLC;
R_2: the inspection cost for LC-MS/MS.
Assume that the true value of melamine (Y or Z) is independent of measurement error (e_i), then X_1 and Z has a bivariate normal distribution, and their correlation can be derived as $r(X_1, Y) = \frac{\mathrm{Cov}(X_1, Y)}{\sqrt{\mathrm{Var}(X_1)\mathrm{Var}(Y)}} = \frac{\mathrm{Var}(Y)}{\sqrt{[\mathrm{Var}(Y) + \mathrm{Var}(e_1)]\mathrm{Var}(Y)}} = (1 + \frac{\sigma_1^2}{\sigma_y^2})^{-1/2}$, similarly, X_2 and Z also has a bivariate normal distribution with the correlation $r(X_2, Y) = (1 + \sigma_2^2/\sigma_y^2)^{-1/2}$.

The scheme of a double screening procedure for melamine inspection is shown as in Figure 1. There are two inspection stages such that HPLC is arranged in the first stage and its exponential value of observed melamine is denoted by X_1, and LC-MS/MS is in the second stage and its exponential value of observed melamine is denoted by X_2; The decision rules for two stages are based on the principle of no positive reading for any inspection method, say, the product is rejected at the first stage if $X_1 > \sigma_1$, otherwise it goes to the second stage for inspection by LC-MS/MS; the product is rejected if $X_2 > \sigma_2$, otherwise it is accepted, where σ_1=ln(2.5ppm) and σ_2=ln(0.05ppm) are detection limits for HPLC and LC-MS/MS respectively.

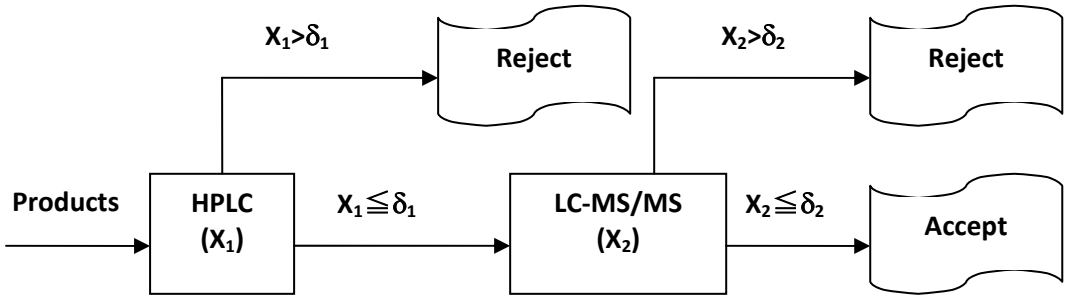

Figure 1: A Double Screening Procedure for Melamine Inspection.

A single screening procedure can be modified in Figure 1 such as the product is rejected if $X_1>\delta_1$, otherwise it is accepted. The average outgoing quality after single screening procedure (or the probability of misjudgment) is defined as the probability of Z exceeds the detection limit δ_1 for those accepted product such as $AOQ_1 = P[Z > \delta_2 \mid X_1 \le \delta_1]$, where the acceptance rate is $S_1 = P[X_1 \le \delta_1]$ The maximum individual misclassification error (max IME) occurs at $X_1=\delta_1$ such as $e\max_1 = P[Z > \delta_2 \mid X_1 = \delta_1]$. Similarly, the average outgoing quality after double screening procedure is defined as the probability of Y exceeds the detection limit δ_2 for those accepted product such as $AOQ_2 = P[Z > \delta_2 \mid X_1 \le \delta_1, X_2 \le \delta_2]$, where the acceptance rate is $S_2 = P[X_1 \le \delta_1, X_2 \le \delta_2]$. Similarly, The maximum individual misclassification error (max IME) occurs at $X_2=\delta_2$ such as $e\max_2 = P[Z > \delta_2 \mid X_2 = \delta_2]$Moreover, the expected per-item inspection cost for double screening procedure is defined as $R = R_1 + R_2 S_1$.

NUMERICAL EXAMPLES

In this section, three numerical examples are provided to show the corresponding results of the proposed double screening procedure for melamine inspection. The distributions of Z=lnY are assumed to be normal distributions with N(-0.5, 1.5^2), N(0, 1.5^2), N(0.5, 1.5^2) for comparison between three examples, all computations are based on the simulation data. The first example has more probability on the left tail (small amount of melamine) while the third example has more probability on the right tail (large amount of melamine). Since HPLC has less precision than LC-MS/MS, it is assumed the inspection errors have variances such as σ_1^2 $=1>\delta_2^2=0.2$. Clearly, AOQ1's are increasing while AOQ2's are decreasing from example 1 to example 3; and AOQ2 are much less than AOQ1 which verifies the efficiency of a double screening procedure than that of a single screening procedure. The third example has smaller expected per-item inspection cost since it rejects more items at the first stage, which demonstrates the efficiency of a double screening procedure than that of a single screening procedure.

Table 2. Three numerical examples of double screening procedure for melamine inspection.

Parameter	Example 1	Example 2	Example 3
$Z=\ln Y \sim N(\mu_z, \sigma_z^2)$	$N(-0.5, 1.5^2)$	$N(0, 1.5^2)$	$N(0.5, 1.5^2)$
$P[Z>\delta_2=0.05]$	0.96	0.98	0.98
$P[Z>\delta_1=2.5]$	0.17	0.28	0.40
$e_1 \sim \tilde{N}(0,\sigma_1^2)$	N(0, 1)	N(0, 1)	N(0, 1)
$e_2 \sim \tilde{N}(0,\sigma_2^2)$	N(0, 0.2)	N(0, 0.2)	N(0, 0.2)
$r(X_1, Y)$	0.829	0.838	0.838
$r(X_2, Y)$	0.991	0.99	0.992
$r(X_1, X_2)$	0.821	0.831	0.835
$S_1=P[X_1 \leqq \delta_1]$	0.79	0.7	0.6
$S_2=P[X_1 \leqq \delta_1, X_2 \leqq \delta_2]$	0.05	0.03	0.02
$AOQ_1 = P[Z > 0 \mid X_1 \leq \delta_1]$	0.946	0.968	0.972
$AOQ_2 = P[Z > \delta_2 \mid X_1 \leq \delta_1, X_2 \leq \delta_2]$	0.255	0.192	0.167
R (NT dollar)	1500+4000*0.79 =4700	1500+4000*0.7 =4300	1500+4000*0.6 =3900

CONCLUSION

The Melamine found in contaminated milk products from Mainland had drawn worldwide attention. In this article an efficient procedure for melamine inspection was proposed by using the well-known screening model, in which two commonly used inspection methods for melamine are appropriately arranged into the scheme of a double screening procedure and the decision rules are based on no positive reading. Since all inspection methods involve some degree of measurement error, a measurement error model was adopted to evaluate the probability of misjudgment and the expected per-item inspection cost. The results show that a double screening procedure is better than a single screening procedure in terms of probability of misjudgment and the expected per-item inspection cost. Besides, the inspection error of a method is a key factor to the probability of misjudgment, therefore, the future research might consider to increase the number of measurement of a certain method to reduce the variance of its error.

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AN INVESTIGATION ON IMPORTANCE OF INTEGRATING ASSEMBLY DETAILS WITH MACHINING OPERATIONS IN CELL FORMATION PROBLEM

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ABSTRACT

This paper investigates the role of assembly operations and product structure in Cellular Manufacturing System (CMS) design. With respect to the common definition of CMS, the cell formation problem (CFP) is identifying of part families and machine cells so that every part type ideally can be produced only in an individual cell. A new definition of CFP can be presented when the assembly details are considered. Therefore, the main purpose of this research is to show the importance of integrating assembly operations and product structure with the machining operations to forming manufacturing cells. Finally, some different examples from the literature are considered and the related results are compared to validate the proposed issue.

Keywords: Group Technology, Cellular Manufacturing System, Cell Formation, Assembly Operations, Product Structure

I. INTRODUCTION

The traditional manufacturing systems including Flow shop and Job shop (i.e. process layouts) is selected when there are a few product types with large annual product demand and or many product types with low annual demand in manufacturing environment, respectively. However, today's industrial environments are met with enormous changes in product configuration and demand, severe competition, increase in variety and reduction in product life cycle. In the other hand, manufacturers tend to improve quality of their products while reducing the cost and delivery time in order to gain competitive advantages in contrast to rivals. Therefore, the companies have been compelled to use more effective strategies and approaches in procurement, production, and distribution.

Group Technology (GT) is a management philosophy in manufacturing that has been applied due to its positive effects in batch production as a successful alternative in order that overcoming disadvantages of current systems in response to above-mentioned requirements. The purpose of GT is to determine and divide the parts into families by taking advantage of their similarities and the processes required to produce them. These similarities may be based on shape, on production process or both. Parts that share similar shapes or processing requirements (or both) are grouped into families.

Cellular Manufacturing System (CMS) is one of the most applications of GT for designing of the manufacturing system that produces the families of similar parts within cells each of which is a cluster of dissimilar machines. From standpoint of the organization related to CMS which is known as Cellular Layout, this layout is a combination of two above mentioned systems; process layout (i.e. job shop) and product layout (i.e. flow shop).

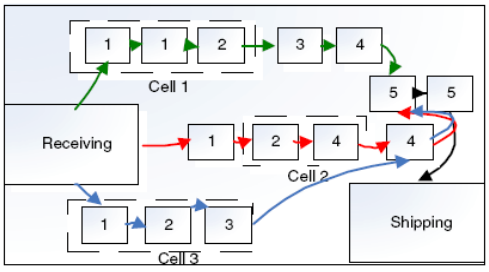

Fig. 1: Cellular Manufacturing System [1]

With respect to the common definition of CMS, the *Cell Formation Problem* (CFP) is how to group similar parts in *Part Families* (PFs) and their associated machines in *Machine Cells* (MCs) so that every part type ideally can be produced only in an individual cell.

II. LITERATURE REVIEW AND CONTEXT DESCRIPTION

So far, many studies have been carried out on CMS design, each of which has taken account of different objectives, constraints and production parameters. Pertaining to this subject, Tavakkoli-Moghaddam et al. [2] have developed a nonlinear integer model of CFP in dynamic condition and solved by using some traditional metaheuristic methods such as

Genetic Algorithm (GA), Simulated Annealing (SA) and Tabu Search (TS). Caux et al. [3] has been addressed the problem of manufacturing cell formation to minimize the inter-cell traffic with alternative process plans and machine capacity constraints. Their method permits to solve simultaneously the cell formation problem and the part-routing assignment problem whereas other methods are based on two heuristics or algorithms: one of the two problems is then solved from the solutions of the second one. Hu and Yasuda [4] have considered cell formation problem with alternative processing routes that the number of manufacturing cells is not known in advance. Defersha and Chen [5] have proposed a mathematical programming model following an integrated approach for cell configuration and lot sizing in a dynamic manufacturing environment. The model development also considers the impact of lot sizes on product quality. Solution of the mathematical model is to minimize both production and quality related costs.

In a comparative manner, the researches in literature on CMS could be considered at two sections which are described in the following of this paper.

2.1. CMS with just machining operations

Regarding to the common definition of CMS design, as previously mentioned, the issue of cell formation has been addressed when converting from job shop to the CMS. In this case, a number of researchers have compared job shop to cellular manufacturing and have generally concluded that the benefits derived from CMS are the reductions in set-up time, increased throughput, higher productivity, more efficient materials handling, reduced raw material, reduction of work-in-process (WIP) inventories, shorter lead times as well as the improvement of quality and better worker satisfaction ([6]- [19]).

However, several studies have mentioned that the implementation of CM does not always lead to performance improvements and there is likely to be some difference between the advantages predicted by various models and the advantages obtained in practice. For example, Flynn and Jacobs, 1987 [6]; Morris and Tersine, 1990 [9]; Kannan and Ghosh, 1996 [16]; Shambu and Suresh, 2000 [19] have reported that CM performs better than job shop only when set-up times are high and demand is stable. In the other hand, Flynn and Jacobs, 1987 [6], Wemmerlov and Hyer, 1989 [8] and Suresh ,1992 [20] state that a well organized and operated job shop produces better flow times and less work-in-process inventories than cellular manufacturing. Johnson and Wemmerlov, 1996 [21] conducted a meta-analysis of 31 model-based studies that compared the performance of functional and cellular layouts under a variety of operating conditions. Shafer and Charnes, 1997 [22] and Johnson and Wemmerlov, 1998 [23] also used modeling in their comparative studies of functional versus cellular layouts.

2.2. CMS with both machining and assembly operations

2.2.1. The role of assembly in manufacturing

In the realistic manufacturing environments, such as electronics and automobile

manufacturing companies, many of products are composed from at least two components. It is maybe because of increased market demand for customization; shorter product life cycles and short product delivery lead times, by which the downstream manufacturers can quickly assemble and deliver small batches of customized products. For example, a plant can package the knocked-down parts or subassemblies and they are shipped to other automobile assembly plants usually in foreign countries and assembled there.

In this situation, the assembly operations are required to be performed in a specific order for making the final products. In other words, a group of parts constitute a subassembly and a group of subassemblies constitute a higher level subassembly and so on. The order of assembly operations can be represented as an in-tree structure (as shown in Fig. 2).

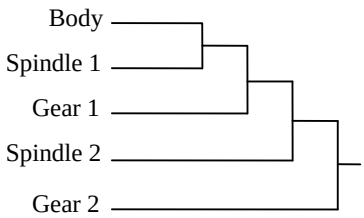

Fig. 2: An example of assembly tree [24]

There are two types of assembly features classified according to the operation flow of component parts. One type is the well-known serial assembly line where a main sub-assembly is transferred from machine to machine by material handling devices and assembled with smaller components. This type can be considered similarly to the flow shop system in whole production environment. The other type is called ‘‘fixed assembly’’ where components are first machined in their own fabrication machines in the pre-assembly stage and then pulled together to be assembled into a final product at a main assembly station. For example, In a fire engine assembly plant, the body and chassis which are the components of a fire engine are produced independently in two different departments and then brought into the assembly station, whereas the engine is purchased from outside. When the body and chassis are completed and the engine is received, they are fed to an assembly line where the fire engine is assembled [25].

2.2.2. Assembly Cells

There are a few number of studies proceeding to CMS when assembly operations exist in the manufacturing environment. Herein, the *Group Assembly* (GA) can be considered as a part of GT based on Burbidge’s [26] concept of Assembly Groups. The *Cellular Assembly* (CA) also is known as an application of GA and a part of CMS. In this case, some researchers (e.g. Levin, 1994 [27]; Feare, 1995 [28]; Bukchin et al. 1997 [29]) have discussed the problems with assembly lines and performance improvements resulting from the conversion of them to Assembly Cells. Assembly cells are formed by creating teams of workers with each team responsible for a specific set of assembly tasks. Workers in the cellular systems are capable of helping their co-workers in the same cell. Such a team approach to product assembly is considerably different from the conventional assembly line approach where a

serial, production system with each worker having individual responsibility for a specific task is usually the norm [30]. The application of assembly cells have been reported in some European companies such as Phillips, Olivetti and Volvo [26], and especially adopting it in Sony highlights the advantages of such cellular layouts over traditional assembly line layouts [31]. McGraw [32] also has described a scenario at Compaq where the cells show an improvement in productivity and quality by as much as 25%.

It must be mentioned that the performance improvement resulting from conversion of an assembly line to assembly cells and the factors which influence these improvements are different than the tradeoffs to be investigated when a functional layout is converted to cells. Therefore, some studies have discussed them to provide the guidelines for best selection. In the research by Gravel et al., 2000 [33], an interactive tool is presented to design manufacturing cells for an assembly shop. The method is based on an analysis of operation sequences and durations and allows machine-sharing among cells and with the non-cellular portion of the shop. They have sought to look at the internal structure of products in order to design one or more cells containing just a few machines that could be used to make portions of more than one product. They have showed that a cellular configuration is not always desirable, and discuss the conditions where this is so. Sengupta and Jacobs, 1998 [34] have stated that the cellular systems outperform an unpaced assembly line when teamwork is efficient and task time variances and setup times are high. In contrast, the assembly line outperforms the cells when task time variances and setup times are low and/or when teamwork in the cells causes an increase in assembly task time. In addition, their next working paper in 2004 [30] has tried to answer to the question that if assembly cells are superior to assembly lines, why have these systems not been adopted more extensively in practice? Thus, they examines two configurations of assembly cells, and compares their performance with that of a conventional assembly line in a controlled environment to understand the effects of the different factors in order to see which type of system is really superior to the other. Johnson, 2005 [35] added to the literature in this area by examining the planned (proposed) conversion of a multi-model assembly line to a set of parallel assembly cells in a real plant. The actual assembly line and the proposed assembly cells are described and the reasons for the expected performance improvements in cycle time and batch throughput time are analyzed using simulation based modeling. These results are used to generate insights about environments where conversions from assembly lines to assembly cells are likely to generate improvements in these metrics and the factors to consider when contemplating such conversions.

2.2.3. Focusing concept

In the other hand, regarding to the problems associated with the application of GT, the Focusing Technology (FT) philosophy has been proposed in which the parts that belong to a product (or a product line) are grouped into a part-family and this family is processed in a focused cell. Focused Cellular Manufacturing (FCM) is the application of the FT concept where components are grouped by end-items (or finished products) and form a group of machines or processes of functionally dissimilar types physically placed together and dedicated to the production (and to the assembly) of all parts of a finished product. In fact, the FT is the means for achieving Skinner's recommendations. Skinner, 1974 [36] suggested

that factories can be more focused. He explained that this should be done by grouping various products and resources into several manufacturing units with each unit focusing on a limited, concise, and manageable set of products, technologies, volume and markets. Skinner states that if it is not possible to focus the whole factory, one should adopt the 'plant within a plant' (PWP) notion. PWP is achieved by dividing the existing facility into organizationally and physically separated sections. As truly mentioned by Wemmerlov and Hyer, 1987 [37], FT concept is not a 'pure' group technology, and similarly FCM is not classified as cellular manufacturing since it does not attempt to take advantage of process similarities in order to reduce set-up times. FCM also is not classified as a flow shop since there are no machines dedicated to individual operations and the machines utilized are not arranged in a series [38].

Similarly to before sections, there is a need to develop a set of guidelines which help manufacturers for best selection. Therefore Al-Mubarak et al. 2003a [38] compared a well designed and operated JS layout to FCM layout. They have conducted experiments assuming that the firm being modeled has specialized resources and expertise by either similarity in process or by product line and concluded that FCM had shorter assemble waiting times whereas the job shop had better balance among machine utilizations. Al-Mubarak et al. 2003b [39] provided a comparison of FCM to CM, and concluded that products were completed in less time and average WIP inventory levels were less in FCM, and CM had less set-up time when batch sizes were small and set-up times were large. In the research by Canel et al. 2005 [40], three manufacturing systems: focused cellular manufacturing (FCM), cellular manufacturing (CM), and the traditional job shop (JS) have been compared and evaluated. All three systems are modeled using the same shop characteristics. The objective of their study is to provide a set of recommendations to assist manufacturing managers in how to organize production in their manufacturing shops. These recommendations should help managers in designing their production cells based on either traditional JS concept or GT concept or FT concept. The manufacturer's choice of a JS, GT or FT concept as a basis for designing production cells is an important strategic decision. A choice of one when the other is more appropriate might result in a very expensive mistake that would adversely affect the competitive position sought by a company.

III. INCORPORATING THE ASSEMBLY DETAILS IN MODELING THE CMS DESGIN PROBLEM

All of the aforementioned researches in the literature on CMS design with both machining and assembly operations didn't have consider assembly details integrating with machining operations in modeling the manufacturing cells formation. However, as mentioned by Vakaharia and Kaku [41], and Albino and Garavelli [42], one of the claimed disadvantages of CM is that end-item markets may grow at different rates, resulting in load imbalances. This is because the common studies of CMS design assume that each part is a final product and don't consider the structure of end-items whereas the individual parts gained by only machining operations differ from items which they are assembled. In the other hand, a family in CMS is typically composed of parts that belong to different finished products.

However, at the first time Panchalavarapu and Chankong [43] considered assembly aspects to model the CFP and presented a new definition of this problem as "identifying

machine cells, part families and a combination of subassemblies so that once the part families are completely processed within a cell, they are also assembled within the cell. The managers of individual cells are now responsible for producing finished subassemblies instead of part families…. The goal of the cellular system design should be to minimize overall material flow resulting in the system due to processing and assembly of parts". For this purpose, they proposed a mathematical model to determine assignment of parts, machines, and subassemblies to manufacturing cells. Their proposed model employs a similarity between part, machine, and subassembly using the part-machine incidence matrix derived from the part routing information, and part-subassembly incidence matrix derived from the product structure. They have analyzed a case study to evaluate the implications of the proposed model. As indicated in Fig. 3, the number of exceptional elements (EEs) due to assembly is significantly higher compared to the integrated model. In the other hand, Fig. 5 indicates clearly the total number of EEs is significantly higher for all the alternative designs evaluated with GT considerations alone without regard to assembly considerations. The results of the case study indicate that a cellular system design with a mix of GT and integration efficiency should increase the productivity of the system compared to a design which emphasizes on GT considerations.

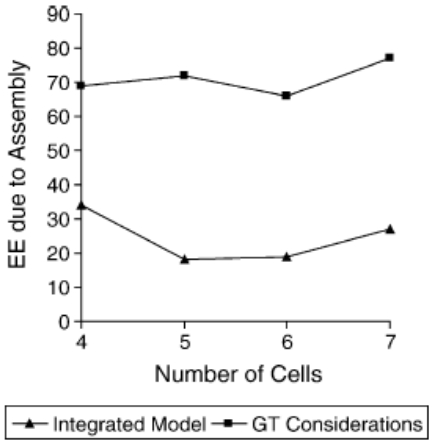

Fig. 3. EE due to assembly for various configurations [43]

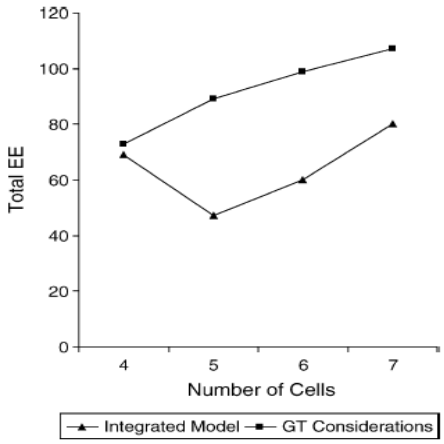

Fig. 4. Total EE for various configurations [43]

It is important that in contrast to what is mentioned by Canel et al. [40], the using of assembly cells and or focused cells for a few end-items would not be always more practical than installing the many required cells for a CM layout. If Similarly to the study by Panchalavarapu and Chankong [43], the whole makeable items are divided into two types: *individual parts* (which contain only the machining consecutive operations and their role is always child) and *assembly items* (such as final product which are composed from a number of components and don't have machining operations), an area can be considered for assembly operations, and all of the individual parts after completion are transferred into assembly area to make the subassemblies and final product. Thus, the planning and controlling process of manufacturing system (without considering movement cost) is done easier. However, if the assembly items contain the machining consecutive operations, separating the assembly area from other machine cells is not justifiable. It must be noticed that the production volume of

lower level components is related to the demand of final product and so the production volume of higher level components. As a result, the place of assembly operations and the role of parent/child relationships influence on material handling, planning, and controlling; thus they must be integrated with machining operations for designing CMS. Therefore, integrating assembly details with machining operations in modeling the cellular manufacturing design will obtain a variety of benefits such as reduction of work-in-process inventories between production of parts and assembly of the finished product, increase of output of the manufacturing system, easier production management, and etc.

According to the above issues and also in order that rectifying the drawbacks of previous researches in the literature, Aryanezhad and Aliabadi [44] developed a nonlinear model to integrate the assembly operations and product structure to the CFP. The proposed model dedicates machining and assembly operations to manufacturing cells so that minimizing the intercellular movements resulting due to both them. For solving aforementioned model, a linearization method is applied and then the computational results from solving different examples on literature for each situation (with and without assembly consideration) are compared and analyzed together. The obtained analytical outcomes show the importance of integrating assembly details in CMS design:

TABLE I
COMPARISON OF COMPUTATIONAL RESULTS OF INTERCELLULAR MOVEMENTS IN TWO SITUATIONS [44]

Problem #	without integrating assembly details		with assembly consideration	
	due to processing	due to assembly	due to processing	due to assembly
1	0	7	0	7
2	51	8	51	4
3	165	15	165	7
4	325	12	325	9
5	0	8	2	4
6	2226	20	2226	20
7	520	32	520	29
8	3724	22	3724	22

As indicated in above table, the number of intercellular movements resulting due to the processing is identical for both situations. It is because of considering the demand of final product and accordingly the production volume of its components which are bigger than the counts of each given child in child/parent relationships. But in all the test problems, the number of intercellular movements resulting in situation with assembly consideration is equal or less than the other situation.

IV. CONCLUSIONS

This paper investigates the incorporating of assembly operations and product structure in CMS design for forming manufacturing cells. It have been shown that the assembly operations and product structure should be integrated with machining operations in CMS design to obtain a variety of benefits such as reduction of work-in-process inventories between production of parts and assembly of the finished product, increase of output of the manufacturing system, easier production management, and so on. For this purpose, some different examples from the literature are considered and the related results are compared.

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AN IMPLEMENTATION ON IMPROVING EFFICIENCY AND ANONYMOUS KEY PAIR FOR THE VEHICULAR AD HOC NETWORK

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Abstract—In recent years, vehicle communications technologies and wireless networking technology are continuous development, when we use wireless communications to exchange information data, traffic will be more secure and convenient than that of the past.We describe the problem that characterizes the privacy of VANETs and proposes a new anonymous key mechanism with a system architecture based on bilinear paring and elliptic curve cryptography which adapts to VANETs. We will make a comparison of this research with other papers to illustrate the advantages of our idea. We have also a computation list to study the required operations. We can believe that the idea will be more secure and efficient to the past published papers.

Keywords: VANETs; security; privacy; identity-based; cryptosystem; bilinear pairing

INTRODUCTION

Telematics is a combination of Telecommunication and information, primarily application vehicle ad hoc network, rapidly developed in recent years and has become the focus of considerable attention as one of the market. Telematics is based on Dedicated Short Range Communication (DSRC)-based, use to build vehicles to vehicles and vehicles to roadside [1, 19]. The international there are many organizations in the development of standards set Telematics. Among them, the United States Vehicle Infrastructure Integration (VII) program based on IEEE 802.11p and IEEE 1609 Wireless Access in the Vehicular Environment (WAVE) / DSRC technology, the most attention [20].

In addition to the network layer below set telematics standard protocol, Society of Automotive Engineers (SAE) has also set up a DSRC Technical Committee, the purpose for the development of the DSRC communications developed on the basis V-2-V and V-2-I application layer protocol of the technical specifications [3].

VANET and MANET characteristics of high homogeneity, VANET is decentralized, with the formation of self-organization and multi-hop transmission capacity of the nodes in mobile network environment.

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Telematics related applications primarily through wireless communication technologies to reach, therefore, the wireless communication of information on the security issues will also be hidden on Telematics, for example, applications of Telematics always regard to information of position system as reference of a routing transfer protocol or generate personal privacy issues [3]. When the traffic information, emergency messages and traffic accident messages happened, it is a major influence to that message. If a malicious attack by spreading false information or tamper information, that attacker can affect the timeliness of incident handling. As the Telematics related industries have not fully developed, security mechanism was not perfect, it is necessary to design a mechanism to protect the transmission of packet content, to establish a messaging security and privacy protection [2].

In 2007, Li and Hwang [5] proposed under the framework of V-2-V and V-2-I, using blind signature technology to protected personal privacy. Papadimitratos and Buttya [15] proposed using Cross-Certification to vehicle registered mechanism. In 2008, M.Raya and J.Freudiger [10] several scholars proposed to send each other messages, using anonymous key pairs to protect personal privacy. [5, 15, 10] This research using crossing research certification and anonymous key pairs to the use for ITS so this give me a lot of idea to comprise this draft. They do not provide protocols. So, we proposed an identity-based encryption, Communication between the parties to anonymously send messages, and achieve to access that mutual authentication mechanism. The method can prevent a malicious attacker to message interception and tampering, and privacy protection.

RELATE WORKS

Identity-based cryptosystem

In order to simplify the traditional public-key cryptography key management issues problem. In 1984, Shamir [4] proposed Identity-Based Cryptosystem (IBC) concept. The characteristic is that sender can just use receiver's identity like e-mail, IP address, or number to encrypt the message, the private key generated by a key generation center (KGC) is to issue. In 2001, Boneh and Franklin [6] proposed bilinear pairings of ellipse curves as a mathematical tool, designed the first practical IBC system. In 2002, Paterson [8] proposed Identity-Based Signature scheme that was based on the bilinear pairings property of ellipse curve.

On the elliptic curve cryptography, Weil pairing feature has many applications, such as IBC schemes, digital signature schemes and Key Distribution are available to achieve the weil pairing. Weil pairing mainly is an algebra non-degenerate bilinear pairings of the basis. So, we will start with some brief non-degenerate bilinear pairing features.

VANETs security application requirement analysis

In 2004, Jeremy Blum and Azim Eskandarian [18] describe security architecture for vehicular communications intended mainly to counter the so-called "intelligent collisions" (meaning that they are intentionally caused) by using an infrastructure of digital signatures. But this is only one type of attacks and building the security architecture requires awareness of as many potential threats as possible.

In 2005, Dotzer [7] on the possible applications for the VANETs gave a rough description, mainly based on safety features to distinguish between the message, be divided into "security service", like traffic information, emergency incidents and response, traffic accidents and other related information, and "non-security services", like entertainment-related, multimedia file transfers with the special needs of the user's personal. Plobl et al [14] to use messages transmitted on the model of the VANETs application for classification, mainly divided into three categories: 1. Telematics message and Warnings, refers to the drivers, by "taking the initiative to pass a regular way" or "passive even-triggered approach" to convey relevant information, to inform other drivers traffic and road accidents. 2. From the police cars, ambulances or fire engines, and other special vehicle used in emergency disaster relief, the issue of the Alarm signals. 3. Addition value-added services, like vehicle guidance service, internet access services and other related applications.

In 2004, Hubaux et al [16] describe the certified identity that a vehicle provides via a wireless link an *electronic license plate*. The protocols that use such license plates can be designed in different ways. An event data recorder (EDR), inspired by the "black boxes" found on airplanes (EDR record all major data from the vehicle for crash reconstruction).

VANETs security privacy requirement analysis

Raya ea al [13, 12] VANETs security threats on the divided into three categories: may lead to disasters and life threat "Attacks on safety-related application", may lead to financial fraud and wireless communications confidential information on stolen "Attacks on payment-based application". At the same time, the road safety message in accordance with their privacy and timeliness are divided into three categories: traffic information (such as traffic flow and traffic jam conditions), a general safety message (such as driving and collision avoidance of information) and attribution of responsibility message (such as traffic accident-relation information, available to law enforcement agencies for reference).

In 2005, Raya and Hubaux [12] describe vehicular networks will be the largest real-life instance of self-organized ad hoc networks. Its size will be in millions of nodes, distributed among different authorities and services providers.

In 2008, Klaus plob1 and Hannes Federrath [17] propose a security infrastructure that uses asymmetric as well as symmetric cryptography and tamper resistant hardware.

After a once-only initialization it employs asymmetric cryptography within a public key infrastructure for messages influencing road safety. But the generation scheme of certificate and anonymous key pairs cannot be described explicitly and apply the process of registration, cannot prevent inside attack. The components of the scheme include tamper-proof devices (TPD_s), digital signatures, public key infrastructure (PKI), tamper resistant hardware (TRH) and anonymous key pairs. However, there are still some key management issues, such as anonymous key pairs update problem.

VANETs security protection architecture

Zhou et al [9] proposed construction of a specific threshold value of the distributed PKI encryption technology distributed architecture. Most of nodes need to cooperate and send the certificate in this protocol, then VANETs high-speed characteristics, and can not guarantee that a certain number of participants. Zarki et al [11] proposed a highway on the VANET infrastructure, suppose the most vehicles will be equipped with GPS devices in future, be able to provide the correct location, in the communication between vehicles will be widespread use of short-range ad hoc network technology.

In wireless network environment, Zariki [11] proposed public key digital signatures are not particularly useful without a certification infrastructure. There are some recent and promising results in cryptography that obviate the need to public key certificates. So we will use IBE system [6] is an elegant method of obtaining public key cryptography without any certificates: in it, an entity's public key is derived from a unique identity string, e.g., an email address or X.500 distinguished name.

SECURE ANONYMOUS KEY MECHANISM

In the proposed mechanism, there are four sub mechanisms: the system initiation mechanism, the electronic plate generating mechanism, the anonymous key pair generating mechanism, the application finish mechanism for VANETs. Table 3.1 shows the mechanism symbols.

- System security requirements:

1. The communication mechanism can achieve data confidentiality, data integrity, non-repudiation, and authentication.
2. The anonymous key pairs can used to secure communication in VANETs.
3. The secure anonymous broadcast mechanism can avoid that attacker tampering and intercept of message content.

Table 3.1 shows the mechanism symbols.

Symbol	Definition
ELP	A vehicle electronic license plate.
G_1	An additive group of prime order q.
G_2	A multiplicative group of the same order q.
$\hat{e}$	Weil pairing function can make $G_1 \times G_1 \to G_2$.
H_1, H_2, H_3, H_4	Hash functions.
K	Secret key of the KGC, $K \in Z_q^*$.
P	Generator of G_1.
PU_K	Public key of the KGC, $PU_K = K \cdot P$.
PU_M, PR_M	Key pairs of the MVO.
PU_K, PR_K	Key pairs of the KGC.
PU_P, PR_P	Key pairs of the Vehicle manufacture
LA	License plate application.
RID	Any one of the applicant's real identities.
RIN	A number to record which real identity is the $HMAC$ key.
AC	Area code of the MVO.
$m_1 \sim m_7$	Temporally combination messages.
$E_1 \sim E_6$	Temporally ciphertexts.
$HMAC()$	A hash-based MAC function.
$EMAC$	HMAC value of the ELP

System initiation mechanism

Figure1. Shows the system members and illustrates the system initiation steps. The KGC is a trusted third party. The LEA such as polices can trace the real identity that corresponds to the anonymity legally. The motor vehicle office (MVO) is a local vehicle management authority that is subordinate to monitor transportation. The private services provider (SP) which belongs to personal enterprise can provide application services in VANETs. The electronic board is a public place that drivers can get the necessary parameters or information from it.

The system initiation steps as follows: Step1. The KGC chooses private key K and generates public key PU_K. Step2. The KGC generates public keys (identities) for members. Step3. The members choose their secret key by themselves, and then generate their private keys. Step4. The KGC and system members put public system parameters with related information on the electronic board. Step5. The KGC makes a signature for whole information on the electronic board. The public system parameter include $\{G_1, G_2, \hat{e}, P, PU_K, PU_M, PU_L, PU_P, S_M \cdot P, S_L \cdot P, S_P \cdot P, H_1, H_2, H_3, H_4\}$. Figure 3.2 shows the system members and illustrates the system initiation steps. First, we describe these members. The KGC is a trusted third party. It is mainly used to generate public key and private key. The LEA such as police, it can trace the real identity from anonymity drivers. The MVO such as supervision station, it can generate electronic plate. The vehicle manufacture (VM) which belongs to personal enterprise, it can

provide drivers of vehicles certificate. The electronic board is a public place that drivers can get the necessary parameters or information.

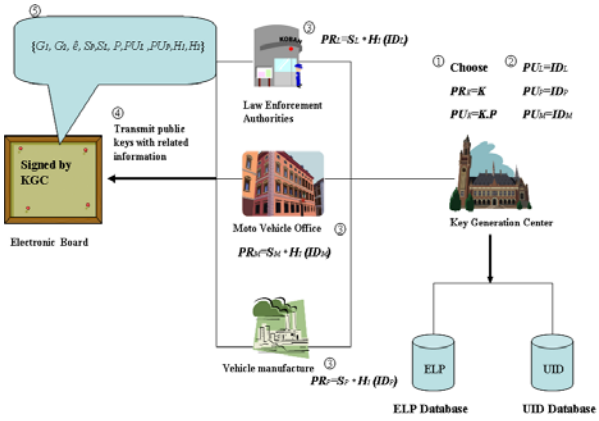

Figure 3.2 System initiation mechanisms

Now we describe the system initiation steps as follows：

1. The KGC chooses private key *K* and generates public key PU_k.
2. The KGC generates public key for numbers.
3. The members choose that their secret key and generates private keys.
4. The KGC and system members put public system parameters with related information on the electronic board.
5. The KGC makes a signature for whole information on the electronic board.
   The public system parameters include {*G1, G2, ê, SP, SL, P, PUL, PUP, PUM,* H_1*, and* H_2*}*.

Anonymous key pair application mechanism

Figure 3.3 illustrates from the vehicle manufacturers to produce electronic plates. Now we describe the steps in this phase as follows:

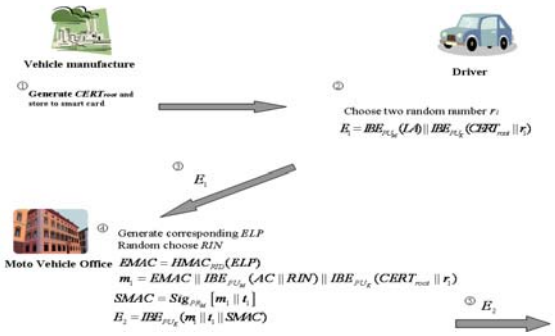

Figure 3.3 electronic plate generate

Step 1：The vehicle manufacture for each car generate ownership certificate ($CERT_{root}$) and stored in smart card. The ownership certificate record the driver information about of the vehicle purchase, for example, purchase car date, vehicle provider proves of car, the driver's signature and vehicle plate. Provide KGC generate anonymous authentication key pair and stored in smart card. Figure 3-7 ownership certificate format content.

Step 2：After the drivers get the car, and then check the $CERT_{root}$ and will their own license plates and title transfer to the MVO produces electronic number plates. Before sends the application (*LA*), driver chooses one random number (*r1*). The random number *r1* is a secret key that only knew by the KGC and the applicant, because the applicant encrypts *r1* with the public key of the KGC (IBE_{puk} ($CERT_{root}$ ||*r1*)).

Step 3：The applicant send a ciphertext (*E1*) to the MVO.

Step 4：The MVO decrypts *E1*= IDE_{PUm} *(LA||t1)* with its private key (*PRM*), and it verify driver's license plate and generates a unique electronic plate (*ELP*), then transfer to KGC generate anonymous key pair. First, the MVO uses any one of the driver's real identities as an encryption key of *HMAC* function to blind the *ELP* (*EMAC* = $HMAC_{RID}$ *(ELP)*). This operation is to make sure that the KGC cannot know the correct *ELP*, but the KGC can have a material to generate anonymous key pairs. The MVO use RIN record driver's identity, and use AC to record drivers license in which area electronic applications. Table 3-2 shows an example of *RIN*. The MVO encrypts them with its public key *PUm* (IBE_{pum} *(AC || RIN))*, RIN and AC are used in anonymity trace mechanisms. And then send to database of KGC to storage.

Step 5：The applicant sent a ciphertext (*E2*) to the KGC.

Anonymous key generate

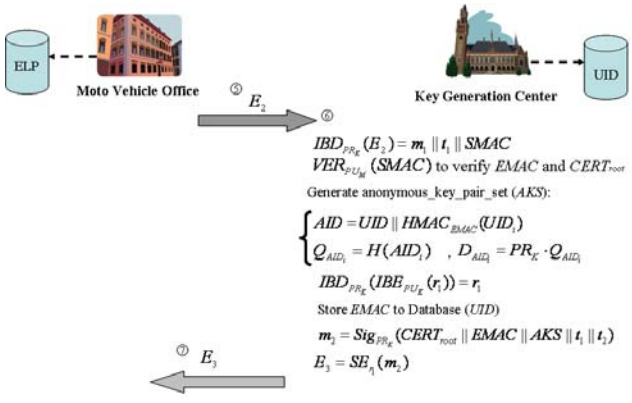

Figure 3.4 generate anonymous key pair phase

Figure 3.4 illustrates the KGC will generate anonymous key pair for driver. Now we describe the steps in this phase as follows:

Step 6：After the KGC decrypt ciphertext *E2*, verify electronic plate and $CERT_{root}$ then to generate an anonymous key pair for driver. The KGC choose a set of driver identities (*UID*) from database and the KGC lets *EMAC* to *HMAC* to be the *EMAC* key. The anonymous identity (*AID*) is *AID = UID || HMACEMAC* (UID_i), so the KGC can generate a set anonymous key pair (*AKS*) by using the scheme. Before transfer message *m2*, the KGC makes a signature for $(Sig_{PRk}\ (CERT_{root}\ ||AKS\ ||\ t1\ ||\ t2))$ with timestamps. Before transmits the ciphertext *E3*, the KGC encrypts it with the secret key *r1*.

Step 7：The ciphertext (*E3*) sent to the driver.

Application fish

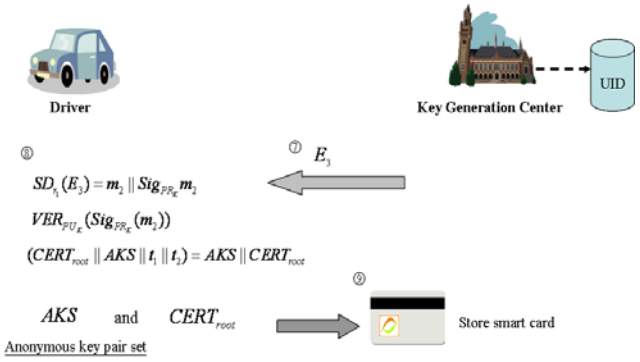

Figure 3.5 application finish phase

Figure 3.5 illustrates anonymous key pair application finish. Now we describe the steps in this phase as follows:

Step 8： the driver decrypts ciphertext for SD_{r1} $(E3) = m2 \| Sig_{PRk}\ m2$, and verifies the message *m2* by checking the signature $(SigPRk\ (CERT_{root}\ ||AKS\ ||\ t1\ ||\ t2))$, then the driver get the *AKS*, *CERTroot*.

Step 9：The driver can put the *AKS* and $CERT_{root}$ store into a smart card.

SECURITY ANALYSIS

We will analyze some security properties of our scheme in order to provide us with a proof of security. We analyze security of the communication with anonymous key management.

Lemma 1 Anonymity

Proof: Driver can random choose an anonymous key pair from the AKS to make a signature for message before message transmit every time.

Lemma 2 Anonymity enforceability

Proof: The AKS are generated by KGC. The generation such as *EMAC*, *RID*, PR_k, and $CERT_{root}$ are provided secretly. Even someone must use unique $CERT_{root}$ to generate the *AKS* by the KGC. It is illegality can be verified by $CERT_{root}$ and public parameters.

Lemma 3 Authentication

Proof: Before the MVO, the KGC, and the Vehicle manufacture transmit messages each other, sender must make a signature for messages by using *Sig ()* function with private key. Receptor make a verified for messages by using *Ver ( )* function with public key. This is in order to achieve the authentication of the information.

Lemma 4 Confidentiality

Proof: Before the MVO, the KGC, and the Vehicle manufacture transmit messages each other, ender must make encrypt for messages by using *IBE ( )* function with public key. Receptor make a verified for messages by using *IDE ( )* function with private key. This is in order to achieve the confidentiality of the information.

Lemma 5 Insider attack avoid

Proof: The vehicle ownership is managed by vehicle manufacture, real identities are managed by the MVO, and anonymities key pair is managed by the KGC. The MVO blind the ELP to generate *EMAC* by *EMAC( )*, and the KGC can not know the ELP content. After the KGC verify the vehicle ownership certificate, then to generate anonymous key pair. So the MVO can not know the anonymous key pair content. The KGC use $CERT_{root}$ to get the applicant's vehicle ownership information. But it can not know the applicant identities content by $CERT_{root}$. So the insider attacker can not match applicant real identities with anonymities.

Lemma 6 Replay attack avoid

Proof: In the proposed scheme, before the message transfer, we use timestamps to prevent replay attack. The system can use timestamps to check the transmission time of the message.

Lemma 7 Non-repudiation

Proof: Before the broadcast message, must be signatures to messages to prove that the sender is legitimate anonymous identity. So it can ensure non-repudiation of messages.

The table 2 shows the security comparison other approaches. From this comparison, we find out that the proposed scheme is better than other schemes. The symbol O means the security requirement is approached and the symbol × means the not.

Paper Property	Our scheme	Plobil et al. [17]
Authentication	O	O
Confidentiality	O	O
Non-repudiation	O	O
Anonymity	O	O
Inside attack avoid	O	×
Anonymity unforgeability	O	O
Dynamic anonymity	O	×
Non-certificate	O	×

Table 4.1 security comparison

CONCLUSION

Vehicular ad hoc networking is a promising wireless communication technology for improving highway safety and information services. In this paper, we introduced the identity-based cryptosystem for the anonymous key pair of vehicle safety application message. The proposed mechanism is a public-key type with the elliptic curve cryptosystem. It is a well-known fact that the public-key cryptography concept solves the anonymous key distribution and storage problems.

Our scheme can be applied to vehicle ad hoc network, so that the users can protect their privacy more easily and reduce the bandwidth of storage space. We believe that our study can provide a guideline for the design of a more secure and practical VANETs.

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MARKET REACTION TO THE RATING REPORTS WITH MIXED OR CONSISTENT FOLLOW-UPS: A PRICE AND TRADING BEHAVIOR ANALYSIS

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ABSTRACT

The purpose of this study is to investigate the trading behavior and stock returns of foreign institutional investors and individual investors in Taiwan stock market around the rating report announcement of foreign institutions. This study develops with the method of event study. Specifically, this study focuses on the effect under different frequencies of rating reports, such as single recommendation, consistent recommendations and mixed recommendations.

Keywords: Abnormal Trading Volume, Abnormal Returns, Trading behavior, Event study

INTRODUCTION

Traditional financial theory often refers to the stock market as an efficient market. By this, it means that the stock price already reflects all the information of the market. However, a growing literature provides empirical evidence that markets are measurable subject and are important mispricing. For instance, Black (1986) points out the concept of noise trade which indicates that investors are easy to misinterpret the irrelevant information as trading signals in the market. However, if investors are naive and aggressive in their trading (e.g., the noise trader) that they may earn higher rewards (DeLong et al., 1990, 1991; Hirshleifer and Lou, 2001; Kyle and Wang, 1997).

On the other hand, several studies provide evidence that investors are too credulous in the sense that they do not pay fully attention to the incentives of interested parties, such as firms, brokers, analysts, or other investors, who tend to manipulate available information. As a result, stock market prices do not seem to discount fully for the forecast bias which made by the analyst (Lin, 2000). Empirical evidence suggests that after analysts recommend or revise their forecast to the stock favorably, there are positive abnormal returns (Chan, et al., 1996; Lin, 2000; Barber et al., 2001; Stickel, 1995; Womack, 1996; Michaely and Womack, 1999; Krische and Lee, 2000). Womack(1996) argues that there is a strong underperformance after analysts' recommendations of downgrade and selling but the weak superior performance only exist after new recommendations of buying. Asquith, Mikhail and Au(2005) indicate that the effect of the analysts' recommendations on the abnormal returns is most significant within the 5-day event. Chao and Lu(2008) and Chao and Chen(2009) argue that the abnormal

trading volume may be an alternative measurement to the study of market information on investors' behavior. Therefore, they investigate the trading behavior of institutional and individual investors around the day of stock information announced. They find that the recommendations by foreign institutions have a significant effect on the abnormal trading volume for both institutional and individual investors. However, the trading behavior of the institutional and individual investors is negatively correlated.

The purpose of this study is to investigate the security returns and trading behavior of individual investors and foreign institutional investors around the stock recommendations by foreign institutions. The given recommendations of the same stock may be re-enforced or challenged by subsequent ratings from other institutions, this study is going to distinguish our sample into those who got consistent ratings and those who got mixed rating results during the sample event period. Base on these this study will to omit the period of October, 2008 to December, 2008.distinguishes, this study is going to examine whether the intense attention will affect the market outcomes as well as the trading behavior of the individual investors.

RESEARCH DESIGN

The data

The data used in this study is observed during the period from January, 2008 to December, 2009. This study omits the period of October, 2008 to December, 2008 due to the fact that Taiwan government narrowed the limit up and limit down of the stock market during that period. Therefore, the sample in this study are those companies whose stocks are listed in the TSEC Taiwan 50 Index which contains the Top 50 highest trading volume stocks in Taiwan stock market. Next, this study focuses on the rating report announcement of foreign institutions. This study adopt the rating report announcements from 16 different foreign institutions, these foreign institutions publicly offer rating report announcement on cnYES.com. All the data of trading volumes and stock returns are obtained from the TEJ data bank.

Typical rating report announcement

According to classification of rating report announcement in I\B\E\S, rating report announcement are classified into 3 types which contain 5 grades in this study. Table 1 provides a description of the composition of the classification.

TABLE 1 TYPES OF RATING REPORTS

Type	Good news		Neutral news	Bad news	
Grade	Strong buy	Buy	Hold	Sell	Strong Sell

Asquith(2005), he reported that the change of rating announcement are more important than single rating announcement. Therefore, in this study, the rating report announcements are classified into three categories according to the frequency and consistency of the rating announcements. Table 2 provides a description of the composition of the second time classification.

TABLE 2 CATEGORIES OF RATING ANNOUNCEMENTS

Name	Definition
Single	1.Only one good news in a period.
	2.Only one neutral news in a period.
	3.Only one bad news in a period.
Consistent	1.Good news: More than one foreign institutions report good news to the same company within a certain period
	2.Bad news: More than one foreign institutions report bad news to the same company within a certain period
Mixed	More than one foreign institutions report good and bad news to the same company within a certain period
*The "period" indicates one week before and after the announced date in this study.	

Event study

The event study method is used while the market model is used to estimate the expected value of the price and trading volume. The abnormal return and abnormal trading volume are therefore calculated and used to examine whether the mixed or consistent follow-up rating reports by other institutions which will affect the abnormal returns and the abnormal trading behavior of the investors in a different way.

The abnormal return is the difference between actual and predicted stock returns during a specific time period around the announce day. The actual return for stock i on day t is given by

$$R_{i,t} = \alpha_i + \beta_i \times R_{m,t} + \varepsilon_{i,t}$$

Where $R_{m,t}$ is the return on a market portfolio (market index) for day t .The parameter estimates α_i and β_i are obtained by using all available data for trading days -70 to -11 relative to the event date and $\varepsilon_{i,t}$ is a stochastic error terms.

The abnormal returns are computed as follows:

$$AR_{i,E} = R_{i,E} - (\hat{a}_i + \hat{B}_i \times R_{m,E})$$

Where $(\hat{a}_i + \hat{B}_i \times R_{m,E})$ is the predicted stock return base on 60 day estimated period, and $R_{i,E}$ is the actual return of stock i in event-time period E.

Finally, the average abnormal returns are computed as follows:

$$AAR_E = \frac{\sum_{i=1}^{n} AR_{i,E}}{n}$$

Where n is the number of all sample companies

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 uses Harris(1986) proposed that to adopt volume ratio to compute the abnormal trading volume. The actual trading volume ratio for stock i in event-time period E is given by

$$EV_{I,E} = \frac{V_{i,E}}{V_{m,E}}$$

Where $V_{i,E}$ and $V_{m,E}$ are the trading volume of stock i and the total TSEC in event-time period E.

The expected trading volume ratio for stock i in event-time period E is given by

$$NV_i = \frac{V_i}{V_m}$$

Where V_i and V_m are the average trading volume of stock i and the total TSEC in the trading days -70 to -11 relative to the event-time.

The abnormal trading volume ratio is computed as follows:

$$AVR_{i,E} = \frac{EV_{I,E}}{NV_i} - 1$$

Finally, the average abnormal volume ratio is computed as follows:

$$AAVR_E = \frac{\sum_{i=1}^{n} VR_{i,E}}{n}$$

Where n is the number of all sample companies

EMPIRICAL RESULTS

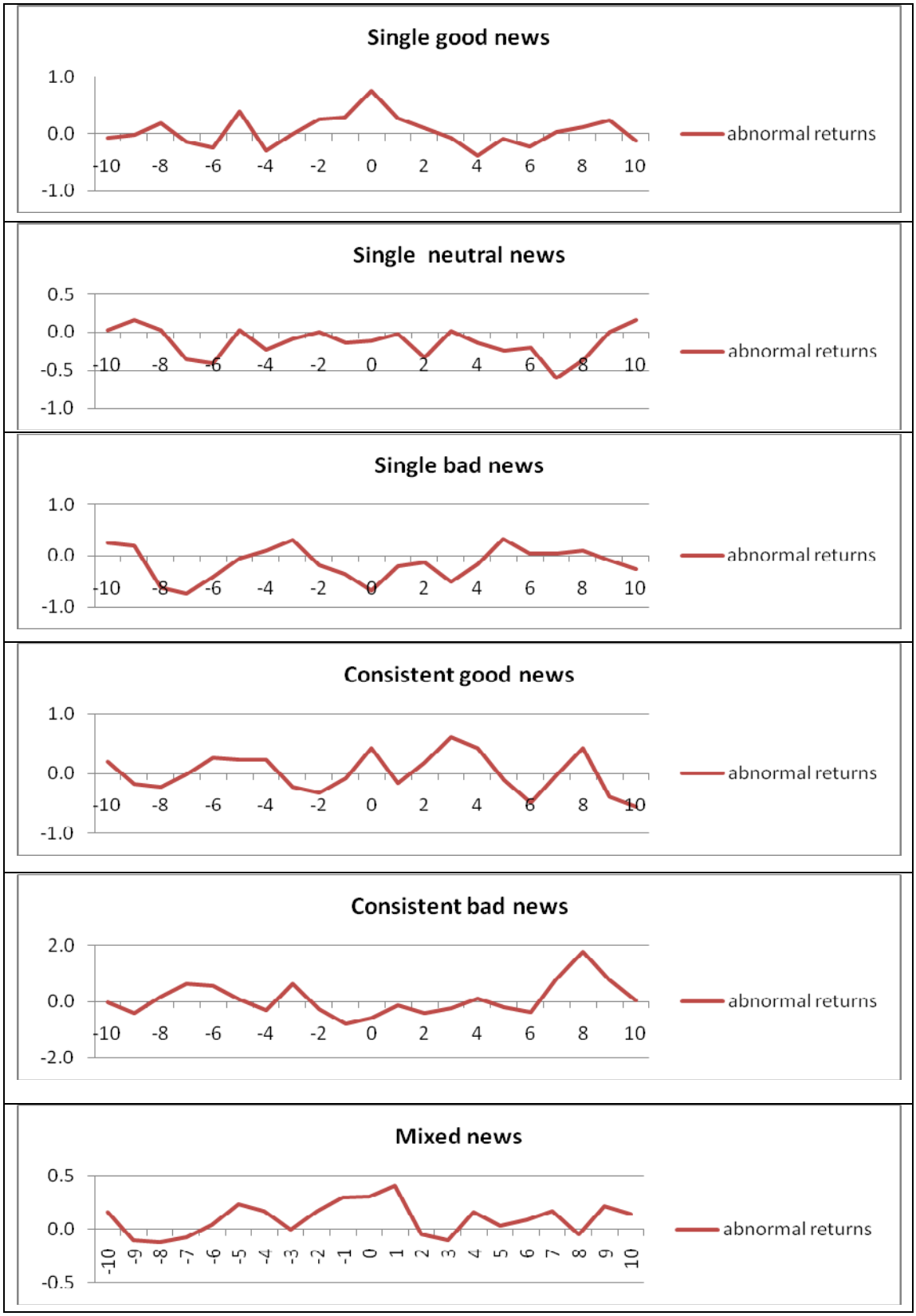
Table 3 and Figure 1 show the market reactions from days -10 to +10. For those companies with only single good news reports, there is a significant effect on their abnormal returns on day -5 and-4 , and a significant positive effect on the event date, but turns to be a negative effect four days after the good news announcement date. It appears that the foreign institutions offer the single good news announcement which causes significant increase in the abnormal return on the event date, but a significant reverse effect will emerge on the following days.

TABLE 3 Market Reactions to the Rating Report by Foreign Institution

Event / Day	Single good news	Single neutral news	Single bad news	Consistent good news	Consistent bad news	Mixed news
	t-Value					
-10	-0.4386	0.128	0.8635	0.5565	-0.0616	0.8519
-9	-0.1221	0.6537	0.6858	-0.5402	-0.7645	-0.5563
-8	0.9895	0.1209	-2.1249**	-0.6627	0.3271	-0.6577
-7	-0.7796	-1.5346	-2.5023**	-0.0516	1.1374	-0.4046
-6	-1.3323	-1.7133*	-1.4421	0.7566	1.0532	0.2292
-5	2.1876**	0.1072	-0.1461	0.6538	0.1499	1.2491
-4	-1.6605*	-0.9933	0.3792	0.6662	-0.5939	0.9189
-3	-0.0115	-0.3462	1.0502	-0.6415	1.1582	-0.0003
-2	1.4072	0.0069	-0.6034	-0.9445	-0.4896	0.9076
-1	1.5508	-0.5872	-1.2367	-0.2122	-1.4459	1.5667
0	4.169***	-0.4538	-2.3061***	1.2258	-1.1004	1.6368
1	1.5062	-0.0698	-0.6795	-0.4644	-0.2562	2.1791**
2	0.5633	-1.3922	-0.4123	0.5282	-0.7952	-0.2485
3	-0.4544	0.0778	-1.7447*	1.7851*	-0.4252	-0.5699
4	-2.1154**	-0.5664	-0.5588	1.2632	0.2197	0.8509
5	-0.5439	-1.0248	1.1078	-0.3475	-0.3552	0.162
6	-1.2902	-0.8425	0.1732	-1.4303	-0.7103	0.4912
7	0.1517	-2.5535**	0.1543	-0.0728	1.4581	0.9205
8	0.6044	-1.5475	0.3563	1.2327	3.2759***	-0.2568
9	1.325	0.0384	-0.2939	-1.1459	1.408	1.144
10	-0.7127	0.6887	-0.8953	-1.6342	0.0436	0.7427

For those companies with a single bad news, there is a significant negative effect on their abnormal returns on the event date, the 7th and 8th days before the event date and the 3rd day after the event date. The result implies information leakages before the announcement of the rating report.

FIGURE 1 Market Reactions to the Rating Report by Foreign Institution



As to those companies with the consistent good news, there is a significant positive effect on their abnormal returns on the event date, the 3th day. On the other side, for those companies with the consistent bad news, here is a significant positive effect on their abnormal returns on the event date, the 8th day. It seems that the consistent good news is more authentic than the consistent bad news. As for the mixed news, we find out a significant increase on the day 1. As the whole, the period of all mixed news was offered of event has no specific trend in abnormal return.

Table 4 shows the effect of the consistent good news announcement on the trading behavior of the individual investors as well as that of the foreign institutional investors.

TABLE 4 Investor reactions to the consistent good news was offered of event

Event / Day	foreign institutions investor		individual investor		total abnormal trading volume
	abnormal buying volume	abnormal selling volume	abnormal buying volume	abnormal selling volume	
	t-Value				
-10	-0.876	-0.538	0.534	-0.136	-0.622
-9	-0.214	0.673	0.687	-1.988	0.043
-8	-1.571	0.263	1.020	-0.424	0.034
-7	0.266	-1.060	-0.046	1.144	-0.174
-6	1.901**	0.733	0.037	0.846	1.015
-5	-0.012	0.082	0.874	0.662	0.491
-4	0.580	0.076	0.032	0.607	-0.131
-3	0.240	-0.219	-0.225	-0.362	-0.476
-2	-2.588**	-1.538	-0.749	-0.524	-1.001
-1	0.840	0.817	-0.020	-0.867	0.526
0	1.405	1.020	1.348	1.168	2.399**
1	1.600	0.955	0.626	0.402	1.883*
2	0.908	0.182	-1.465	0.379	0.852
3	0.944	0.861	1.094	0.842	1.535
4	2.669***	0.760	0.930	2.253**	2.429**
5	1.830*	0.150	0.371	0.098	1.091
6	-0.230	-0.779	-1.656	-1.878**	-2.159**
7	0.067	0.661	-1.719*	-2.544**	-1.899*
8	0.895	0.202	-1.299	-1.814*	-0.355
9	0.355	-0.787	-0.479	-1.705*	0.275
10	0.572	0.382	-0.736	-2.923***	-0.551

The total trading volume has a significant increase on the even date, the 1st and the 4th day after the event. But the total trading volume decreases at the 6th and 7th day. The decrease in the total trading volume may be due to the fact that when most people have the same

predictions due to consistent news announcement, the trading activity will be limited. And this is Consistent with the result of Bamber and Cheon(1995).

For the foreign institutional investors, according to Table 4, we find out a significant decrease in the abnormal buying volume on the day -2 and a significant increase in the abnormal buying volume on the day -6, 4, 5. At the same time, there is no significant effect on the abnormal selling behavior. Therefore, it appears that the trading behavior of foreign institutional investors is consistent with the ratings report.

TABLE 5 Investor reactions to the mixed news was offered of event

Event / Day	foreign institutions investor		individual investor		toatl abnormal tranding volume
	abnormal buying volume	abnormal selling volume	abnormal buying volume	abnormal selling volume	
	t-Value				
-10	-0.110	1.364	-0.228	-2.815	-0.395
-9	-0.713	-0.775	-0.212	-0.903	-0.417
-8	1.174	0.060	-0.525	-1.264	-1.038
-7	0.219	1.692*	0.356	-1.608	0.403
-6	1.472	-0.303	-0.234	-0.772	-0.347
-5	0.783	-0.555	1.070	-0.828	-0.796
-4	1.129	1.189	1.554	0.642	1.075
-3	0.390	1.489	1.336	0.153	1.641
-2	1.113	1.026	1.659*	0.089	1.604
-1	2.262**	1.284	1.680*	1.986**	2.576**
0	3.801***	5.891***	5.114***	2.954***	6.711***
1	2.100**	3.493***	3.224***	2.620***	4.710***
2	2.800***	2.640***	3.091**	2.836***	3.402***
3	2.226**	2.153**	2.508**	1.546	2.713***
4	2.319**	1.077	1.422	2.324**	2.379**
5	1.761*	1.008	1.197	2.194**	1.674
6	1.439	0.747	1.694*	1.189	1.598
7	1.434	1.250	0.944	1.091	1.649*
8	0.886	1.424	0.866	0.767	1.716*
9	1.640	1.086	0.762	0.853	1.475
10	1.668*	1.233	1.416	0.674	1.359

On the other hand, under a consistent good news, the individual investors have a significant increase in the abnormal selling volume on the day 4 and decrease in the abnormal selling

volume on the day -6, -7, -8, -9, -10. It implies that the consistent good news affect the individual investors' selling behavior more than their buying behavior.

Table 5 shows the results of the mixed news announcements. The total abnormal trading volume has a significant increase around the (-1, 4) event window, and similar results are observed on the buying and selling behaviors of both the individual and institutional investors. This is another evidence consistent with Bamber and Cheon(1995). When market is full of mixed information, investors tend to have different interpretations of the market, and therefore will perform differently on the stock market. This leads to the increase in both the buying volume and selling volume of the stocks.

CONCLUSION

This paper investigates the stock returns and trading behavior of individual investors and foreign institutional investors around the stock recommendations by foreign institutions. The samples in this study are those companies whose stocks are listed in the TSEC Taiwan 50 Index.

On the security abnormal return, there are significant increases on the day 0 by the event of the single good news was offered and the significant decrease on the day 0,3 by event of the single bad news was offered which seems that a single news is indeed provide influence to security return, but it is temporarily. About the consistent and mixed news, they also provide influence to security return, and it is temporarily, too. These are consistent with the result of Bauman, Datta and Iskandar-Datta(1995).

Abnormal trading volume suggests that rating report announcements are informative to investors. This study examines the information which contained in rating report announcements and we extend the previous research in this area by employing six different kinds of rating report announcements which allows us to assess the relative informativeness of the individual investor and foreign institutions investor across different classes of rating report announcements.

By the event of consistent good news was offered, for foreign institutions investor, there is a significant variation in abnormal buying volume, but there is an insignificant variation in abnormal selling volume. Contrarily, for individual investor, there is an insignificant variation in abnormal buying volume, but there is a significant decrease in abnormal selling volume. It indicates that the foreign institutions investors' different form individual investors' reaction to the consistent good news was offered. In the end, no matter what kind of investors and buying or selling side, every situation cause significant increase in the abnormal trading volume by the event of the mixed news was offered.

These results can help researchers and investors to understand the information which effect on the individual investors' trading behavior and the stock price. For investors, understanding the different trading behavior helps them to make better decisions when receiving information.

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DOES INFORMATION VALUE OF THE ANALYSTS' STOCK RECOMMENDATIONS STILL EXIST?

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ABSTRACT

The purpose of this study is to examine how stock price changes around the common recommendations in presses of Economic Daily News and United Evening News. By using event-study methodology, the impact of common recommendations in presses on recommended stocks is examined. The result indicated that stocks price was reflected in statistically significant positive abnormal return relevant with presses common recommendations in announcement day and before announcement day. Post-announcement day, stocks returns in statistically are significantly negative relevant with presses common recommendations. Empirical evidence proof that presses common recommendations is a lagging indicator.

Keywords: Market Model, Press Common Recommendations, Abnormal Return,

INTRODUCTION

Stock returns are always the most important issues for security investors. Therefore, investors are sensitive to the disclosure of information in the stock market. Investors will make use of available means to collect information that may have an impact to stock price. Feasible tools including television news, newspapers, financial magazines and other mass media are often used to collect information.

In usual, corporate investors have better stock analysis expertise and information access channels then general public. Therefore, the profitability of their investments are considered to be better than the general public. In view of this, the general public likes to search professional advices from institutional investors.

The purpose of this study was to examine whether the recommendations of stocks listed on the newspaper the share price after recommendation. Whether there is a positive growth, or investors can profit through stock trading are examined. Employing Scholes-Williams model of Event study method, stock price variation is utilized as an indicator to measure the

difference of stock price between pre-recommendations and past-recommendations in Taiwan.

This paper is organized as follows. Section 2 presents the related literature. Section 3 describes the data and preliminary analysis. The Scholes-Williams modeling that measures the financial return is also introduced. Section 4 presents empirical evidence. Finally, section 5 discusses the results and presents conclusions.

LITERATURE REVIEW

The market efficiency is the relevant information can be fully reflected in securities prices. And the new information must be immediately reflected in stock prices. In an efficient market, stock price and real value are almost the same. According to *Fama(1970)* the efficiency of the market is divided into three types:

1. *Weak form of the efficiency market hypothesis:* Stock price already reflects all past information. Investors can not earn excess returns by the historical information in the market. Technical analysis in the weak form of market efficiency can not help investors find the price of the stock.

2. *Semi-strong form of the efficiency market hypothesis:* The current stock price fully reflects all public information, such as financial statements, notices and dividends, stock splits, new issues of the declarations, etc., investors can not use this information to develop a set of rules and achieve excess return. If this hypothesis is true, then fundamental analysis is invalid.

3. *Strong form of the efficiency market hypothesis:* All available relevant information were complete responded in the price, including the open and the inside information. Even if the investors who possess inside information can not gain excess return.

Investors always expect that from the existing information can lead to obtain excess return with hope accompanying by low cost. Naturally, general media like financial magazines, papers, TV or radio programs are information channels to collect. Therefore, it is an interest issue for scholars and researchers to investigate the object of whether investors can profit to earn excess return by the decisions based on the recommendation on newspapers.

The analyst result of Wang, Lin and Liu () and Chen, Chen and Liu (2006) are consistent with our study about investors whether can obtain the excess return after the information expose. Investors only can earn excess return at event day if they are able to purchase the stock. Xu and Liu (2008) indicate that after the announcement of stock recommendation of analyst, there is little positive abnormal returns. It lasts only one day of the announcement day.

The empirical evidence of Chang and Chan (2007) suggests that financial analysts' downward stock recommendation revisions provide superior information to investors than do upward stock recommendation revisions. Yang, Chou, Doong and Lin (2007) point out that the analyst characteristics are proposed to be important factors to explain the variations of the

accuracy of EPS forecast. Zarowin (1989) presented the analysis results that fail to support the assumption of overreaction to earnings announcement. It is similar to the result of Lin, Lee and Tsao (2007) that the overreaction effect does not exist in Taiwan stock market. Yang (2003) found that when the annual increasing dividend announcement was revealed, security investors can not obtain abnormal return by inside trading. It also supports that the security market is efficient. On the contrary, after the decreasing dividend announcements, security investors can obtain abnormal return by inside trading. It proves that the security market is not efficient. The empirical evidence of Werner, Bondt and Thaler (1985) is consistent with the overreaction hypothesis.

Chang, Chen and Lai (2008) indicate that there is a positive influence of International Strategic Alliances experience on firm performance. Shelor, Aanderson and Cross (1991) has found the information conveyed in the earthquake is very important to the market. The stock returns are statistically significantly negative.

DATA AND METHODOLOGY

This section describes the source of data and the reasoning of data selection, and explains the model to measure the abnormal return. The Event Study and the Market model are applied to calculate the abnormal return.

Description of the sample

This study investigated the information content of the newspaper columns. The data are collected from the weekend issues of *Economic Daily News* and *United Evening News* during the period January 1, 2007 to August 16, 2009. There are 238 stock samples totally.

The first step of Event study is to confirm the event and event that may affect shortly or last for a period of time. In this study, event days were the first trading day after each of common recommendations, and event periods were taken from five trading days before and after the event. Related financial data were obtained from the prospectuses of Taiwanese listed companies on TSEC and OTC, and the **TEJ database** of the Taiwan Stock Exchange Corporation.

Empirical model

Event study is modern in the financial area which is one of the widely used research design. The purpose of the event study method is for a particular event, whether if the event cause the abnormal stock returns or excess returns. Expected patterns are as follows: market model, mean adjusted return model and market adjust return model. We make used of the most commonly used-the market model for the study of empirical method.

The abnormal return defined as: at a specific time point, the differences between actual return and expected return of specific securities,

$$AR_{it} = R_{it} - E(R_{it}) \qquad (1)$$

where AR_{it} present the abnormal return of security *i* at time *t*, R_{it} is the actual return of security *i* at *t*, and $E(R_{it})$ is the expect return of security *i* at *t*. In this paper, Scholes-Williams model of Event study method is employed to exam whether abnormal existed after the common recommendations. Assuming that rate of return of individual securities confirm to the following pattern, the

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \qquad (2)$$

model parameters α and β were obtained from the estimation period. β_i stands for regression coefficient, or risk factor, behalf securities returns the market index sensitivity. Definition of securities in time for the expected rate of return:

$$E(R_{it}) = \hat{\alpha}_i + \hat{\beta}_i R_{mi} \qquad (3)$$

Scholes and Williams pointed out that the general least squares estimate of $\hat{\beta}_i$ estimates will produce errors. This makes relatively frequent stock trading, risk factor to be underestimated; trade too often, a risk factor is overvalued. In such thin trading or non-synchronous trading, recommend using the following formula to adjust the risk factor:

$$\hat{\beta}_i^* = \frac{\hat{\beta}_t^- + \hat{\beta}_t + \hat{\beta}_t^+}{1 + 2\hat{\rho}_m} \qquad (4)$$

$\hat{\beta}_t$ was the rate of return during the same period of least squares estimates; $\hat{\beta}_t^-$ was pre-market stock returns and the return of the least squares estimate; $\hat{\beta}_t^+$ compared to stock returns and post-market returns of least squares estimates. $\hat{\rho}_m$ was the market rate of return of the first order autocorrelation coefficient. Least squares model estimates the value of the intercept:

$$\hat{\alpha}_t^* = \overline{R}_i - \hat{\beta}_i^* \overline{R}_m \qquad (5)$$

$\overline{R}_i$ stand for average rate of return of security estimate period, $\overline{R}_m$ stand for average rate of market return.

THE EMPIRICAL RESULTS

In this section we discussion the empirical results for the information effect the period of before and after information exposed by whether statistically significant. Table 1 & 2 shows analyzed through Scholes-Williams model and it's displayed by generalization.

Table 1. Analysis through Scholes-Williams model Generalization

Event window	*AR*	*Traditional method (T-test)*
-5	0.4557	2.6223***
-4	0.3425	1.9708**
-3	0.6909	3.9756***
-2	1.5581	8.9653***
-1	1.1694	6.7287***
0	0.4136	2.3796**
1	-0.6053	-3.4826***
2	-0.616	-3.5446***
3	-0.3098	-1.7825*
4	-0.2698	-1.5522
5	-0.096	-0.5523

Note: * denotes statistical significance at the 10%; ** denotes statistical significance at the 5%; *** denotes statistical significance at the 1%.

Table 2. Analysis through Scholes-Williams model Generalization (Cumulative)

Event window	*CAR*	*Traditional method (T-test)*
-5	0.4557	2.6223**
-4	0.7982	3.2478**
-3	1.4892	4.9471**
-2	3.0473	8.767**
-1	4.2167	10.8506**
0	4.6303	10.8767**
1	4.025	8.7535**
2	3.409	6.935**
3	3.0992	5.9442**
4	2.8294	5.1483**
5	2.7335	4.7422**

Note: * denotes statistical significance at the 5%; ** denotes statistical significance at the 1%

Table 1 presents the result of abnormal return (AR) and Table 2 presents the result of cumulative abnormal return (CAR). Both were tested statistics by Traditional T-test for common recommendations on event window around announcement. We observed only before announcement day (t= -5~0) has the statistically significant positive in both Table 1

and 2 , but from days 1 to days 3 turns to significant negative in table 1. Although cumulatively t-test still remain significant, but continued to decrease. When over the days -5 to 0 abnormal return turns into negative. That is when investors obtain the message from the column of presses and follow the instruction to buy the stock been recommendations, only can lose their funds. Previous literature has point out that the reason caused this situation might be the information has been exposed in some form of way before days 0, the effect of information has been reflected already.

Fig. 1 and Fig. 2 exhibit the abnormal return and cumulative abnormal return for upgrades and downgrades of recommendations.

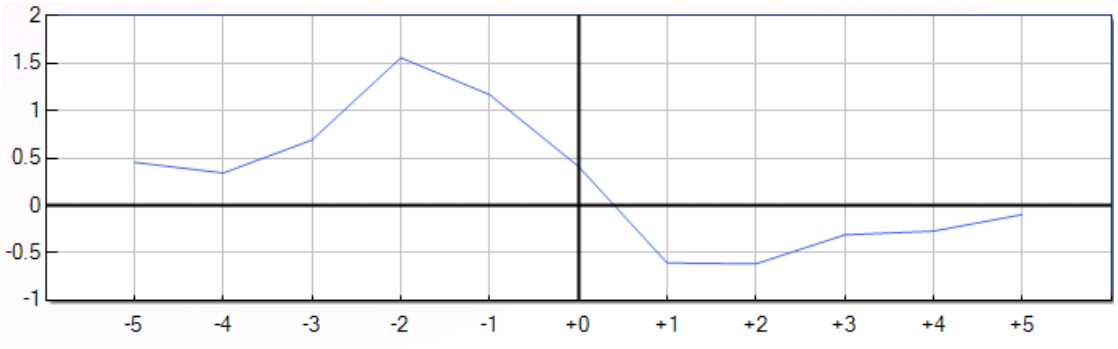

Fig.1 Abnormal returns about the recommendation of analysts in the newspapers.

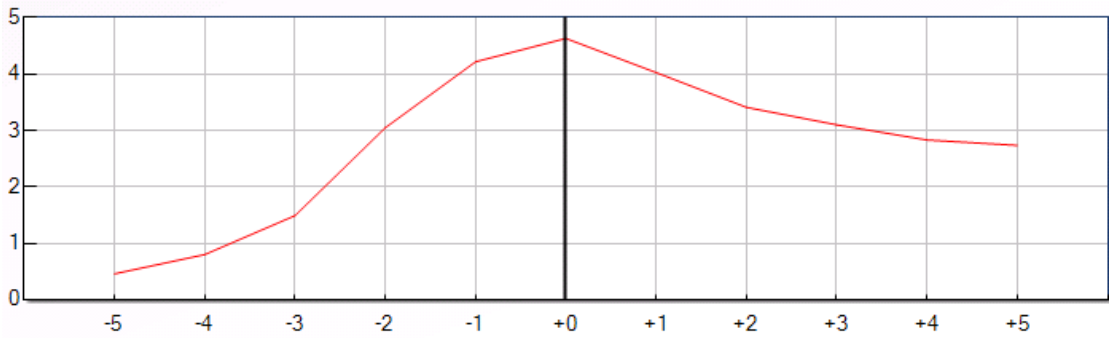

Fig. 2 Cumulative abnormal return about the recommendation of analysts in the newspapers.

CONCLUSIONS

The purpose of this study was to examine how the stock price changes before and after the information exposes, and whether the generally investors are able to profit excess return from the weekly publication. We used the common recommendations of press column of *Economic Daily News* and *United Evening News* as data base, from the period of January 1, 2007 to August 16, 2009.

The result shows that the ability of generally investors gets the information to profit is limited because of the message effects usually occurred only one day after the incident. Stock price has better performance before the information revealed. In other words, investors can only purchase stocks that were just recommended to earn excess return in event day. Otherwise, they could lose because of the message they received. This study provides an important message to investors

that appositive abnormal return exist only in day -5 to day 0, and then abnormal return will be vanish in the days after the announcement. Investors who face the source of such information and might adopt the information should be more cautious.

Our study provided evident that the Taiwan stock market seems a *semi-strong efficiency market*. The reason is that investors can not obtain excess return by presses or newspapers of public information source. Information has already been reflected before announcement of recommendations.

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STOCK MARKET RETURNS, SYSTEMATIC RISKS, AND CORPORATE CHARACTERISTICS IN THE TAIWAN STOCK EXCHANGE MARKET AROUND THE BEARISH-BULLISH TURNING POINTS

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ABSTRACT

A number of studies have investigated the causes and effects of stock market crashes. These studies mainly focus on the factors leading to a crash and on the volatility and co-movements of stock market indexes during and after the crash. However, how a stock market crash affects individual stocks and if stocks with different financial characteristics are affected differently in a stock market crash is an issue that has not received sufficient attention. In this paper, we study this issue by using data for Taiwan stock market around the Bearish-Bullish Turning Points that have taken place during the August 1997–February , 2009 period with a large sample of Taiwan firms. We use the multivariate regression analysis and consider certain company-specific characteristics, such as the China-concept factors, board of directors, and the percentage of shares owned by foreign institutions to study the determinants of stock returns around the Bearish-Bullish Turning Points.

Keydword: stock return, China concept factor, Company-specific idiosyncratic risk

1. INTRODUCTION

Stock market returns have long been a popular research topic in finance. In the traditional capital asset pricing model (CAPM) of Sharpe (1964), Lintner (1965) and Mossin (1966), stock returns are explained by their market risks (i.e., beta). The three-factor asset-pricing model of Fama and French (1992,1993) challenged the empirical validity of the Sharpe–Lintner–Mossin single-factor capital asset pricing model (CAPM). In their three-factor asset pricing model, in addition to beta, Fama and French (1992, 1993) use size and market-to-book ratio as determinants of asset returns. They find that smaller firms and firms with a low market-to-book ratio consistently provide relatively higher returns compared with larger firms and firms with a higher market-to-book ratio.

This study focuses on the relationship between the Taiwan stock market returns around the bearish-bullish turning points and the systemic risk and corporate characteristics, such as the China-concept factors, board of directors, and the percentage of shares owned by foreign

institutions. The data used in this study is observed from 1997 to 2009. The sample companies in this study are the stocks listed in the Taiwan Stock Exchange.

The purposes of this study are as follows. First, following Wang et al. (2009), this study is going to apply three-factor CAPM, i.e., the systematic risk (β), the size premium and the value premium, to explore how these variables affect the Taiwan stock market returns during the bearish-bullish and bullish-bearish turning points. Unlike previous studies, this study collects data around the turning points of bear-to-bull or bull-to-bear markets.

Secondly, in addition to controlling the systematic risk variables, this paper controls factors of corporate characteristics. Traditionally, the CAPM relies on systematic risks and it assumes that company-specific idiosyncratic risk can be diversified away. However, Xu and Malkiel (2003) show that idiosyncratic volatility is a significant determinant of earnings growth and equity returns. They suggest that company-specific idiosyncratic risk factors can become significant determinants of capital asset prices. Therefore, in this study, certain company-specific characteristics, such as the China-concept factors, board of directors, and the percentage of shares owned by foreign institutions, are included in the regression model to investigate whether these corporate characteristics play a significant role in determining stock returns around the bearish-bullish turning points.

2. SAMPLE CHARACTERISTICS

Our sample for each bearish-bullish turning points consists of the stocks listed in the Taiwan Stock Exchange. We obtain the stock returns and other explanatory variables data from the Taiwan Economic Journal (TEJ). We identify bearish and bullish points using the approach of Pagan and Sossounov (2003).The Pagan and Sossounov (2003) adaptation of the Bry-Boschan (BB) algorithm can be summarized as follows:
1. Identify the bullish and bearish by using a window of 8 months.
2. Enforce alternation of phases by deleting the lower of adjacent bullish and the higher of adjacent bullish.
3. Eliminate phases less than 4 months unless changes exceed 20%.
4. Eliminate cycles less than 16 months.

The Taiwan stock market bearish and bullish period from 1997 to 2009 are presented below(Table 2.1):

Table 2. 1 Classification of bearish-bullish.

Bearish	Bullish
1997 / 7 ~1999 / 1	1999/1~2000/5
2000/5~2001/9	2001/9~2002/5
2002/5~2003/4	2003/4~2004/11
2004/11~2005/10	2005/10~2007/10
2007/10~2008/1	2009/1~2009/9
2008/5~2009/1	

Table2.2 shows the study period used in this article, which is one month after the turning point.

Table 2.2 The study period used in this article a month after the turning point.

Bearish	Bullish
1997/8	1999/2
2000/6	2001/10
2002/6	2003/5
2004/12	2005/11
2007/11	2009/2
2008/6	

This stock return in this study is the one-month return after the bearish-bullish or bullish-bearish turning points. And the number of companies listed in Taiwan Stock Exchange from 1997 to 2009 is listed in table 2.3.

Table 2.3 Number of listed companies

year	Number of listed companies
1997	404
1998	437
1999	462
2000	531
2001	584
2002	638
2003	669
2004	697
2005	691
2006	688
2007	698
2008	718
2009	730

3. METHODOLOGY

The purpose of this study is to examine the relationship between the Taiwan stock market returns around the bearish-bullish turning points and the systemic risk and the corporate characteristics, such as the financial ratios, corporate governance variables, and China-concept factors. The regression model used in this study and the related variables are as follows:

$$RET_{t+1} = \beta_0 + \beta_1 Beta_{t+1} + \beta_2 MVBV_{t+1} + \beta_3 Size_{t+1} + \beta_4 ROE_{t+1} + \beta_5 TD_{t+1} + \beta_6 Share_{t+1} + \beta_7 RP_{t+1} + \beta_8 ED_{t+1} + \beta_9 CEO_{t+1} + \beta_{10} FH_{t+1} + \beta_{11} CCF_{t+1}$$

BETA: the CAPM beta of the stock
SIZE: the logarithm of the firm's market capitalization

MVBV: market value/book value ratio pre share.

TD: Debt ratio

ROE：Return of equity.

SHARE: The percent of the firm's stock owned by the managers

CEO Chair-Duality(CEO): A dummy variable equal to 1 if the CEO is also the chairman of the board.

ED：Earnings distribution ratio
Formula = (direct distribution of surplus power + Σ ownership rates between the control chain).

Ratio of pledged shares of insider ownership (RP)

FH: Foreign shareholding ratio

CCF: China concept factor

In this study, the variables are as follows:

(1)BETA

In the capital asset pricing model (CAPM), an asset's risk consists of company-specific idiosyncratic risk, which can be eliminated through diversification, and market risk, which cannot be diversified away. Market risk, measured by BETA, is the contribution of an asset to the riskness of a well-diversified portfolio. Since it cannot be eliminated by diversification, investors must be compensated by receiving a risk premium for bearing it. BETA measures the volatility of the returns on the asset relative to the returns on the market portfolio. We use BETA as an explanatory variable in the regressions to determine if stock returns are affected by BETA for each bearish-bullish turning points. BETA is computed using the market index model with historical monthly returns. Wang, Meric, Liu and Meric(2009) find the higher betas incur greater losses in stock market crashes. So this study wants to explore how BETA variables affect the Taiwan stock market returns during the bearish-bullish and bullish-bearish turning points.

(2) SIZE & MVBV

In their three-factor asset pricing model, in addition to BETA, Fama and French (1992, 1993) use SIZE and market-to-book ratio(MVBV) as determinants of asset returns. They find that smaller firms and firms with a low market-to-book ratio consistently provide relatively higher returns compared with larger firms and firms with a high market-to-book ratio. Miyajima and Yafeh (2007) find firm size and market-to-book ratio to be among the most important determinants of firm performance during the 1995–2000 Japanese banking crisis. Jiang and

Lee (2007) also find book-to-market ratio to be an important determinant of future profitability and excess stock returns. Therefore, in our regressions, in addition to BETA, we also use SIZE and MVBV as explanatory variables to study if these variables influence stock returns in stock market crashes. We define SIZE as the logarithm of the firm's market capitalization. MVBV is computed as the market value of the firm's equity divided by its book value. To explore how these variables affect the Taiwan stock market returns during the bearish-bullish and bullish-bearish turning points.

(3) TD & ROE

The CAPM relies on systematic risk and it assumes that company-specific idiosyncratic risk can be diversified away. However, Xu and Malkiel (2003) and others show that idiosyncratic volatility is a significant determinant of earnings growth and equity returns(ROE). These studies suggest that company-specific idiosyncratic risk factors can become significant determinants of capital asset prices during unexpected stock market events that cause sudden changes in volatility. Therefore, we add some stock- and company-specific financial characteristics as explanatory variables in the regressions to investigate if these characteristics play a significant role in determining stock returns during the bearish-bullish and bullish-bearish turning points.

One of the firm characteristics we use as an explanatory variable in the regressions is the total debt/total assets ratio (TDTA). Miyajima and Yafeh (2007) find financial leverage to be one of the most important determinants of firm performance during the 1995–2000 Japanese banking crisis. The Hamada (1969) equation specifies the effect of financial leverage on beta. The leveraged beta only captures the volatility risk contribution of financial leverage. However, the debt ratio can have an added importance during the bearish-bullish and bullish-bearish turning points.

(4) SHARE (manager ownership)

Jensen and Meckling (1976) emphasized the importance of the agency costs of equity arising from the separation of ownership and control of firms whereby managers tend to maximize their own utility rather than the value of the firm, and develop more formally the classical owner-manager agency problem. They advocate that managerial share-ownership may reduce managerial incentives to consume perquisites ,expropriate shareholders' wealth or to engage in other sub-optimal activities and thus helps in aligning the interests of managers and shareholders which in turn lowers agency costs. We consider both the effects of manager ownership and stock return during the bearish-bullish and bullish-bearish turning points. We measure ownership (SHARE) by the percentage of shares held by manager shareholding.

(5) CEO Chair-Duality (CEO)

It has long been argued that when the board chairperson is also the CEO (unity), the motivation of the board to monitor and oversee the management is compromised due to a lack of independence and conflicts of interest. The CEO also holding the board chairmanship reduces the board's ability to ensure that the management pursues value-increasing activities. This issue was considered sufficiently important for the Cadbury Report (1992) to

recommend that listed companies separate the roles of CEO and board chair (duality). However, proponents of CEO unity argue that the combining of the two positions provides a strong and unambiguous leadership that is capable of making decisions that are in the best interests of the firm (Brickley et al. 1997), and that separating the positions could lead to the incomplete transfer of company information between the two officeholders and confusion over who is in charge of running the firm. CEO unity appears to be even more important during during the bearish-bullish and bullish-bearish turning points, which requires rapid and decisive recommendations by corporate boards to cope with the new dangers and opportunities. So We consider both the effects of CEO Chair-Duality and stock return.

(6) Earnings distribution ratio (Cash-control right ratio) ED

The ownership of publicly traded companies is largely concentrated in the hands of families in Taiwan. The controlling shareholders face strong incentives to monitor managers and maximize profits when they retain substantial cash flow rights in addition to control. These incentives, emphasized by Jensen and Meckling (1976) and Shleifer and Vishny (1986), also restrain the diversion of corporate resources by the controlling shareholders, and enhance the value of minority shares. So we use TEJ date to consider both the effects of Cash-control right ratio and stock return during the bearish-bullish and bullish-bearish turning points.

(7) Ratio of pledged shares of directors ownership (RP)

Directors of public companies are obliged to report to the Securities and Futures Commission (SFC) the percentage of their shareholdings that are pledged for loans and credits. These data matter since pledging for loans effectively reduces the personal funds required for shareholding. In other words, the degree of personal leverage expands and then the over-investments to the stock market of the largest shareholder also undertake the risk of the companies to a certain degree. So we use TEJ date to consider both the effects of Ratio of pledged shares of directors ownership and stock return during the bearish-bullish and bullish-bearish turning points.

(8) Foreign shareholding ratio(FH)

Foreign institutional investors have gained a significant role in Taiwan stock markets, In this paper, we address these issues in the context of foreign institutional shareholding in Taiwan stock markets. So we use TEJ date to consider both the effects of Foreign shareholding ratio and stock return during the bearish-bullish and bullish-bearish turning points.

(9) CCF: China concept factor

China has the closest relationship with Taiwan owing to long history of political relation and economic collaboration. Since the economic reform by Deng in 1990s, China has allured hundreds of billion dollars of funds from all over the world. Since a great percentage of Taiwanese firms have made real investments in China, we call these firms “China-concept” firms. If these firms are listed firms in Taiwan stock markets, then, their stocks are called “China-concept” stocks. So we use TEJ date to consider both the effects of China concept factor and stock return during the bearish-bullish and bullish-bearish turning points.

4. REGRESSION RESULTS

The regression results for the bearish-bullish events are presented in Table 4.1 and

Table 4.1 the bearish-bullish turning points

Mode		Not standardized coefficient		Standardized coefficient	t	Significant
		Coefficient	Standard error	Beta Distribution		
1	(Constant)	-1.915	1.657		-1.156	.248
	Beta	7.470***	.403	.342	18.546	.000
	MVBV	.517**	.206	.049	2.511	.012
	Size	.468**	.204	.052	2.289	.022
	TD	-.041***	.012	-.060	-3.326	.001
	ROE	.007	.026	.005	.270	.787
	Share	.372***	.108	.060	3.434	.001
	RP	-.038***	.010	-.068	-3.812	.000
	ED	-.048***	.014	-.062	-3.447	.001
	CEO	1.109**	.509	.038	2.180	.029
	FH	-.008	.022	-.007	-.334	.738
	CCF	-1.899**	1.071	-.032	-1.773	.076*

R=0.414
R- Square=0.171
Adjusted R-square=0.168
Dependent variable：Return
* Indicates that the variable is significant at the 10% level.
** Indicates that the variable is significant at the 5% level.
*** Indicates that the variable is significant at the 1% level.

Table 4.2 The bullish-bearish turning points.

Mode		Not standardized coefficient		Standardized coefficient	t	Significant
		Coefficient	Standard error	Beta Distribution		
1	(Constant)	-5.301	1.958		-2.708	.007
	Beta	-6.944***	.463	-.262	-14.984	.000
	MVBV	.693***	.163	.080	4.264	.000
	Size	.064	.230	.006	.278	.781
	ROE	-.191***	.024	-.139	-7.791	.000
	TD*	.054***	.014	.070	3.908	.000
	Share	.046	.131	.006	.352	.725
	RP%	-.002	.012	-.003	-.144	.885
	ED	.026*	.015	.029	1.664	.096
	CEO	.146	.570	.004	.256	.798
	FH	-.007	.024	-.006	-.283	.777
	CCF	-.208	1.221	-.003	-.170	.865

R=0.414
R- Square=0.171
Adjusted R-square=0.168
Dependent variable：Return
* Indicates that the variable is significant at the 10% level.
** Indicates that the variable is significant at the 5% level.
*** Indicates that the variable is significant at the 1% level.

BETA is statistically significant at the 1% level during the bearish-bullish regression and bullish-bearish turning points regression. The sign of the coefficient is positive in bearish-bullish regression implying that stocks with higher betas incur greater profit in stock market bearish-bullish turning points. The sign of the coefficient is negative in bullish-bearish turning points regression implying that stocks with higher betas incur greater losses in stock market bullish-bearish turning points.

MVBV is statistically significant at the 1% level during the bearish-bullish regression and bullish-bearish turning points regression. The sign of the coefficient is positive in the bearish-bullish regression and bullish-bearish regression implying that stocks with higher MVBV(market-to-book ratio) incur profit in stock market.

The SIZE variable is statistically significant at the 5% level during the bearish-bullish regression, the sign of the coefficient is positive in bearish-bullish regression implying that stocks with higher betas incur greater profit in stock market bearish-bullish turning points. Size variable is not statistically significant in bullish-bearish turning points regression. TD(total debt ratio) is statistically significant at the 1% level during the bearish-bullish regression and bullish-bearish turning points regression. The sign of the coefficient is negative in bearish-bullish regression implying that stocks with high TD incur greater losses in stock market bearish-bullish turning points. The sign of the coefficient is positive in

bullish-bearish turning points regression implying that stocks with higher TD incur greater profit in stock market bullish-bearish turning points.

ROE (Return of equity.)variable is not as important in bearish - bullish turning points regression. ROE is statistically significant at the1% level during the bullish - bearish regression. The sign of the coefficient is negative in the bullish - bearish regression and implying that stocks with higher ROE incur loss in stock market.

Share(The percent of the firm's stock owned by the managers) is statistically significant at the 1% level during the bearish-bullish regression. The sign of the coefficient is positive in bearish-bullish regression implying that stocks with higher Share incur greater profit in stock market bearish-bullish turning points.

RP(Ratio of pledged shares of insider ownership) is statistically significant at the 1% level during the bearish-bullish regression. The sign of the coefficient is negative in bearish-bullish regression implying that stocks with higher RP incur greater profit in stock market bearish-bullish turning points. RP variable is not as important in bullish - bearish turning points regression.

CEO(CEO Chair-Duality) is statistically significant at the 5% level during the bearish-bullish regression. The sign of the coefficient is positive in bearish-bullish regression implying that stocks with CEO Chair-Duality incur greater profit in stock market bearish-bullish turning points.CEO variable is not as important in bullish - bearish turning points regression.

FH(Foreign shareholding ratio) variable is not as important during the bearish-bullish regression and bullish-bearish turning points regression.

CCF(China concept factor) is statistically significant at the 10% level during the bearish-bullish regression. The sign of the coefficient is negative in bearish-bullish regression implying that stocks with China concept factor incur greater loss in stock market. CCF variable is not as important in bullish - bearish turning points regression.

5. CONCLUSIONS

This study focuses on the relationship between the Taiwan stock market returns around the bearish-bullish turning points and the systemic risk and corporate characteristics, such as the financial ratios, corporate governance, and the China-concept factors. The data used in this study is observed from 1997 to 2009. The sample companies in this study are the stocks listed in the Taiwan Stock Exchange.

We find that stocks with higher betas, higher MVBV, ,larger Size, high Share, CEO Chair-Duality, low TD, low RP, low ED and not China concept factor tend to increase stock returns during the bearish-bullish turning points. On the other hand, we also find higher betas, low MVBV, higher ROE, low TD, and low ED tend to decrease stock returns during the bullish - bearish turning points.

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INVESTOR SENTIMENTS AS THE CONDITIONING INFORMATION IN ASSET PRICING MODEL DURING THE BULLISH AND BEARISH PERIODS IN TAIWAN STOCK EXCHANGE

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ABSTRACT

Previous studies argue that the CAPM based on the efficient market theory cannot explain the empirical results of certain asset-pricing anomalies. Moreover, many studies suggest that investor sentiments could shift the valuation away from the fundamental values by behavioral factors. In order to incorporate those anomalies and investor sentiments, this study uses the investor sentiment conditional information asset-pricing framework of Ho and Hung (2009) to discuss the effects during the bullish and bearish period in Taiwan Stock Exchange. Through our research result, we find that conditional CAPM seems to be more significant in bullish than in bearish. The z_{t-1} *in all specification are significant, and this is consistent with the model of Avramov and Chordia(2006). And these* β*s seem to be more significant in bullish than in bearish. We thought it is because the news on the newspaper are tend to be optimistic, so when the stock market is in the bullish, the sentiment effect will be more significant.*

1. INTRODUCTION

The capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965) has long been a basic tenet of finance. The CAPM theoretically contends that systematic risk is measured by the exposure to the market portfolio, and investors would like to require stock return by the systematic risk from CAPM. In early tests of the Sharpe (1964)–Lintner (1965) mean-variance capital asset pricing model (MV CAPM), Black et al. (1972), Blume and Friend (1973) and Fama and MacBeth (1973), among others, find the estimated relationship between average excess return and beta is too flat and the intercept is positive. This led to a consensus that the Sharpe–Lintner riskfree rate version of the CAPM should be rejected and replaced by Black's (1972) zero-beta version. More recently, Fama and French (1992) find that beta alone does not explain the cross-section of expected returns.

In addition, certain studies argue that the CAPM based on the efficient market theory cannot explain the empirical results of the significant relationship between the stock returns and the firm size (Banz, 1981), value(e.g.,Chan et al., 1991), momentum (Jegadeesh and Titman, 1993)and liquidity(Pastor and Stambaugh, 2003). Consequently, these effects have been named as the asset-pricing anomalies. Besides, many studies suggest that investor sentiments could shift the valuation away from the fundamental values by behavioral factors(DeLong

and Shleifer, 1991; Shiller, 2000; Brown and Cliff, 2005), such as representativeness, conservatism(Barberis, Shleifer and Vishny, 1998) and overconfidence(Danie, Hirshleifer and Subrahmanyam, 2001).

Fisher and Statman (2000) find that the sentiments of both small and large investors are reliable contrarian indicators for future S&P500 index returns and that high consumer confidence is generally followed by low returns. Brown and Cliff (2004) document a relationship between institutional investors' sentiments and the returns on large size stocks. Charoenrook (2005) shows that changes in consumer sentiment are positively related to contemporaneously excess market returns. Some recent studies suggest that investor's sentiment has a negative relationship with stock returns in the long-run (e.g., Baker and Wurgler, 2006, 2007; Brown and Cliff, 2004), especially for those stocks whose valuations are highly subjective and difficult to arbitrage.

In order to incorporate those anomalies and investor sentiments, this study use the investor sentiment conditional information asset-pricing framework of Ho and Hung (2009) to discuss the effects during the bullish and bearish period in Taiwan Stock Exchange. Engle, Lilien and Robins(1987) use time-series method, and extent it to be conditional CAPM. They given the price of risk of market were fixed, and use excess return and conditional model, let the size and value effect to be more predictable. To illustrate time-varying betas, many studies have considered macroeconomic variables such as the term premium, default spread, or consumption-wealth ratio as conditioning variables (e.g., Shanken, 1990; Ferson and Harvey, 1991; Braun Nelson and Sunier, 1995; Ferson and Schadt, 1996; Jagannathan and Wang, 1996; and Lettau and Ludvigson, 2001).

As to the sentiment measures, two types of measures are widely used in the literature, namely, the direct and indirect measures(Brown and Cliff, 2004; Baker and Wurgler, 2006, 2007; Ho and Hung, 2009). This study is going to construct a direct measure of investor's sentiment by recording the frequency of discussions of stocks on some financial-related websites. Recently the Internet has become a very important tool for investors to get market information. Many studies use website data mining to develop sentiment measure and analysis (Das and Chen, 2007; Miao, Li and Dai, 2009; Li and Wu, 2009), but few studies use the frequency of investors' discussion on certain stocks as a sentiment measure. If certain stocks are mentioned more frequently on the website, it likely that the investors are paying more attention on those stocks, or, in other words, the investor's sentiment is relatively high.

The purpose of this study is to examine whether the conditional asset pricing model can explain the conditional expected returns. We run cross-sectional regressions of the estimated risk-adjusted returns on firm size, book-to-market ratio, liquidity and momentum effects. In addition, this study constructs a direct sentiment measure based on the frequency of discussions on the website. Finally, this model will be examined during the bullish and bearish period of the Taiwan Stock Exchange. . Huang (2006) argues that investors' sentiment could be different during the bullish and bearing periods. Following Pagan and Sossounov(2003), this study distinguishes the bullish and bearish periods and analyzes whether the results will be change when the investment atmosphere is different.

We first exam whether conditional models completely explain conditional expected returns and also use fixed effects estimation method to deal with the alpha Next, we evaluate the relative performance of various specifications of conditional asset-pricing models in respect of how well they capture the size, value, liquidity, and momentum effects. We use the two-pass regression framework of Ho and Hung (2009) we regress monthly individual stock returns on the risk factors of asset pricing models in which factor loadings may vary with conditioning variables. Especially, we set the sentiment to be a firm characteristic variable in our framework, and test it in two phases that the bullish and bearish periods. In the second-pass, we run cross-sectional regressions of the estimated risk-adjusted returns - the sums of the pricing error and the residual from the first-pass regressions - on firm characteristics of size, book-to-market ratio and variables representing the liquidity and momentum effects. The null hypothesis of exact pricing is that the conditional pricing models specified in the first-pass regressions successfully capture the anomalies on both period, and thus, the size, value, liquidity, and momentum effects do not explain the cross-section of risk-adjusted stock returns in the second-pass regressions.

This paper contributes to the literature in the following areas. First, we extend frequency of discussions on the website to be a deirct sentiment variable and using it to be a firm's characteristic, and then loading this factor in conditional CAPM. Most literature use macroeconomic sentiment variables to discuss the relationship between stock return and sentiment, such like Association of Individual Investor(AAII), ML(Merrill Lynch) or Consumer Confidence Index (CCI) (Schmeling, 2009, Lemmon and Portniaguina, 2006, Brown and Cliff ,2005, Ho and Hung, 2009),but few study use microeconomic sentiment variables to discuss it, so this study try to figure out whether stocks will influence by its own sentiment variable. It seem like when the news post in the media more frequency and investors will discuss more often (Sehgal and Song, 2007). If certain stocks are mentioned more frequently on the website or newspaper, it likely that the investors are paying more attention on those stocks, or, in other words, the investor's sentiment is relatively high.

Second, many study suggests that the betas will be different in bullish and bearish (Huang, 2006), so we use the simple framework of Pagan and Sossounov(2003) to distinguishes the bullish and bearish periods and analyzes whether the results will be change when the investment atmosphere is different, especially in Taiwan.

The rest of the paper proceeds as follows. The next section describes the two-pass methodology for examining various specifications of the asset-pricing models. Section 3 details the sentiment indices and the stock trading data used in the analyses. Section 4 examines whether conditional models completely explain conditional expected returns and presents the results of models in capturing the asset-pricing anomalies. Section 5 concludes.

2. METHODOLOGY

2.1. The two-pass framework

We assume that returns are generated by a conditional version of a K-factor model

$$R_{jt} = E_{t-1}(R_{jt}) + \sum_{k=1}^{K} \beta_{jkt-1} f_{kt} + e_{jt} \quad \text{.....(1)}$$

where $E_{t-1}$is the conditional expectations operator, $R_{jt}$is the return on security j at time t; f_{kt} is the unanticipated (with respect to information available at $t-1$) time t return on the k th factor, and β_{jkt-1} is the conditional beta corresponding to the k th factor. $E_{t-1}(R_{jt})$ is modeled using the exact pricing specification

$$E_{t-1}(R_{jt}) - R_{Ft} = \sum_{k=1}^{K} \lambda_{kt-1}\beta_{jkt-1} \quad \text{.....(2)}$$

where R_{Ft} is the risk-free rate and $\lambda_{kt}$is the risk premium for factor k at time t. The estimated risk-adjusted return on each security for month t is then calculated as

$$R_{jt}^{*} \equiv R_{jt} - R_{Ft} - \sum_{k=1}^{K} \hat{\beta}_{jkt-1}F_{kt} \quad \text{.....(3)}$$

where $F_{kt} \equiv f_{kt} + \lambda_{kt-1}$ is the sum of the factor innovation and its corresponding risk premium and $\hat{\beta}_{jkt}$ is the conditional beta estimated by a first-pass time-series regression over the entire sample period as per the specification given below. Our risk adjustment procedure imposes the assumptions that the conditional zero-beta return equals the conditional. The two-pass conditional framework can be summarized in a generic form as

$$R_{jt}^{*} \equiv R_{jt} - \left[R_{Ft} + \beta(\theta; S_{t-1}, z_{t-1}, X_{jt-1})'F_t\right] = c_{0t} + c_t Z_{jt-1} + e_{jt} \quad \text{.....(4)}$$

where $R_{jt}^{*}$is the estimated risk-adjusted return on stock j for time t and is equal to the sum of the intercept and the residual obtained from a first-pass time-series regression. θ denotes the parameters that capture the dependence of β on investor sentiment (S_{t-1}), default spread (z_{t-1}), and firm characteristics (X_{jt-1}). Ft is the vector of risk factors specified in the asset-pricing model. The vector of the conditional beta is estimated by the first-pass time-series regression over the entire sample period. $Z_{jt-1}$is the vector of the asset-pricing anomalies – the size, value, liquidity, and momentum effects – that we intend to capture. c_t is the vector of characteristics rewards.

Eq.(4) is a cross-sectional regression by which we run, in each month, the estimated risk-adjusted returns of individual stocks on the variables of size, B/M, liquidity, and prior returns. We test the null that the second-pass cross-sectional slopes on the asset-pricing anomalies are zero and statistically insignificant, that is $\hat{c}_t = (Z_{t-1}Z_{t-1})^{-1}Z_{t-1}R_{jt}^{*} = 0$, The adjusted R squared in the second-pass regression serves as an indicator for comparing the relative overall performance of the conditional specifications of the asset-pricing model.

To further illustrate the conditional models, we use the single-factor CAPM as an example to describe the empirical specifications. We set the sentiment to be a firm characteristic variable, so we modify the framework of Ho and Hung(2009) in the first-pass regression for stock returns. To describe the beta modeling in the time series regressions, let us focus on the one factor CAPM, and we assume that there is a single macroeconomic predictor z_{t-1}. The

beta of the excess market return, β_{jt-1}, can be expressed as a function of investor sentiment (S_{t-1}), default spread (z_{t-1}), and firm characteristics ($SIZE_{jt-1}$ and $(B/M)_{jt-1}$) as

$$\beta_{jt-1} = \beta_{j1} + \beta_{j2} z_{t-1} + (\beta_{j3} + \beta_{j4} z_{t-1}) S_{t-1} + (\beta_{j5} + \beta_{j6} z_{t-1}) SIZE_{jt-1} + (\beta_{j7} + \beta_{j8} z_{t-1})(B/M)_{jt-1} \quad (5)$$

where $SIZE_{jt-1}$ and $(B/M)_{jt-1}$ are the market capitalization and the book-tomarket ratio at time $t-1$. In the empirical examinations, beta is modeled under four specifications. In the first, the unconditional one, all βs except for β_{j1} are restricted to be zero. The next three are conditional versions:
(i)$\beta_{j2} = \beta_{j4} = \beta_{j6} = \beta_{j8} = 0(ii)\beta_{j3} = \beta_{j4} = \beta_{j5} = \beta_{j6} = \beta_{j7} = \beta_{j8} = 0$(iii)all βs are allowed to depart from zero. To illustrate, the first pass time series regression for the very last specification is

$$r_{jt} = \alpha_i + \beta_{j1} r_{mt} + \beta_{j2} z_{t-1} r_{mt} + \beta_{j3} S_{t-1} r_{mt} + \beta_{j4} z_{t-1} S_{t-1} r_{mt} + \beta_{j5} SIZE_{jt-1} r_{mt} + \beta_{j6} z_{t-1} SIZE_{jt-1} r_{mt} + \beta_{j7} BM_{jt-1} r_{mt} + \beta_{j8} z_{t-1} BM_{jt-1} r_{mt} + u_{it} \quad (6)$$

wherer_{jt}=$R_{jt} - R_{Ft}$ and r_{mt} is excess return on the value-weighted market index. Note that the firm characteristics size, book-to-market ratio, sentiment and the macroeconomic predictor are all lagged one period as compared to the excess market and individual stock returns. R^*_{jt} in Equation (4), the dependent variable in the cross-section regression, is given by $R^*_{jt} = \alpha_i + u_{it}$. The time series regression (6) is run over the entire sample.

The asset pricing models we have considered in second-pass is the Fama-French (1993) three-factor model augmented by the Pastor-Stambaugh (2003) liquidity factor and the winners-minus-losers portfolio (WML) which proxies for the momentum factor. The equation is below.

$$r_{jt} = \alpha_i + \beta_{jm} r_{mt} + \beta_{jSMB} SMB_t + \beta_{jHML} HML_t + \beta_{jPS} PS_t + \beta_{jWML} WML_t + u_{jt}$$

u_{jt} is the error term. *SMB* denotes the monthly return difference between the average return on the three small size portfolios minus the average return on the three big size portfolios. *HML* denotes the monthly return difference between the average return on the two value portfolios minus the average return on the two growth portfolios. *PS* is the Pastor-Stambaugh (2003) liquidity factor constructed by the difference between the value-weighted return on the high liquidity sensitive portfolios and the value-weighted return on the low liquidity sensitive portfolios. *WML* is the momentum factor that represents the difference between the returns on the winner and the loser portfolios of the momentum strategies depicted by Jegadeesh and Titman (1993).

3. DATA

3.1. Sentiment Index

We calculate the monthly frequencies of stock-related news for each individual stock as our sentiment index. If the news of certain stock show up more frequently during a certain period, we assume that the sentiment for that stock will be relatively high. The index is constructed as follows:

$$\text{Sentiment Index}_i = \text{Ln (monthly frequencies of stock-related news)}_i$$

for each individual stock i.

3.2. Trading data

Data are collected from TEJ for the period from Mar 2000 to Feb 2010. We use the monthly report data for those listed companies whose stocks are listed in the TSEC Taiwan middle 100 Index. Some studies suggest that smaller or hard-to- arbitrage stocks will be more difficult to evaluate, and therefore are more likely to be influenced by sentiments (e.g., Baker and Wurgler, 2006, 2007; Brown and Cliff, 2004). Consequently, we choose Taiwan middle 100 stocks as our sample companies.

We use the TAIEX value-weighted returns as a proxy for the market returns. Our monthly variables are the levels of S (sentiment index), SIZE and B/M (the natural logarithms of a firm's market capitalization and the book-to-market ratio, respectively) TURNOVER (the ratio of trading volume to the number of shares outstanding), RET2-3, RET4-6 and RET7-12 (the cumulative returns over the past second through the past third, the past fourth through the past sixth and the past seventh through the past twelfth months, respectively) and default spread (z, the return difference between capital loan rate and government bonds of ten year period).

3.3 bearish-bullish period

We identify bearish and bullish periods using the approach of Pagan and Sossounov (2003). The Pagan and Sossounov (2003) adaptation of the Bry-Boschan (BB) algorithm can be summarized as follows:

1. Identify the bullish and bearish by using a window of 8 months.
2. Enforce alternation of phases by deleting the lower of adjacent bullish and the higher of adjacent bullish.
3. Eliminate phases less than 4 months unless changes exceed 20%.
4. Eliminate cycles less than 16 months.

The Taiwan stock market bearish and bullish period from 1997 to 2009 are presented below (Table 3.3.1):

Table 3.3.1 Classification of bearish-bullish.

Bearish	Bullish
1997 / 7 ~1999 / 1	1999/1~2000/5
2000/5~2001/9	2001/9~2002/5
2002/5~2003/4	2003/4~2004/11
2004/11~2005/10	2005/10~2007/10
2007/10~2008/1	2009/1~2009/9
2008/5~2009/1	

Table 3.3.2 shows the sample period used in this study, which is one month after the bearish-bullish turning point.

Table 3.3.2 Sample Period in this Study

Bearish	Bullish
1997/8	1999/2
2000/6	2001/10
2002/6	2003/5
2004/12	2005/11
2007/11	2009/2
2008/6	

4. EMPIRICAL RESULTS

First, we regress the first pass time-series regression for estimating the βs so that we can calculate the $R_{jt}^{*} = \alpha_i + u_{it}$ for second-pass cross-section regression. And we have three specifications need to test in Bullish and Bearish. See Table 1-2.

$(i)\beta_{j2} = \beta_{j4} = \beta_{j6} = \beta_{j8} = 0\ (ii)\beta_{j3} = \beta_{j4} = \beta_{j5} = \beta_{j6} = \beta_{j7} = \beta_{j8} = 0\ (iii)$all βs

Table1

Bullish $(i)\beta_{j2} = \beta_{j4} = \beta_{j6} = \beta_{j8} = 0$

model	rm	S	SIZE	B/M
βs	.854	.013	.052	.107
Standard error	.089	.016	.029	.022
t	9.563	.847	1.785	4.834
p-value	.000	.397	.074	.000
Adj R^2	**0.324**			

Bullish (ii) $\beta_{j2} = \beta_{j4} = \beta_{j5} = \beta_{j6} = \beta_{j7} = \beta_{j8} = 0$

model	rm	z
βs	1.381	-15.959
Standard error	.045	2.910
t	30.416	-5.484
p-value	.000	.000
Adj R^2	**0.313**	

Bullish (iii) all βs

model	rm	z	S	SIZE	B/M
βs	2.255	-74.284	-.030	-.407	.570
Standard error	.224	11.671	.031	.069	.071
t	10.053	-6.365	-.989	-5.930	8.015
p-value	.000	.000	.323	.000	.000
Adj R^2	**0.344**				

Table2

Bearish (ii) $\beta_{j2} = \beta_{j4} = \beta_{j5} = \beta_{j6} = \beta_{j7} = \beta_{j8} = 0$

model	rm	z
βs	1.024	-12.223
Standard error	.043	3.270
t	23.532	-3.738
p-value	.000	.000
Adj R^2	**0.166**	

Bearish (i) $\beta_{j2} = \beta_{j4} = \beta_{j6} = \beta_{j8} = 0$

model	rm	S	SIZE	B/M
βs	.794	.011	.058	.085
Standard error	.104	.017	.033	.038
t	7.620	.647	1.780	2.217
p-value	.000	.518	.075	.027
Adj R^2	**0.202**			

Bullish (iii) all βs

model	rm	z	S	SIZE	B/M
βs	1.085	-29.246	-.013	.011	.131
Standard error	.194	14.503	.032	.060	.083
t	5.590	-2.017	-.391	.191	1.579
p-value	.000	.044	.696	.849	.114
Adj R^2	0.204				

All the R^2 seem to increase when we add our variable. The z_{t-1}in all specification are significant, and this is consist with the model of Avramov and Chordia(2006). Next we will work on the second-pass regression yet, which will be finished shortly.We can then calculate the $R_{jt}^{*} = \alpha_i + \mathcal{U}_{it}$ for the second-pass cross-section regression, after estimating these βs.

5. CONCLUSIONS

This study uses the investor sentiment conditional information asset-pricing framework of Ho and Hung (2009) to discuss the effects during the bullish and bearish period in Taiwan Stock Exchange. The z_{t-1}in all specification are significant, and this is consist with the model of Avramov and Chordia(2006). And these βs seem to be more significant in bullish than bearish. We thought it is because the news on the newspaper are tend to be optimistic, so when the stock market is in the bullish, the sentiment effect will be more significant.

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AN ANALYSIS OF DEMAND FOR LIFE INSURANCE – PROFITABILITY REGIONS. AN EMPIRICAL STUDY

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ABSTRACT

The aim of the paper is to demonstrate the effect of the regional death risk differentiation method upon the financial management and effectiveness of life insurance. Such an aim involves answering the question of whether the application of regional death risk differentiation in the process of financial management can improve effectiveness of life insurance companies or rate of return of life insurance contract?

The above issue is explored on the basis of empirical research undertaken by the author. The research followed the pattern of premium differentiation for the main categories of assurance by special so called profitability regions. The study is based on the demographic data which refers to territory of Poland. First, the profitability regions are created. Regions are comprise by all Polish voivodeship (preliminary regions). The final stage is an approach to proof that the regional differentiation of an insurance rate has an improving effect on overall profitability of an life insurance contract. That is checked by implementation of an approached provided by D. Moffet[1] who calculated effective rate of return on life insurance.

JEL classification: G32, C1
Keywords: life insurance, spatial risk analysis, pricing of life insurance

1. INTRODUCTION

Insurance companies are complex economic institutions of a specific structure, distribution and financial system. Financial management of insurance, like other companies are part of the general economic phenomena associated with the accumulation and redistribution of funds.

The specific nature of "insurance product", especially life insurance, its long-term nature, heterogeneous and intangible nature distinguish economies of insurance from other economic

[1] D. Moffet, *An analysis of the Demand for Life Insurance: Mathematical Foundation*, The Journal of Risk and Insurance, Vol.46, No 2 (Jun 1979) pp.87-98

institutions.

Some of the most important metrics for the assessment of the insurance company is financial result (profit). "The financial result mirrors the relevance of the strategy for the insurance company, as portfolio management and accuracy of calculation of costs of risk. ". The costs reflect the level of insurance premiums.

In the fierce competition and the risk of losing the trust of customers, insurance, especially life insurers must constantly look for new factors of competitiveness. One of the key areas to create competitive advantage is the modification of the offer of life insurance products. One of the main factor which determines the sale of life insurance is the price. Previous research conducted by the author shows that the price determines the demand for life insurance in Poland [2]. It is interesting that in the first period after the transformation of the nineties the relationship between price and demand for life insurance were added. Demand has grown with the increase in prices. Life insurance was a luxury good. Having a long-term policy was seen as a social advancement. After several years of market development, this relationship was reversed. The lower the price the higher the demand for life insurance. Life insurance companies using this tendency should optimize the level of contributions due to different criteria. Optimization should provide long-term financial solvency of insurer. The paper contains a proposal for spatial risk diversification in the long-term insurance. The condition of spatial differentiation is a significant variation in the level of risk of death occurring in different regions. The paper aims to present the results of studies on death risk analysis in Polish regions. The result is division of the Polish territory, in a number of so-called profitability regions. In the future, life insurance companies could differentiate the level of insurance premiums by the risk of death in those regions. The study is based on the demographic data which refers to territory of Poland. First, the profitability regions are created. Regions are comprise by all Polish voivodeship (preliminary regions). Preliminary regions are merge together by comparison of the main characteristic of death probability distribution. The cluster analysis is applied into the merging process. The final stage of the paper is an approach to prove that the regional differentiation of an insurance premiums has an improving effect on overall effectiveness of an life insurance contract. The approach provided by D. Moffet[3] is implemented to verify it.

2. LITERATURE REVIEW

The decent justification for such a research is luck of the previous study on the spatial death risk differentiation and its application into the process of life insurance pricing. After the in-depth literature analysis only two papers were found on the similar. First is the study provided by B.Babel, S. Eckel, R Schmidt and V Schmidt[4]. The stated authors have studied

[2] A.Sliwinski, T.Michalski., M.Rószkiewicz, *Determinants of the consumption of life insurance in Poland,* Journal of Wroclaw Economic University, Wroclaw 2010 (forthcoming)

[3] D. Moffet, *An analysis of the Demand for Life Insurance: Mathematical Foundation*, The Journal of Risk and Insurance, Vol.46, No 2 (Jun 1979) pp.87-98

[4] B. Babel, S. Eckel, R Schmidt and V Schmidt, *Mortality maps based on spatial extrapolation*, working paper of University of ULM, available at: http://www.mathematik.uniulm.de/stochastik/personal/eckel/Publications/MortalityMaps20060131.pdf

the difference between mortality rate according to Germans regions. They created the mortality maps for East, West and South Germany for the various age groups. After the mortality analysis the authors discussed the possible consequences of observed differences for the risk based pricing of life insurance. They concluded that the regional differences of mortality in South, East and West Germany have implication on the premium of life insurance contract or pension plans.

Second paper is the paper written by D.Moffet[5]. In the paper the problem of life insurance effectiveness determination by the way of death risk calculation is described. The author touched the problem of effective rate of return on life insurance contract form the perspective of policyholder. As an example he used whole life insurance policy issued to a male, age 22, at a annual premium of 101USD. In his model which is briefly described later in the text the rate of return is influenced by the choice of the survival probability. Consequently the rate is sensitive to the probability of survival. Thus there is a question if in terms of created regions in Poland the differences in probability of survival influence significantly the effective rate of return. If yes, that would be one of the justification for risk based pricing of life insurance contracts in Poland. The biggest the effective rates the better for the client and in hence the overall demand for life insurance polices improve.

3. METHODOLOGY AND DATA

The paper consist two main parts. In the first part the regions are merged into so- called profitability regions. That part consist the demographic analysis. To provide the study the demographic data are used. The database covers 16 Polish provinces (regions) and includes information about the population of regions in the years 1999 to 2003. For regions obtained the following data:

1. size of the population by individual age (from 0 to 100 years), separately for men and women;
2. number of deaths from regions (deaths in older and younger deaths by individual age from 0 to 100 years),
3. number of births in different regions.

Table 1 presents the summary of established regions taken together with their coding used by Polish Central Statistical Office.

[5] D.Moffet, *An Analysis of the demand for life Insurance: Mathematical Foundations,*The Journal of Risk and Insurance, Vol.46, No.2 Jun.1979.pp87-89

Table 1. The codes and researched regions.

Kod	Województwo
D02	Dolnoslaskie
C04	Kujawsko-Pomorskie
L06	Lubelskie
F08	Lubuskie
E10	Ludzkie
K12	Malopolskie
W14	Mazowieckie
O16	Opolskie
R18	Podkarpackie
B20	Podlaskie
G22	Pomorskie
S24	Slaskie
T26	Swietokrzyskie
N28	Warminsko-Mazurskie
P30	Wielkopolskie
Z32	Zachodniopomorskie

Source: Polish Central Statistical Office.

In the first stage there is an estimation of the frequency of deaths for the people aged from 5 to 84 years. The calculations were made separately for all studied regions. Age restriction stems from the fact that in the age ranges from 0 to 4 years we have a heterogeneous distribution of empirical probabilities of death. Thus in this age range processes, extinctions processes are difficult to theoretical modeling. The probabilities of death over the age of 84 years are extrapolated on the assumption of exponential function. In the presented studies frequency of death is used to characterized different regions. Narrowing the age range will not affect the importance of the achieved results and their interpretation from the perspective of optimizing the level of premiums for life insurance. The largest group of life insurance customers are people in so-called production aged. The general conditions of insurance companies offer life insurance limit access to the upper age 65-70 years depending on the type of product and system of premium payment. Age of admission to life insurance contracts more than 65 years usually refers to the situation of one-instalment of total premium, and it is associated with the unit – linked life insurance products. Analysis of risk of death in the accepted age range, and the separation regions on the basis of a similar level of probability will correspond to the needs of life insurance companies.

Then after the calculation of frequency of death by individual ages and separately for the regions other variables were chosen to compare the regions by probability of death distribution. The comparison let to merged the regions in so-called profitability regions.

In order to identify the profitability regions cluster analysis were used. Cluster analysis was made separately for two moments in time. The first group was made for the implementation of features evaluated on the basis of data from the years 1998/1999. Then the analysis was repeated using the characteristics of the estimated value based on data from the years 2002/2003. This approach allowed the analysis of the changes that have occurred in the 5

years period. Segmentation was based on the Ward algorithm for 16 regions with 5 variables. Used variables are:
1. the average age of people living in the region (Var1),
2. frequency of deaths in middle-aged people living in the region (Var 2),
3. parameter B of Gompertz function (Var 3)
4. parameter h of Gompertz function (Var 4),
5. participation of men in the average age in the total number of people in average age residing in the region (Var 5).

The result of the first part of the research are clusters which includes the regions that could be characterized by similar probability of death distribution. The results could be used by life insurance company to implement risk based pricing of life insurance contracts. The company could value the premiums separately for achieved profitability regions.

In the second part of the paper Moffet's approach is implemented to check if the risk based strategy influences the effective rate of return of life insurance contract.

4. THE CHARACTERISTIC OF CHOSEN VARIABLES

4.1 Average age of the region's population

Average age is a variable chosen for the test. This variable was chosen because the distribution of the probability of death determines the level of that probability for a person at a given age. Average age were counted as a weighted average, where weights are the number of people living in the age of the region. Table 2 presents the results of calculations of average age in the different regions in the analyzed periods.

Table 2. The average age of population living in the region between 1999 and 2003.

No	Regions	Code	Average age		Difference	Change [%]
			1999	2003		
1.	Dolnoslaskie	D02	36	38	2	5,6%
2.	Kujawsko-Pomorskie	C04	35	36	1	2,9%
3.	Lubelskie	L06	36	37	1	2,8%
4.	Lubuskie	F08	35	36	1	2,9%
5.	Ludzkie	E10	38	39	1	2,6%
6.	Malopolskie	K12	35	39	4	11,4%
7.	Mazowieckie	W14	37	38	1	2,7%
8.	Opolskie	O16	36	37	1	2,8%
9.	Podkarpackie	R18	34	36	2	5,9%
10.	Podlaskie	B20	36	37	1	2,8%
11.	Pomorskie	G22	35	36	1	2,9%
12.	Slaskie	S24	36	38	2	5,6%
13.	Swietokrzyskie	T26	36	38	2	5,6%
14.	Warminsko-Mazurskie	N28	34	36	2	5,9%
15.	Wielkopolskie	P30	35	36	1	2,9%
16.	Zachodniopomorskie	Z32	35	37	2	5,7%

Source: Calculation done by the author based on data published by Polish Central Statistical Office.

In the period considered the average age increased in all regions analyzed. The largest increase, equal to 11.4% took place in the region of K12 (Malopolskie). In nine regions, the average age has increased more than 2%, but not more than 3%. The other six regions, the average age increased by more than 5%. The lowest average age change occurred in the region of W14 - Mazowieckie region. This may be due to the arrival of younger people in connection with the dynamically developing economy of the region, labor market and in total better prospects for the future.

4.3 Frequency of death

Second variable includes information about the number of people living and the dead at a given age. It is an estimator of the probability of death. The adopted frequency of death taking into consideration information on the number of people who died in average age. This information is important for life insurance. The risk of death is the primary factor determining the level of insurance premiums. For the study the frequency of death counted on the basis of empirical data is used. Frequency comparisons were made for people in average age in the regions separately for two moments in time. Taking into account the characteristics of the distribution of probability of death is known that the level of the probability increases with age. For life insurance companies is important to have an information about the direction and strength of changes in the frequency of deaths of people at any given age. Table 3 presents estimates of the frequency of deaths of people in average age, and changes in a given period of time for different regions.

Table 3. The frequency of death in average aged of population living in the regions between 1999 and 2003.

No	region	Code	Frequency of death		Difference	Change[%]
			1999	2003		
1.	Dolnoslaskie	D02	0,00127	0,00115	-0,00012	-9,5%
2.	Kujawsko-Pomorskie	C04	0,00173	0,00154	-0,00019	-11,1%
3.	Lubelskie	L06	0,00179	0,00096	-0,00083	-46,4%
4.	Lubuskie	F08	0,00142	0,00176	0,00034	23,9%
5.	Ludzkie	E10	0,00298	0,00291	-0,00007	-2,3%
6.	Malopolskie	K12	0,00188	0,00231	0,00043	22,7%
7.	Mazowieckie	W14	0,00357	0,00092	-0,00265	-74,2%
8.	Opolskie	O16	0,00107	0,00139	0,00032	30,0%
9.	Podkarpackie	R18	0,00130	0,00138	0,00008	6,2%
10.	Podlaskie	B20	0,00135	0,00208	0,00073	54,1%
11.	Pomorskie	G22	0,00127	0,00158	0,00031	24,5%
12.	Slaskie	S24	0,00144	0,00202	0,00059	40,8%
13.	Swietokrzyskie	T26	0,00159	0,00094	-0,00065	-40,8%
14.	Warminsko-Mazurskie	N28	0,00114	0,00164	0,00050	44,4%
15.	Wielkopolskie	P30	0,00174	0,00155	-0,00019	-10,8%
16.	Zachodniopomorskie	Z32	0,00273	0,00187	-0,00086	-31,4%

Source: Calculation done by the author based on data published by Polish Central Statistical Office.

Analyzing the results shown in the table 3 it is visible that the level of death rates behaved differently depending on the region. In eight regions, there is a fall in the frequency of deaths in average age. The highest decrease was observed in the region W14 - Mazowieckie. In other regions, the frequency of death of people in average age increases. The highest increase was recorded in the region of B20 - Podlaskie.

4.4 Parameters of Gompertz law of mortality

Gompertz law of mortality[6] is based on the assumption of exponential distribution of probabilities of death. The law is based on the hypothesis of the so-called the human life force. Gompertz understood human life force as an inverse of the force of mortality (1 / μx (t)). He accepted that the loss of life force is proportional to the size of this force at any given time and the period in which the loss occurred. At the end he received the following formula:

$$\mu_x = Be^{hx} = Bc^x, \qquad (1)$$

where *B* and *h* are constant over the range of age considered. The parameter *B* determines the level of force of mortality of infants. However, the higher the value of the parameter *h* the force of mortality for the population is changing slower. Calculation of parameters may give rise to calculate force of mortality for separate Polish regions. Table 4 contains the estimates of Gompertz parameters of the exponential function (B, h) for all investigated regions separately. The analysis was based on demographic data from 1999 and 2003. This approach allows the assessment of changes in the force of mortality in regions within the period of 5 years. Estimates were based on the smoothed distributions of the probabilities of death in different regions. In order to smooth the empirical probabilities of death by individual ages moving average was used according to the Polish Central Statistical Office's methodology[7].

Table 4. Parameters of Gompertz law of mortality.

No	Region	Code	1999		2003		Change [%]	
			B	h	B	h	B	h
1.	Dolnoslaskie	D02	0,00020	0,0817	0,00010	0,0830	-50,00%	1,59%
2.	Kujawsko-Pomorskie	C04	0,00020	0,0814	0,00010	0,0838	-50,00%	2,95%
3.	Lubelskie	L06	0,00020	0,0793	0,00010	0,0827	-50,00%	4,29%
4.	Lubuskie	F08	0,00020	0,0814	0,00010	0,0842	-50,00%	3,44%
5.	Ludzkie	E10	0,00020	0,0805	0,00020	0,0815	0,00%	1,24%
6.	Malopolskie	K12	0,00020	0,0845	0,00020	0,0845	0,00%	0,00%
7.	Mazowieckie	W14	0,00030	0,0784	0,00010	0,0810	-66,67%	3,32%
8.	Opolskie	O16	0,00010	0,0839	0,00010	0,0743	0,00%	-11,44%
9.	Podkarpackie	R18	0,00010	0,0834	0,00010	0,0847	0,00%	1,56%
10.	Podlaskie	B20	0,00020	0,0785	0,00020	0,0796	0,00%	1,40%
11.	Pomorskie	G22	0,00010	0,0836	0,00010	0,0834	0,00%	-0,24%
12.	Slaskie	S24	0,00010	0,0840	0,00010	0,0853	0,00%	1,55%
13.	Swietokrzyskie	T26	0,00020	0,0791	0,00020	0,0804	0,00%	1,64%
14.	Warminsko-Mazurskie	N28	0,00020	0,0784	0,00020	0,0781	0,00%	-0,38%
15.	Wielkopolskie	P30	0,00020	0,0826	0,00010	0,0852	-50,00%	3,15%
16.	Zachodniopomorskie	Z32	0,00030	0,0793	0,00007	0,0857	-76,67%	8,07%

Source: Author.

[6] The full description of Gompertz law of mortality could be found for example at: A. Neil, *Life contingencies*, Heinemann, London 1983, pp.27

[7] The methodology could be found at: *Life Table of Poland 2007*, GUS, Warsaw 2008, pp.34

Analyzing the above parameters of Gompertz function is visible that they differ in the regional section. For example, the parameter *B* for the region marked with the symbol Z32 is *0.0003* for the parameter *h* equal to *0.0793*. For the region D02 *B = 0.0002*, *h = 0.0817*. In 1993, the coefficient *B* takes three values equal to: *0.0001*, *0.0002* and *0.0003*. According to this parameter, all analyzed regions can be divided into three groups corresponding to three different values of the parameter. In 2003, you can not see the value of *0.0003*.

4.5 Population structure

The share of middle-aged men in the total number of persons of the same age living in different regions were used due to the fact that the probability of death for men in that age is higher than the probability of death of women in the same age. This trend is visible by analyze the life expectancy tables on Polish territory. Table 5 compares the probability of death of selected age group of men and women. The probabilities are estimated based on data from the year 2006 for whole territory of Poland.

Table 5. Comparison of probabilities of death for men and women in Poland.

Age	Probability of death		Difference (1-2)
	Men (1)	Women (2)	
15	0,00329	0,00122	0,00207
20	0,00537	0,00130	0,00407
25	0,00593	0,00147	0,00446
30	0,00822	0,00233	0,00589
35	0,01312	0,00412	0,00900
40	0,02187	0,00747	0,01440
45	0,03597	0,01288	0,02309
50	0,05531	0,02056	0,03475
55	0,07939	0,03084	0,04855
60	0,11021	0,04384	0,06637
65	0,15196	0,06437	0,08759

Source: Author.

Increased participation of men in total region population, due to higher probability of death would have negative impact from the perspective of life insurance company. Table 6 contains the estimated share of men in the population of polish regions.

Table 6. The share of middle-aged men in the total number of people living in the region at this age in the years 1999 and 2003.

No	Region	Code	Share [%]		Difference
			1999	2003	
1.	Dolnoslaskie	D02	50,15	50,69	0,54
2.	Kujawsko-Pomorskie	C04	49,72	50,05	0,33
3.	Lubelskie	L06	51,47	50,51	-0,96
4.	Lubuskie	F08	51,01	50,64	-0,37
5.	Ludzkie	E10	50,63	50,12	-0,51
6.	Malopolskie	K12	51,22	51,23	0,01
7.	Mazowieckie	W14	50,13	50,45	0,32
8.	Opolskie	O16	52,07	50,96	-1,11
9.	Podkarpackie	R18	51,19	50,40	-0,79
10.	Podlaskie	B20	50,95	51,21	0,26
11.	Pomorskie	G22	49,89	51,61	1,72
12.	Slaskie	S24	50,09	50,25	0,16
13.	Swietokrzyskie	T26	51,85	51,45	-0,40
14.	Warminsko-Mazurskie	N28	50,89	50,19	-0,70
15.	Wielkopolskie	P30	50,35	50,11	-0,24
16.	Zachodniopomorskie	Z32	51,53	51,00	-0,53

Source: Author.

The share of middle-aged men in the total number of persons in this age of regions varies around 50%. Comparing the shares in two periods, could be seen that the share has changed slightly. In the nine regions male participation has decreased, but increased in seven. The highest growth was recorded in the region G22 - Pomorskie. The decrease occurred in the region A16 - Opolskie.

5. SPATIAL ANALYSIS OF RISK OF DEATH AND THE SO-CALLED PROFITABILITY REGIONS

Cluster analysis was made separately for the two moments in time. The first grouping was made for the implementation of variables evaluated on the basis of data from the years 1998/1999. Then the analysis was repeated using the estimated value characteristics based on data from the years 2002/2003. This approach allowed the analysis of the changes that have occurred in the period of 5 years. Segmentation was based on the Ward's algorithm for 16 regions with 5 above described variables. Before cluster analysis all variables were standardized. Standardized values of variables for the years 1999 and 2003 are summarized in Tables 7 and 8.

Table 7. Values of the variables after standardization - 1999.

No	Region	Code	Variables				
			Var1	Var2	Var3	Var4	Var5
1.	Dolnoslaskie	D02	0,42444	-0,69190	0,20189	0,20266	-0,93721
2.	Kujawsko-Pomorskie	C04	-0,54571	-0,04596	0,20189	0,06755	-1,53759
3.	Lubelskie	L06	0,42444	0,03513	0,20189	-0,87818	0,90580
4.	Lubuskie	F08	-0,54571	-0,48218	0,20189	0,06755	0,26354
5.	Ludzkie	E10	2,36472	1,69470	0,20189	-0,33776	-0,26703
6.	Malopolskie	K12	-0,54571	0,16236	0,20189	1,46363	0,55674
7.	Mazowieckie	W14	1,39458	2,51679	1,81704	-1,28349	-0,96514
8.	Opolskie	O16	0,42444	-0,97432	-1,41325	1,19342	1,74353
9.	Podkarpackie	R18	-1,51585	-0,65135	-1,41325	0,96825	0,51486
10.	Podlaskie	B20	0,42444	-0,58144	0,20189	-1,23845	0,17976
11.	Pomorskie	G22	-0,54571	-0,69469	-1,41325	1,05832	-1,30023
12.	Slaskie	S24	0,42444	-0,46260	-1,41325	1,23845	-1,02098
13.	Swietokrzyskie	T26	0,42444	-0,24869	0,20189	-0,96825	1,43636
14.	Warminsko-Mazurskie	N28	-1,51585	-0,88064	0,20189	-1,28349	0,09599
15.	Wielkopolskie	P30	-0,54571	-0,03897	0,20189	0,60797	-0,65797
16.	Zachodniopomorskie	Z32	-0,54571	1,34377	1,81704	-0,87818	0,98957

Source: Author.

Table 8. Values of the variables after standardization - 2003.

No	Region	Code	Variables				
			Var1	Var2	Var3	Var4	Var5
1.	Dolnoslaskie	D02	-0,08979	-0,32404	0,03946	-0,40693	0,72628
2.	Kujawsko-Pomorskie	C04	-1,32121	-0,09912	0,03946	-0,16123	0,14175
3.	Lubelskie	L06	-0,70550	-0,43362	0,03946	-0,49906	0,56188
4.	Lubuskie	F08	-1,32121	0,02775	0,03946	-0,03839	0,68061
5.	Ludzkie	E10	0,52592	0,69098	2,74521	-0,86760	0,20569
6.	Malopolskie	K12	0,52592	0,34495	2,74521	0,05374	1,21947
7.	Mazowieckie	W14	-0,08979	-0,45669	0,03946	-1,02115	0,50708
8.	Opolskie	O16	-0,70550	-0,18563	0,03946	-3,07881	0,97288
9.	Podkarpackie	R18	-1,32121	-0,19140	0,03946	0,11517	0,46142
10.	Podlaskie	B20	-0,70550	0,21230	2,74521	-1,45111	1,20121
11.	Pomorskie	G22	-1,32121	-0,07605	0,03946	-0,28408	1,56653
12.	Slaskie	S24	-0,08979	0,17770	0,03946	0,29944	0,32442
13.	Swietokrzyskie	T26	-0,08979	-0,44515	2,74521	-1,20542	1,42040
14.	Warminsko-Mazurskie	N28	-1,32121	-0,04145	2,74521	-1,91178	0,26962
15.	Wielkopolskie	P30	-1,32121	-0,09336	0,03946	0,26872	0,19655
16.	Zachodniopomorskie	Z32	-0,70550	0,09119	-0,77227	0,42228	1,00941

Source: Author.

Dendrograms showing the final results of the segmentation procedures are presented on the next page.

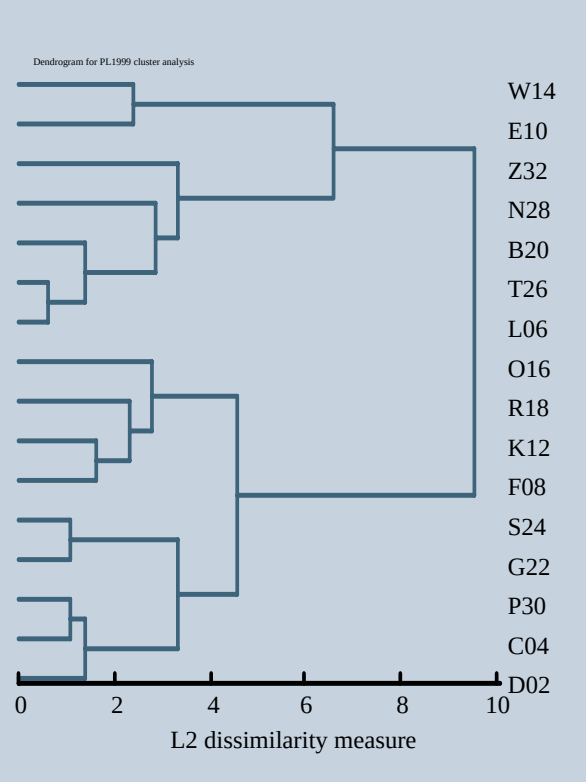

Figure. 1. Clusters for the regions – 1999. Source: Author.

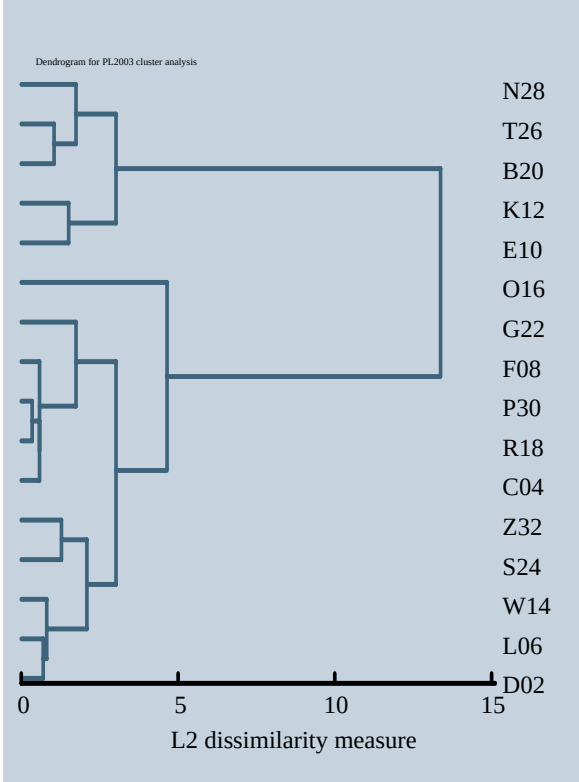

Figure. 2. Clusters for the regions – 2003. Source: Author.

There has been a change in the similarity of the regions due to the value of the analyzed variables within the period of 5 years. Presented clusters differ. The allocation of regional groups (clusters) has changed in the period under review. For example, at the level of similarity measure equal to 6 in 1999 is subdivided into three clusters. With the same similarity measure in 2003, the regions can be grouped into two clusters. Extracted at a fixed level of similarity measurement areas (clusters) and regions belonging to them are summarized in Table 9. The extracted regions could be characterized by different risk of death. Therefore life insurance companies might implement the proposed approached to risk based pricing strategy. However before the implementation the influence has to be proved. If there is an influence on overall profitability of life insurance contract the regions could be so-called profitability regions. To show the possible effect of regional risk differentiation on the life insurance contract effectiveness Moffet approach is used. The results are shown and described in the next section of the paper.

Table 9. Grouped regions.

No	Regions	Code	Regions	Code
	1999		2003	
	Cluster I		**Cluster I**	
1.	Mazowieckie	W14	Warminsko-Mazurskie	N28
2.	Lodzkie	E10	Swietokrzyskie	T26
	Cluster II		Podlaskie	B20
1.	Zachodniopomorskie	Z32	Malopolskie	K12
2.	Warminsko-Mazurskie	N28	Lodzkie	E10
3.	Podlaskie	B20	**Cluster II**	
4.	Swietokrzyskie	T26	Opolskie	O16
5.	Lubelskie	L06	Podlaskie	G22
	Cluster III		Lubuskie	F08
1.	Opolskie	O16	Wielkopolskie	P30
2.	Podkarpackie	R18	Podkarpackie	R18
3.	Malopolskie	K12	Kujawsko-Pomorskie	C04
4.	Lubuskie	F08	Zachodniopomorskie	Z32
5.	Slaskie	S24	Slaskie	S24
6.	Podlaskie	G22	Mazowieckie	W14
7.	Wielkopolskie	P30	Lubelskie	L06
8.	Kujawsko-Pomorskie	C04	Dolnoslaskie	D02
9.	Dolnoslaskie	D02		

Source: Author.

6. EFFECTIVE RATE OF RETURN OF LIFE INSURANCE CONTRACT

The characteristic of distribution of probability of death was used as a general factor of merging regions. However Moffet proved that the effective rate of return on life insurance seen to be related to the consumer's subjective probability of survival. There is an obvious relation between probability of death (q) and the probability of survival (p) where q=1-p. Moffed in his research introduced new approach to the topic of life insurance based on matrix analysis. The life insurance contract[8] in the year t^{th} could be written as the following vector:

$$[P+V_{t-1},Q,V_t], \quad (2)$$

where:
P- premium,
Q – face amount,
V_t – cash value available at the end ot the t^{th} year.

[8] D.Moffet, *An analysis of the Demand for Life Insurance: Mathematical Foundations*, The Journal of Risk and Insurance, Vol. 46, No.2 pp.96

Application of the *principal of equivalence*[9] yields the following expressions for the effective rate of return r_t:

$$r_t = \left[\frac{(1-p_t)Q + p_t V_t}{P + V_t} - 1\right](100), \qquad (3)$$

where:
p_t – policyholder survival probability in the year *t*. Using the above formula Moffet calculated the rate of return on an example of the $10.000 whole life insurance policy issued for a male age 22, at an annual premium of $101. The rate of return is sensitive to the probability of survival. The same example is used to show the influence of the probability of survival calculated separately for polish received clusters. The results are shown in table 10.

Table 10. Rate of return for received clusters – 2003.

t	V_t	p_t	r_t (%)	Cluster I		Cluster II		Difference
				p_t	r_t(%)	p_t	r_t (%)	
1	0	0,99814	-81,6%	0,99884	-88,5%	0,99892	-89,3%	0,8%
2	0	0,99811	-81,3%	0,99880	-88,1%	0,99888	-88,9%	0,8%
3	0	0,99809	-81,1%	0,99877	-87,8%	0,99884	-88,6%	0,8%
4	0	0,99807	-80,9%	0,99875	-87,6%	0,99881	-88,2%	0,7%
5	60	0,99804	-21,3%	0,99872	-28,0%	0,99877	-28,5%	0,5%
6	150	0,99801	5,3%	0,99868	1,2%	0,99872	1,0%	-0,3%
7	250	0,99797	7,5%	0,99862	5,0%	0,99866	4,8%	-0,2%
8	360	0,99792	8,3%	0,99854	6,6%	0,99858	6,5%	-0,1%
9	460	0,99787	4,2%	0,99842	3,0%	0,99848	2,9%	-0,1%
10	570	0,99781	5,3%	0,99829	4,5%	0,99836	4,4%	-0,1%
11	680	0,99775	4,5%	0,99814	3,9%	0,99823	3,8%	-0,1%
12	790	0,99763	3,9%	0,99796	3,6%	0,99808	3,4%	-0,1%
13	910	0,99760	4,6%	0,99776	4,4%	0,99790	4,3%	-0,1%
14	1030	0,99749	4,1%	0,99755	4,1%	0,99770	3,9%	-0,1%
15	1160	0,99736	4,6%	0,99731	4,7%	0,99748	4,5%	-0,1%
16	1280	0,99720	3,4%	0,99705	3,5%	0,99723	3,4%	-0,1%
17	1420	0,99699	4,7%	0,99678	4,8%	0,99694	4,7%	-0,1%
18	1550	0,99675	3,7%	0,99647	3,9%	0,99663	3,8%	-0,1%
19	1690	0,99647	4,1%	0,99614	4,3%	0,99628	4,2%	-0,1%
20	1830	0,99616	3,9%	0,99578	4,1%	0,99589	4,1%	-0,1%

Source: D. Moffet. op.cit. pp.97 and own calculation for cluster I and cluster II.
In general the differences are not so significant however the rate of return varies by received clusters. The smaller probability of survival the higher rate of return. It could be seen that the rates are higher in terms of cluster I.

[9] The paradigm of traditional life insurance is the so-called principle of equivalence, which is based on the notion of risk diversification in a large portfolio under the assumption that the future development of interest rates and other relevant economic and demographic conditions are known.

7. CONCLUSIONS

The Polish life insurance industry has grown rapidly during the transition period. The changes concern almost all life insurance aspects, especially the level of competition. The number of companies raised more then eight times in comparison to 1991 when new reforms were implemented. Life insurance companies should constantly improve their competitiveness to attract more costumers. The negative influence of financial crisis and the final lost of trust to life insurance companies also caused the need for new strategies of life insurers. One of the new approach to the costumers could be risk based pricing. Currently life insurers differentiate premiums by sex. The results described in the paper proved that the premiums could also be differentiated by regions. However, first the demographic study is needed. There is no need to calculate premiums separately for each regions of particular country owe to the level of risk of death which is similar for some regions. Therefore, before the premium calculation the regions could be merged in to so-called profitability regions. Seems that cluster analysis is really useful to do that merging. However the variables chosen for the study are always disputable and the final result of merging depends on the kind of variables used to compare the regions. The main intention of the author of the paper was to show the possible direction for life insurers in terms of risk based pricing. The study shows that the similarity of probability of death distribution allows to create two clusters (profitability regions). Implementation of that approach also has an influence on the rate of return on life insurance. Hence the results of the study should be in a scope of interest of life insurers. There is also no legal limitations. According to polish insurance law insurance companies are obliged to collect statistical and actuarial data which then might be use to calculate insurance premiums and eventually to the process of premium differentiation. Only the differentiation of the premium by pregnancy and maternity is formally prohibited.

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SERVICE-ORIENTED ELECTRONIC TOWNSHIP GOVERNANCE: CASE STUDY ON STREET LIGHT MAINTENANCE SYSTEM IN TAIWAN

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ABSTRACT

For many years in Taiwan's local government, especially on the level of township street light maintenance keeps at the traditional manual operation manner. It has significant difference to the underlying goal of electronic government (e-government) general policy and cannot effectively approach public sector service-oriented task. The existing study, however, seldom discussed on the computerised civil convenience-oriented service systems of the townships which involve in some research fields i.e. enterprise, government, and social community. The authors of this article were taking the experience and knowledge about participate the electronic civil administration system to combine with the literature, the analysis and integration on the questionnaire to the resident in the townships. The conclusion above wishes to offer the academician and government decision makers the reference on promoting electronic civil administration and the follow-up study.

Keywords: Electronic government (e-government), Electronic civil administration, Township office management, Outsourcing of public-sector services.

INTRODUCTION

In the past years, the experience of civilians waiting for public services often time-consuming that even much slower than taking public obligations. Insufficient transparency, inefficiency and ineffectiveness often were blamed on the whole service procedure. Despite the concept of electronic governance (E-governance) is becoming an important role in the existing governance (Kieran and McDonagh, 2006), many of previous literatures were emphasis the quality of website design and connectivity (Reichheld et al., 2000a, 2000b.), influence of democratization (Lowndes and Sullivan, 2004), and local welfares (Granberg, 2008). Later, Deliotte and Capgemini (2008) proposed that two sub-dimensions of E-governance effectiveness were conducted to ease administrative load and inhabitants' satisfaction respectively. Above these studies, however, were only focused on European countries E-governance development instead of aimed at specific administrative work. In addition, previous works were more concerned about the level of E-governance policy-making (RDEC, 2003), a conceptual framework (Kumar et al, 2007), and nation's information communication and technology (ICT) infrastructure construction (Colesca and Loliana, 2009). Fewer described that the level of local government carrying out E-governance administrative

measures in addition to Keiran and McDonagh (2006)'s study on a county authority undertaken public service modernisation in E-governance.

This article is aiming at the town level E-governance based a specific case of the electronic street lights maintenance system (ELMS) implementation. A failed street lamp may cause public safety and traffic accident problem in the region. Without doubt, quick response under fault condition of failed street lamp is worth to make effort administrative work. This study is surveying numerous representative townships where have using ELMS experience through residents' perspective on this specific E-governance administrative that revealing some implications as the reference to the subsequent study.

METHODOLOGY

Sampling

The survey areas covered 3 townships where are employs ELMS more than 4 years in Taiwan. In an attempt to explore impact of using e-service in ELMS, the survey respondents are town resident. Every questionnaire items on Likert 5-point scale and the options description is depend on dimensions. The survey period is from 2009/12/1 to 2010/1/31, and 390 questionnaires were issued. For precisely measuring, prior to this survey, has excluded invalid questionnaires as well as interviewee who are not willing to answer. Thus, 280 valid responses (approximately 72%) were conducted with *face to face* interview.

Variable selection

In order to measure the value of services in town's using ELMS, this article classifying *service content* dimensions which developed by Ruiz et al. (2007) as follows: service quality, service equity, confidence benefits, perceived sacrifice, service value, customer satisfaction and repurchase intensions. Part of the dimensions in the study that can be interesting derived from the last 'repurchase intensions' that may certain interpret the support extent of town residents for incumbent town managements.

RESULT

Table 1 shows the perspective of town resident opinions on service content after towns ELMS using. The study KMO value is 0.76 and the Barlett test is significant revealed ($p<0.001$). In the dimension of *service quality*, the interviewees are general satisfaction with ELMS implementation (35%) and what is more 'extremely satisfied' with ELMS having 18.9%. In the section of *service equity*, 42.3% comments agreed that they are being treated fairly whilst meet the trouble about street lamp failed since ELMS operation. The general comment on *confidence benefits* is occupied 57.8% as recognize town residents have a strong confidence in ELMS service. Whilst asked about town residents whether they have experiencing be trade-off to get the new-style service, 63.6% comments considered that they have not *perceive sacrifice* on ELMS. 37.5% regard ELMS as 'worthy' as even 30.7% as 'absolutely worthy' on the dimension of *service value* perception. In the section of *customer satisfaction*, most of interviewee is extremely satisfied with ELMS (45.7%). Interestingly, whilst asked about *repurchase intentions* interpreted as 'reconsider incumbent management'

or their political organization in the next town election, despite more than half expressed they will support it, however, not significant enough compare to other dimensions.

Table 1. Questionnaire result after towns implementation of ELMS

Sample items	Frequency	Percentage(%)
Service quality		
Satisfied	98	35
Extremely satisfied	53	18.9
Service equity		
Upgraded	120	42.3
Confidence benefits		
Have it	162	57.8
Perceive sacrifice		
Not much	178	63.6
Service value		
Worthy	105	37.5
Extremely worthy	86	30.7
Customer satifaction		
Extremely satisfied	128	45.7
Satisfied	88	31.4
Repurchase intentions		
Will re-buy	98	33.2
Absolutely will re-buy	62	22.1

IMPLICATIONS

Accretion 'electronic' concept of existing civil services

Taiwan has been started E-Government Program since 1997. The initial stage of the program is strengthening ICT network infrastructure environment (Wu, et al, 2002). The major goal of E-Government program is to establish 'competent' and 'competitive' government (RDEC, 2003). After over 10 years with ICT infrastructure development, Taiwan, as well as Sweden, was ranked 9th among the 34 countries and region on the World e-Government Ranking survey by Institute of E-Government at Waseda University, Japan, in 2008 (Obi, 2008).

The sector of township level, in practical terms is frequently limited to budget unequal distribution. The township level formulating fiscal policy regularly under the factions (*paixi*) pressures especially wrestling in the town council. Faction in the town level is mostly maintains good relationships with the ruling party due to interacting the interests instead of royalty (Rigger, 1999). In addition to the civil service recruited through public competitive examinations, more township employees employed by faction supports included managements of town office. Hence, compared to the superior level, town level policy implementation is must be more closely local needs that are also performed faction demands. The subjective and objective conditions of electronic services is just right to fit the township management are paying attention on administrations *as can be seen* (fig.1).

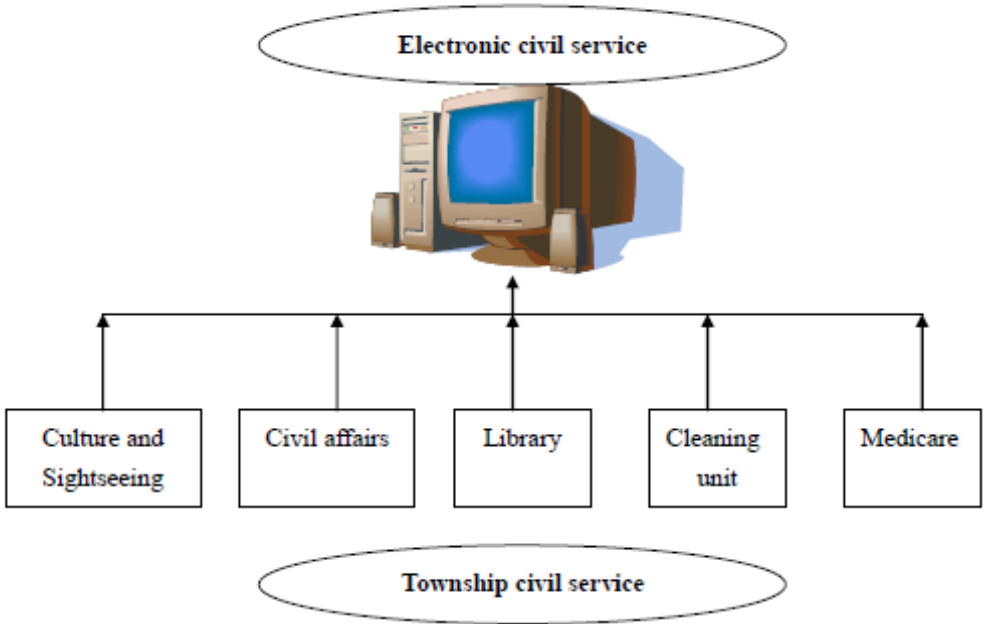

Figure 1. Accretion 'electronic' concept of existing civil services

Therefore, the quality of street lightening is spontaneously become a prime issue of public concern. Under the traditional manual operation of repairing failed street lamp had to take about a week. On the other hand, while the electronic street lights maintenance system started operations that is shortened from a week to 3 days. Consequently, on this survey, service value, service quality, confidence benefits and customer satisfaction have positive significant so as to repurchase intensions has also significant effect. Once town residents are satisfying the public convenience-oriented services, town managements is also improving its support degrees. Due to voter intention is susceptible to various cause, township governance needs attract their attention with the help of the exhaustive approach to covered administrations.

User satisfaction with contemporary governance

Upon the period of the martial law ruled, due to lack of checks and balances system, Taiwanese people were only simply accepted the public services instead of response its contents effectively. Rising awareness of the public services quality after democratic trend makes the ruling management could not disregard the voices from the rank-and-file. Needless to say that township governance is no exception to the trend. The representative assembly of the commission voted by town residents is responsible to supervise the township management and administrative procedure. The public opinion, furthermore, is turning into a functional approach to direct supervision of the government administration as figure 2 shows.

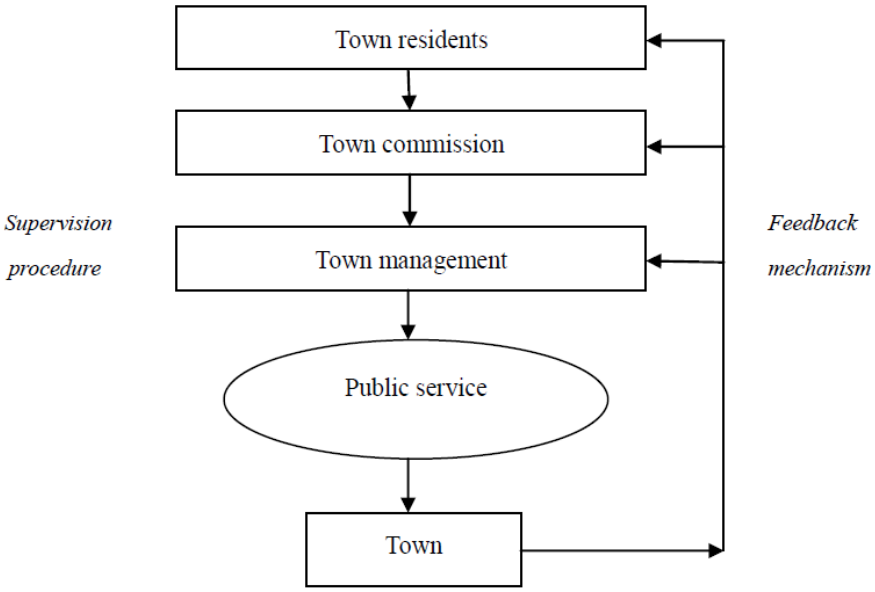

Figure 2. Supervision procedure and feedback mechanism of public services in the township governance

After the electronic street lights maintenance system implementation, besides it has shorten the repairing period, the fruitful result is provided an initiative service the user may check the failed street lights lamp repairing process online instead of queue wait to be processed. No doubt that strengthens confidence benefits of the town residents' mind. It also coincidence with '*Increased user value and satisfaction*' proposed by Codagnon and Boccardelli (2006) in eGep Measurement Framework Analytical Model.

CONCLUSION

This article is having outlined the positive impact of ELMS in the town level governance. As a part of the public services, the *quality* issue determines resident satisfaction in to some degree. The stakeholders, including town resident and its management, both are improving the merit in E-governance implementations. Due to the subject limitation, this study is only focuses on the effect of town office introduces street lights maintenance system. In addition, other kind of public services affection in terms of electronic assistance can be discussion subsequently in the future.

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DEVELOPING THE RESEARCH MODEL OF INTERNET BANKING CUSTOMERS' LOYALTY

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ABSTRACT

The growing of the internet brings a challenge to banking. In order to maintain its competitive edge, banks develop internet banking services. And in order to build a successful internet banking services, banks need to know how to attract customers whom continuously use their service. The purpose of this study intends to develop a research model based on the commitment-trust theory to explore the factors influencing the customers' loyalty of internet banking. The results of this study indicate that shared values, communication and system security have a positive impact on the trust of customers; relationship benefit, customers' authorization, and customer trust have a positive impact on relationship commitment. Trust and relationship commitment from customers have a positive impact on the retention of customer in using of internet banking; customer retention and customer satisfaction have a positive impact on customer royalty. The future work of this study will conduct a survey research to collect the data from internet banking customers and use SEM statistical technique to validate the reliability and validity of the measurement and validate the research model and hypotheses.

Key words: Internet Banking, Relationship Commitment, Customers Royalty.

INTRODUCTION

The popularity of the Internet has introduced a new access of promoting products and services provided to corporations, yet it also brings a challenge to them. For banks which have highly adapted information technology to their banking system, the impact can be enormous. In order to maintain their competitive edge and follow the trend, more and more banks now develop Internet banking services. Since the cost of internet access is low and most web interfaces and features are easy to imitate, most banks provide similar internet

banking services. As a result, there are more options for customers to choose from. If they are not satisfied with an internet banking service, they can always find a substitute easily.

The report " A survey of Internet banking service usage in Taiwan" conducted by 104.com indicates that the population of internet users above the age of 18 who has experienced internet banking service in 2008 was 72.7 % of the whole population. Compared with 53% in 2007, it has increased nearly 20 per cent. And the percentage of internet users who experienced internet banking service within the last 6 months is 61.1%. From the information above, we can understand that along with the massive development of internet, internet banking is also developing in a fast and massive way. However, banks only retain 60% of the population of internet banking users. Therefore, how to be niche in order to attract more customers and to retain them in using the service has became a challenge for most banks.

The Commitment-Trust Theory (Morgan and Hunt, 1994) indicates that during the process of relationship exchange, commitment and trust are the key success factors. This study use Commitment-Trust Theory to discuss the impact on customer retention using a banking service from commitment and trust perspective. Furthermore, relationship quality is formed by trust, satisfaction, and commitment (Dwyer et all., 1987; Grove et all., 1998., Wulf et all., 2001). The relationship between customers and banks can be measured by the three aspects above.

Michael (2002) considers quality, customers' satisfaction and loyalty as a series of reason-result relations. They are considered as one unit to be managed and evaluated. And service quality, customers' satisfaction, and customers' loyalty are a part of customer relationship management. Through customer relationship management, corporations can handle customers' information efficiently in order to establish a longer two way relationship with customers. Hence, increase the loyalty of customers to corporations. The result of a sustainable customer loyalty can be great, chronic and profitable. The longer the loyalty from a customer, the more profits a corporation can gain from it.

Through customer relationship management, a corporation is able to establish a longer relationship with customers. Therefore, our research adopts part of customer management relationship into our study. Hopefully we are able to result a better explanation of the factors which influenced customers' retention in the use of internet banking service.

From all the perspectives above, our research focuses on issues of the percentage of users which continue using internet banking services and factors which are able to influence the retention and loyalty of customers using internet banking. We are going to find out whether customers can be committed to establish a relationship with a bank due to the features of internet banking services provided. After that, testify the degree of relationship commitment to the influence of customers' retention in using internet banking services. On the other hand, from the perspective of customer relationship management (CRM), we are going to find out whether the service provided by internet banking is able to satisfy its customers. Also, this study tries to find out whether customer satisfaction has something to do with customers' retention in using internet banking services. We hope the outcome of this research can be part of the references of the future of internet banking service development in Taiwan.

Here are the purposes of this research:

(1) From a relationship commitment point of view to explore customer retention in the use of internet banking services and have a further discussion of the influences which affect customer loyalty to it, and establish a research model.
(2) From different perspectives of CRM exploring factors which affect customers' loyalty to internet banking services.

THEORETICAL BACKGROUND

Relationship Commitment

According to the definition of commitment given by scholars, it is an interaction dominated by obligations. These obligations may be mutual, or self-imposed, or explicitly stated, or may not. Distinction is often made between commitments as a member of an organization (Dweyer et al., 1987; Moorman at al., 1993). Other scholars, however, considered commitment as an interaction in a partnership as a continuing desire to maintain a valued relationship (Morgan and Hunt, 1994; Mactintosh and Lockshin, 1997). Wulf et al (2001) indicates that this continuing desire to maintain a valued relationship keeps consumers willing to retain a certain consumer-retailer relationship. Morgan and Hunt (1994), moreover, raised Commitment-Trust theory. They believe that the key successful factors of relationship marketing are relationship commitment and trust. Since trust and commitment enable both consumers and retailers to (1) work harder to maintain a valued relationship; (2) focus on a long term benefit instead of a short term advantage; and (3) have mutual trust between each other that would avoid opportunistic behavior by either of the parties. Therefore, one party considers the there is a lower possibility of another party taking a new action. It is the model of Key Mediating Variable (KMV) which acquires that commitment and trust enables the success of relationship marketing.

Trust leads to commitment, and commitment leads to a greater possibility of customer retention which increases the possibility of relationship retention (Garbarino and Johnson, 1999). Therefore, our research indexes Trust and Commitment to measure customer retention using an internet banking service.

As we all understand, commitment is the key feature of continuing a good relationship. It can also be considered as a positive feedback from customers retaining cooperation with a firm. Customers gradually form a psychological attachment to certain websites is seen as a relationship commitment. It only exists when customers are willing to continue the relationship with these websites (Gruen et al., 2000). Relationship commitment can be used as a method to discuss the impact after customers started to build up a relationship with internet banking services, thus, to measure customer retention using internet banking services. Followed by the discussion of Vatanasombut et al (2008), our research employs relationship benefit, shared values and communication as external factors to discuss whether these factors can influence customers' commitment to continue using internet banking services and trust of internet banking services.

The study of Trust has been discussed and explored in various fields, including: Psychology, Sociology, Economics, and Marketing. Trust is often considered as a key factor of

establishing a successful relationship (Berry, 1995; Dwyer et al, 1987; Moorman et al, 1993; Morgan and Hunt, 1994). Moorman et al (1993) defined trust as a will of retaining a relationship with a trustworthy partner due to a partner's professionalism, reliability and will. Morgan and Hunt (1994), on the other hand, defined trust based on the recognition of honesty and reliance to a partner. We simply organized the related literature reviews of trust as below: Trust is when a party believes in another party's commitment and thinks he is trustworthy. Even in an unpredictable condition, the party still believes another party is able to finish his commitment with honesty and a positive will (Grazioli and Jarvenpaa, 2000). For example, a trust in a customer means he has faith in a supplier (Crosby et al, 1990; Gefen, 2000). Aside from this, Trust comes when a company believes under certain conditions a customer shows the ability of reliance, security and faith (Grandison and Sloman, 2000). Gefen (2000) in his research discovered in many cases that the trust of customers comes from the interaction between suppliers. If a supplier's action is expected by customers and a supplier achieve these expectations. It increases the trust from customers to suppliers, even though suppliers are not able to guarantee they are going to act the same way in the future.

There are three constructs of Trust: Ability, Benevolence, and Integrity (McKnight and Chervany, 2002; Mayer et al, 1995). McKnight and Chervany (2002) added predictability as another construct aside from the three. However, Mayer et al (1995) advocated predictability should be excluded from the constructs of trust. He thinks that if the cooperated party is given a high predictability, this party might ignore others needs and only focus on his own benefits. As a result, the party is not trustworthy.

Our research adopts the view from Mayer at al (1995), emphasis that when customers are doing commercial activity with suppliers, if they have uncertainties toward suppliers, it can leads to a negative impact on retention the commercial activity (Gefen 2000).Uncertainties appear when customers eager to understand supplier's actions but they are not able to do it because suppliers are seen as a individual, its actions cannot be control. This influences customers' retention. If suppliers are not able to reduce the condition, the commercial activities between the two parties cannot last. Establishing trust between the two is the only efficient way of doing commercial activities (Gefen, 2000; Hart and Saunders, 1997).

Dealing issues related to Trust has become more important on internet banking services than traditional banking (Ratnasingham, 1998). Since internet banking considered as a risky and unsecured trading environment, users find it difficult establishing trust without contractual or guarantee protection (Grazioli and Jarvenpaa, 2000; Crosby et al, 1990). In addition, the leak of personal information could happen when a web without proper internet security. As a result, opportunists are able to access the information. This also adds the risk for internet banking service, since most of the trades done on the web. Moreover, when users are doing trading on the web, they are not able to see a physical trading, so they are not able to observe another party's behavior to determine if he is trust-worthy or not. This is also a factor of uncertainty (Clarke, 1997). We can put this way- trust is a key factor determines the growth of internet banking service.

Customer Relationship Management (CRM)

According to Kalakota and Robinson (1999), Customer Relationship Management (CRM) is a series of actions developed under strategies of Integrated Sales and Marketing, and service tactics. Under the integration of corporations with procedures and technology, to find the real needs from customers while require the internal of corporations to improve their services to contribute to customer satisfaction and loyalty to corporations.
The concept of customer satisfaction was proposed by Cardozo (1965), indicated that the increase of customer satisfaction leads to more consume behaviors; Howard and Sheth (1969) was the first scholars adapted consumer satisfaction to consumer theory. They considered customer satisfaction as a mental condition outcome when a customer thinks what he pays and what he receives is cohesive and reasonable. Oliver (1981) believed that customer satisfaction is a reaction comes from the surprise after consumer purchasing goods. Churchill and Carol (1982), on the other hand, considered customer satisfaction as an outcome from purchasing and using products. It comes from the comparison of expectations and the real results from consumers.

Fornell (1992) mentioned consumer satisfaction is an evaluative feeling comes from customers' comparison with their expectation before purchasing and the result after purchasing. Before the purchasing, customers might have an assumption that they would be satisfied and content with the products or services; however, they might actually feel dissatisfied with the products or services. Kotler and Scheff (1996) regarded consumer satisfaction as a function represents the difference between a customer's expectation and the real result he receives; Reichheld and Sasser (1990) believed customer satisfaction increases customer loyalty. It could also increase the purchasing retention from customers. Kotler and Scheff (1996) also believe customers with higher customer satisfaction are easy to develop an emotional attachment to a certain corporation, enables the corporation gains more customer loyalty.

Michael (2002) considered customer satisfaction, customer loyalty, and quality are a series of cause and effect. They depend on each other. So, they have to be evaluated and managed as a unit. Not only saving the cost, customer loyalty is able to create a long term and continuous profits to a corporation. In other words, establish a company with higher customer loyalty benefits the company with an accumulative and positive return (Griffin, 1995).

Trust can be divided to the trust before trading and the trust after trading (Singh and Sirdeshmukh, 2000). The trust before trading can influence the customer satisfaction after trading. Customer satisfaction accumulates from the past trading experiences. As a result, its accumulative degree of trust can also influence customer satisfaction towards corporations.
From the past researches, there were various views toward the definition for customer retention and fields it covered. Some researches believed customer retention is the outcome of attitude. For instance, Jones et al (2000) redefined customer retention as a repurchase intention in their customer retention research. Other researches considered customer retention is simply an outcome of behavior, which means a repetitive purchasing behavior to suppliers (Hennig-Thurau and Klee, 1997). For example, Bolton (1998) redefined customer retention as a continual relationship between customers and corporations in his study of Customer Satisfaction to Mobile Phone corporations. There are other researches believed customer

retention contains two standpoints: Behavior and Attitude. Gerpott, Rams, and Schindler (2001) defined customer retention as an activity retains the trading between customers and suppliers. It can be carried out by two approaches. (1) A continuous contractual relation between customers and suppliers or repurchasing. (2) The idea of giving up a continuous contractual relation or reconsidering purchasing in the future.
Our research adopts the view that customer retention includes Behavior and Attitude. After integrating the literature reviews above, we defined customer retention as customer retention in using internet banking services and the remaining degree of customer retention in using internet banking services.

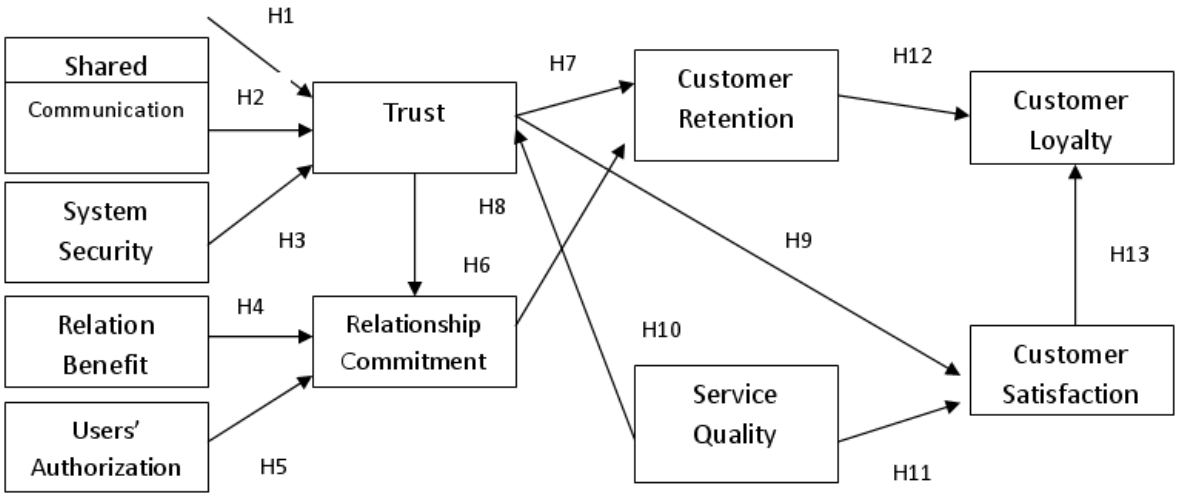
RESEARCH MODEL AND HYPOTHESES DEVELOPED

Research Model Developed

This study mainly explored the factors which influence customer retention and customer loyalty after customers using internet banking services. The research models can be divided to two parts: First, discussing whether shared values, communication, system security, and service quality are able to influence customers' trust. We are also going to discuss whether relationship commitment can be influence by trust, relation benefit, and users' authorization. In addition, we are going to discuss if relationship commitment is able to affect customer retention, and if customer retention can influence customer loyalty.

Second, discussing whether trust, service quality are able to influence customer satisfaction. After that, we are going to discuss whether trust and relationship commitment can influence customer retention, and customer retention can influence customer loyalty. The models of our research are shown as figure 1.

figure 1 Research Model of Internet Banking Customers' Loyalty



Research Hypotheses Developed

(1). Shared Values

Morgan and Hunt (1994) considered the higher the share values is, more positive effect it can bring to the trust between two parties. Hart et al (1986) also discovered that Shared Values is a key factor that brings trust to customers. Sitkin and Roth (1993) believed Shared Values is a sign of trust. Since each individual has different values, each individual might have different of views. If individuals are not able to share their values, they are not able to trust each other. They distrust each other. Based on the inference above, we propose the hypotheses as follows.

> H1: The Shared Values from internet banking services to customers has a positive effect on customers' trust to internet banking services.

(2). Communication

Communication increases the reliability, instant, and accuracy of information sharing. It is also a key factor of trust (Morgan and Hunt, 1994). Communication solves argument and adjusts the expectation and values between both parties so that it creates trust between both parties (Etgar 1979). In E-commerce, customers develop trust toward corporation when corporations give instantly feedback to their problems, provide a secured trading environment, and provide new products information to them, or give them notice before the system has to be repaired. Based on the inference above, we raise our hypothesis:

> H2: A good communication between internet banking services and customers has a positive effect on customers' trust to internet banking services.

(3). System security

Kini and Choobineh (1998) defined trust in E-commerce as an ability which believes in the capability, reliance, and safety of a higher risky environment. They pointed out system security is a key factor which affects trust in E-commerce. System security in internet banking services usually refers to a system wins customers' trust when it is able to protect and secure customers' personal information during on line trading. Based on the inference above, we propose our hypothesis:

> H3: The system security of internet banking services has a positive effect on customers' trust to internet banking services.

(4). Relationship Benefit

Vatanasombut et al (2008) indicated when products meet customers' need, it can reach to an expected profit. Relationship benefit only happens when customers think the products are valuable to them and it is synchronized. For instance, Web ATM mechanism provides services such as free transmission, instantly checking personal banking account's details and orders, even apply for any loans. Corporations which able to provide higher relationship benefit are more likely to develop relationship commitment with customers. Based on the inference above, we raise our hypothesis:

H4: Relationship benefit provided by internet banking services to customers has a positive effect on developing relationship commitment with customers.

(5). User Authorization

Vatanasombut et al (2008) believed User Authorization as banking authorizes customers more conveniences to control trading with banks. This comes from service satisfaction's aspect which is very different from marketing's point of view. Internet banking services provide customers doing trading anytime, anywhere. Even for people who are the first time users, they can pick it up easily. Kappelman and Guynes (1995) had testified user authorization. During the internet banking system was updating, the bank authorized its staff with a little right. It actually increased staff's recognition of control user authorization has been considered as a kind of perceptual control. It is also considered as a key factor in relationship commitment in Key Mediating Variable. Based on the inference above, the study proposes the hypothesis.

H5: If internet banking services is able to authorize to customers, it has a positive influence on establishing relationship commitment between internet banking and customers.

(6). Trust

Trust is very important in relationship of cooperation. Partners all do their best to contribute to their commitment to each other (Wang and Head, 2007). But one party which is more devoted is easy to get hurt by another party's action (Mayer et al, 1995). Vatanacombut et al (2008) believed, customers have to trust corporations before they commit to the relationship to them in E-commerce. Customers have to carry with a certain degree of risk after they make a commitment. Based on the inference above, our research raised our hypothesis:

H6: Trust from customers to internet banking services has a positive effect on establishing relationship commitment between internet banking and customers.

Trust takes a crucial part in internet. A complete trust is one of the successful factors in E-commerce (Coutu, 1998). Customers want to completely control their own trading based on securities. Under trust and commitment, when customers commit to corporations, it means they agree on the relationship and they value the relationship. In addition, customers believe the services their partner provides are cohesive, reliable, and helpful (Vatanacombut et al, 2008; Gefen, 2000). Based on the inference above, we raise our hypothesis:

H7: Trust from customers to internet banking services has a positive effect on customer retention to internet banking services.

Trust can be divided to before trading and after trading, the trust before trading affects customer satisfaction after trading (Singh and Sirdeshmukh, 2000). Customer satisfaction accumulates from the pasting trading experiences. Its accumulative degree of trust can also affect customer satisfaction to corporations (Zeithaml et al, 1996). Based on the inference above, we raise our hypothesis:

H9: Trust from customers to internet banking services has a positive effect on customer satisfaction to internet banking services.

(7). Relationship Commitment

According to the description of Key Mediating Variable, relationship commitment means customers value a relationship and try their best to retain the relationship. Since related banking regulations and policies state it is illegal to spread customers' information to a third party, and banks have to put the regulations in public, it helps in increasing trust from customers so they are more willing to commit to this relationship (Vatanacombut et al, 2008). Base on the inference above, we raise our hypothesis:

H8: Relationship commitment established from customers to internet banking has a positive effect on customer retention to internet banking services.

(8). Service Quality

Trust comes from the benevolence and integrity of the party which customers trade with. Customers evaluate clues from both explicit and implicit sides then gradually they increase their trust to corporations. As a result, when customers receive good services, they increase their trust to the service provider (Anderson et al, 1994). Based on the inference above, we raise following hypothesis:

H10: Service quality provided by internet banking services has a positive influence on the trust from customers to internet banking services.

Service quality refers to the service levels outcome from the interaction between service providers and their customers (Parasuraman et al, 1991). Anderson et al (1994), raised the relation of cause and effect from service quality to customer satisfaction, they considered service quality as one of the factors which affects customer satisfaction. Based on the inference above, we raise the following hypothesis:

H11: Service quality provided by internet banking service has a positive influence on customer satisfaction to internet banking services.

(9). Customer Retention

Customer retention is a very crucial link in customer relationship management. It refers to a broadly recognized, widely-implemented strategy for managing and nurturing a company's interactions with customers. But corporations mostly miss out the importance of customer retention when introducing customer relationship management. They rarely to evaluate, understand, and discuss if customer retention is possibly able to bring them any benefit (Smith, 1999). So we infer customer loyalty is influenced by customer retention. Based on the inference above, we raise the hypothesis:

H12: Customer retention in using internet banking services has a positive effect on customer loyalty to internet banking services.

(10). *Customer Satisfaction*
According to the aspect of demand, consumers' service demand forces them to purchase. If the purchased service meets the consumers' demand, they are satisfied with the service outcome (O'Reilly and Chatman, 1986; Burke and Stets, 1999). Satisfaction is considered as an evaluation of emotion. Emotion can possibly causes dependence to a service when customers are satisfied with the service (Hunt, 1977). This emotion forms the commitment to service providers. This commitment transforms to the behavior of repurchasing or loyalty. Base on the inference above, we raise the hypothesis:

> H13: Customer satisfaction to internet banking services has a positive effect on the loyalty to internet banking services.

RESEARCH DESIGN

Operational Definition of Constructs

According to all the references, we operate on those variables and workout a scale which is related to variable measurement research. After choosing appropriate questions, we rephrase them and put the questions to our questionnaire. We adopt Likert Scale (1 = strongly disagree, 5= strongly agree) to collect the result. The operational definition of all the constructs is shown as Table 1.

Instrument Design

The content of questionnaire is amended from the previous research literatures. In order to validate the content validity, we conducted a pilot test to invite two professors in information management and two senior manager of banking to revise the instruments. The constructs and number of measurement items and referred literature is shown as Table 2.

Sampling and Data Analysis Methods

The sampling frame for this study will come from internet banking users in Taiwan. They all have the experience of using internet banking services. The survey will be carried out by sending it out by the internet to our subjects. For example, posting the questionnaire on BBS or sending the questionnaire by emails.

This study will use Partial Least Squares (PLS) to validate the instrument reliability and validity, and verify the hypothesis in the research model. PLS is a structural equation modeling approach similar to LISREL, where the covariance structure derived from observed data is used to simultaneously fit measurement equations and structural equations specified in the model. Such covariance-based approaches are appropriate for areas with strong a priori theory, where theory testing and refinement are the research goals, as was the case in this study.

Table 1 Operational Definition of the Constructs

Measured Variables	Operational Definition	References
Shared Values	The understanding of customers' behaviors, objects, views of banks, and customers' understanding of banks' policies.	Morgan and Hunt, 1994
Communication	When customers are using internet banking services, they expect themselves to have good information sharing with banks.	Morgan an Hunt, 1994
Relationship Benefit	When customers are using internet banking services, they expect themselves to believe the benefit the banks can provide in their relationship.	Morgan and Hunt, 1994
System Security	When customers are using internet banking services or when they are doing online trading, they believe the system security can provide the secure they need.	Kini and Choobineh, 1998; Morgan and Hunt, 1994
User Authorization	When customers are using internet banking services, subjectively they believe the banks authorize them with more users' right.	Morgan and Hunt, 1994; Hartline and Ferrell,1996; Harrison et al, 1997
Trust	The degree of customers subjectively believes the products, services, and information provided by internet banking are reliable.	Doney and Cannon, 1997
Relationship Commitment	When customers are using internet banking services, subjectively they are willing to commit to their banks.	Morgan and Hunt, 1994
Service Quality	The feeling followed after customers browsing the web, interacting with the service system, and the services it provided.	Zeithmal et al, 1996
Customer satisfaction	The evaluation after comparing the expectation before using the services and the actual result after using the services.	Engal and Blackwell, 1994
Customer Retention	When customers retain using the internet banking system or retain using certain internet banking webs.	Kotler, J and Scheff, 1996
Customer Loyalty	The degree of customers repetitively using certain internet banking services, and the degree of trading with certain internet banking services.	Sirgy and Samli, 1985; Dick and Basu, 1994

Table 2 Measured Variables Questionnaire Content

Measured Variables	number of measurement items	References
Shared Values	4	Morgan and Hunt, 1994
Communication	4	Morgan an Hunt, 1994
Relationship Benefit	4	Morgan and Hunt, 1994
System Security	5	Kini and Choobineh, 1998
User Authorization	4	Hartline and Ferrell,1996; Harrison et al, 1997
Trust	5	Doney and Cannon, 1997
Relationship Commitment	4	Morgan and Hunt, 1994
Service Quality	4	Zeithmal et al, 1996
Customer satisfaction	3	Engal and Blackwell, 1994
Customer Retention	3.	Kotler, J and Scheff, 1996
Customer Loyalty	4	Sirgy and Samli, 1985; Dick and Basu, 1994

CONCLUSION

Internet development has totally changed consumer habits. Credit cards, physical currency, and traditional brick-and-mortar banks can no longer satisfy consumers. As a result, the financial industry started to provide internet banking services, mobile banking services and an internet ATM in order to satisfy consumers. It is crucial for the financial industry to learn how to deal with the impact the internet has brought to it. It is important to learn how to use its hardware and software resources in order to build up an internet service. However, more important is to learn how to attract and inquire consumers to use it. On the other hand, the financial service industry has to improve its operating model and affiliate with the same industry or different industries in order to confront the dramatic change of the business environment and the enormous new market opportunities the internet has brought while maintaining its competitive edge at the same time. Also, going deeper to understand consumers' needs and promoting consumer's loyalty are important for the financial service industry on the issue of profit and a long lasting business.

The purpose of this study intends to develop a research model based on the commitment-trust theory and customer relationship management theory to explore the factors influencing the customers' loyalty of internet banking. The results of this study indicate that shared values, communication and system security have a positive impact on the trust of customers; relationship benefit, customers' authorization, and customer trust have a positive impact on

relationship commitment. Trust and relationship commitment from customers have a positive impact on the retention of customer in using of internet banking; customer retention and customer satisfaction have a positive impact on customer royalty. The future work of this study will conduct a survey research to collect the data from internet banking customers and use SEM statistical technique to validate the reliability and validity of the measurement and validate the research model and hypotheses.

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A STRATEGIC ANALYSIS OF THE COMPANIES OPERATING IN THE ICT SALES AND DISTRIBUTION CHANNEL: THE EUROPEAN CASE

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ABSTRACT

The strategic role of Information and Communication Technology (ICT) is evident in the enterprises. Also Small and Medium Enterprises (SMEs) adopt ICT tools to improve their processes and products/services. Due to scarcity of resources and ICT competences of SMEs, they need the support of ICT suppliers in the ICT adoption process. As a consequence, ICT suppliers can play an important role. On the other hand, the ICT sales channel is nowadays characterized by strong dynamism. Nevertheless, little attention has been paid by literature to the business models of these operators. The goal of the paper is to provide, through 53 case studies, a detailed picture of the ICT sales channel in the European market.

Keywords: Information and Communication Technology, ICT, SMEs, strategy, ICT sales channel.

INTRODUCTION

Nowadays Small and Medium Enterprises (SMEs) are recognizing the important role that ICT can have supporting business processes but also company products and services.
ICT innovation rate is very high, ICT tools are ever more pervasive and they can create or support the companies' competitive advantages (McFarlan, 1984; Porter and Millar, 1985). This fact is true in enterprises in general but it is relevant and critic for SMEs, that do not have competences and resources to invest much in ICT and to guide the whole process of new technologies adoption (Fuller, 1996).

For these motivations ICT suppliers can play an important role for SMEs, as enablers of ICT adoption but also as generators of business innovation (Wroe, 1989; Geisler, 1992). Nevertheless, in practice, in many cases this important potential role is not completely exploited yet (Fuller, 1996).

ICT suppliers, which operate in the ICT sales and distribution channel, providing hardware, software and ICT services with enterprises, are facing a period of important changes in strategies and business models.

It is relevant for SMEs to choose the right ICT partner, with all the right characteristics and competences (Montazemi, 1988): an actor that can offer the best fitting technologies and support them in the process of adoption. Nowadays there are not models or guidelines to choose the most adapt suppliers. In literature, contributes about ICT suppliers models classification are absent.

In this context, the goals of the paper are:

- to propose a *classification framework* to analyze the *strategic positioning* (Porter, 1985) and the competences of the ICT suppliers. This framework – defined on the basis of an empirical analysis on the European market - can be useful to:
  - top management of the ICT suppliers, as a means to define strategic actions more effectively;
  - ICT vendors that sell ICT suppliers to market their products and services especially to SMEs, in recruiting and selecting the most suitable sales channel partners;
  - companies ICT decision makers (for example Chief Technology Officers, Chief Information Officers), to help understand the competences and the commercial offer of the different ICT suppliers and to select the most effective external partner for the company;
- to identify the main strategic trends in the European market.

The research uses the case study methodology to analyze 53 ICT suppliers operating in the European market. Work was carried out between January 2006 and December 2007.

THEORETICAL BACKGROUND

ICT was seen in the past mainly as a cost centre and a service – useful but not core – in support of enterprise activities. Despite the increase in ICT spending, companies that manage to extract significant business value from their ICT investments were few. In the last ten years, ICT has become an important element in enterprises processes, in the products/services distributed to the market, a lever enabling strategic and organizational projects of change and the re-definition of business models and thus a potential source of uniqueness and competitive advantage for companies (Venkatraman, 1997; Andal Ancion, Cartwright and Yip, 2003). ICT managers (called Chief Information Officers in large enterprises) are today more and more involved in strategic activities aimed at innovating products/services, enterprises processes and business models (Loebbecke and Jelassi, 1999; Sambamurthy, Bharadwaj and Grover, 2003). Researchers have began to study ICT contribute to business, in terms of value generation.

A direct linkage between ICT and firm performance was established by Powell and Dent-Micallef (1997). Bharadwaj (2000) found that high ICT-capable firms (those that invest heavily in ICT) outperform competitors that do not invest to the same extent (also see, Sambamurthy, Bharadwaj and Grover, 2003). These results suggest ICT offers firms a

competitive competency, which aids firms in differentiating themselves in the marketplace, such as through innovation.

However, since prior studies focused on the population of large and often diversified companies, questions remain as to whether these results are generalizable to SMEs (Dibrell, Davis and Craig, 2008). Supposedly, the more flexible managerial capabilities of SMEs dictate the extent of success of ICT adoption and the resulting positive effects on financial performance (Khazanchi, 2005). In this event, smaller firms should be able to more effectively utilize ICT, to exploit newer technologies than their larger, less agile competitors (Xiang and Lan, 2001; Bonk, 1996). Principally, the arguments have been that Information Technology (IT) is a resource which small firms can utilize to behave like bigger firms (McFarlan, 1984; Porter and Millar, 1985). Recognition of strategic IT utilization issues faced by SMEs is perhaps more important than those facing big businesses since SMEs drive the economies of many nations (Kyobe, 2004).

Actually, many small and medium enterprises (SMEs) try to adopt ICT to support their business. Due to their limited resources, SMEs ICT adoption is different from larger business (Fink, 1998; Thong, 1999; Welsh and White, 1981; Kyobe, 2004; Pollard and Hayne, 1998). An incorrect ICT investment decision can have devastating effect for SMEs. Therefore, they need to be very careful in their ICT investment decision-making. According to this perspective, researchers concentrated, in the past years, on ICT adoption process for SMEs. Existing literature that documents some of the drivers and barriers of ICT adoption within SMEs is very rich (Drew, 2003; Dutta and Evrard, 1999; Thong, 1999; Thong and Yap, 1996; Utomo and Dodgson, 2001; Walczuch, Braven and Lundgren, 2000; Kyobe, 2004). The drivers and barriers may come from two different sources, those from within the internal SMEs and those from outside SMEs (Sarosa and Zowghi, 2003). Knol and Stroeken (2001) underlined an important internal barrier: the lack of awareness of entrepreneurs regarding IT effects. SMEs face specific problems in the formulation of their innovation strategies due to their deficiencies arising from their limited resources and range of technological competencies (Kyobe, 2004; Tidd, Bessant and Pavitt, 1997). They have smaller budgets for IT investments than their larger counterparts (Raymond, 1985), so financial limitations have traditionally prevented SMEs from making investments in large and complex IT applications. In addition, smaller companies are historically managed and operated by personnel with rich product and domain expertise but limited IT skills (Auger and Gallaugher, 1997; Fuller, 1996). Together, these findings along with other prior researches on levels of IT knowledge in SMEs suggest that collaborative efforts with external suppliers of IT opportunities may be a good investment (Ray and Ray, 2006; Wroe, 1989; Geisler, 1992).

A much cited source for SMEs assistance in ICT adoption process is independent and impartial consultants and ICT suppliers (Fuller, 1996; Chau, 1995; Fink, 1998; Utomo and Dodgson, 2001). They could provide expertise regarding ICT value and use for SMEs.

If we focus on ICT suppliers figure, in literature it is evident that ICT providers can be a source of important ICT capabilities for enterprises, of different size. They are a lever to support enterprises innovation and change processes, through technologies innovation (McGray and Clark, 1999). They offer specialized ICT competences that increase enterprise dynamic capabilities (Lacity, Willcocks and Feeny, 1996). According to the Continuous

Innovation theory (Boer and Gertsen, 2003), this requires the ability to combine exploitation and exploration capabilities. Exploration capabilities can be enabled by ICT suppliers' experiences. Especially when a firm's internal IT (Information Technologies) capabilities are lacking, external IT capabilities represent a very effective tool to pursue organizational goals (Massey and Walker, 1999; Thong, Yap and Raman, 1996).

An important part of literature is focused on advices that can help enterprises to choose the best ICT supplier and to manage correctly the relation (for example Feeny and Willcocks, 1998; Dail and West, 2005). These contributes offer operative suggestions but they do not guide the client in the recognition of the best fitting supplier, in terms of strategy, competences and so on. This is a problem that, especially for SMEs, has to be helped in the search and selection process.

We can say that considering the important role of ICT suppliers, especially in SMEs context, the attention in literature has been focused more on the "client's perspective", analyzing the determinants of the process of suppliers selection and the benefits related to stronger relationships. A few contributes examine ICT vendors' perspectives (motivations, strategies, business models, products offered). (Hussey and Jenster, 2003; Morabito, Pace and Previtali, 2005; Rayala, 2007). The existing academic and managerial literature dealing with ICT suppliers can be classified into two main categories:

- *qualitative contributions* (Patrakosola and Olsonb, 2007; Cheng, Sheen and Lou, 2006; Curry and Kenney, 1999; Kenney and Curry, 2001; Kumar, 2006), focusing on the analysis of ICT suppliers business models, their competences, the main internal activities, and their organization;
- *quantitative contributions*, especially provided by research centers, (like Forrester Research, Reed Research Group; National Electronic Distributors Association; Isuppli Corp.; National Electronic Distribution Association; Avnet, Inacom; Kompass) focusing on the size of the ICT market targeted by the ICT suppliers, which is the focus of our the empirical analysis.

As far as the first category is concerned, the analyses have indicated a lack of contributions going beyond a "traditional classification" of the ICT suppliers business models. In fact, the majority of academic and professional contributions indicate only three kinds of players in the ICT sales and distribution channel: (i) hardware resellers that sell hardware products (for example personal computers, servers, storage systems) of well known brands (for example HP, IBM, Acer, Fujitsu Siemens); (ii) software houses that sell self-developed software applications (for example Enterprise Resource Planning systems, Customer Relationship Management applications, Business Intelligence applications, CAD, and Product Lifecycle Management systems); (iii) system integrators that customize and integrate for the company-users software applications provided by software vendors (for example Microsoft, SAP, Oracle).

As far as the second category is concerned, quantitative data and figures dealing with the size of the ICT market targeted by ICT suppliers are provided mainly by research companies.

Our research goal is to know better ICT suppliers nature, classifying their business models, understanding how they are evolving, and studying their specific competences. This is

relevant to support enterprises, especially SMEs, in choosing the best ICT suppliers. On the other hand, our research results can be useful also for ICT suppliers' management to understand how to organize their structures and competences to serve a particular area of the market.

METHODOLOGY

The present research is based on case studies, defined by Yin (2003) as "empirical inquiries that investigate a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident".
Since the objectives of the present research are to propose a classification framework to analyze the strategic positioning and competences of ICT suppliers and to identify the main strategic trends acting in the European market, this methodology seems to be the appropriate for two reasons. First, case studies provide both qualitative and quantitative results by the combination of several data collection methods (for example interviews, questionnaires, archives) (Eisenhardt, 1989). Second, the case study methodology is very suitable for description (Kidder, 1982).
When using a case study methodology, at least two different choices have to be made; first, the number of case studies to carry out (one or more than one) and second, the type of case study (explanatory, descriptive or exploratory). In the present case, multiple exploratory case studies seem to be most appropriate, since:

- we seek to describe a phenomenon which is poorly analyzed by the literature;
- despite their complexity, multiple case studies are valuable when the data is inappropriate for statistical analysis, unavailable or too expensive to collect (Andersen, 1997).

To describe the analysis conducted, we have identified the following main phases:

- research design;
- case studies implementation;
- analysis of data and interpretation of case studies evidence;
- assessment of research quality.

Research design

As suggested by Yin (2003), we first identified the study questions. In accordance with the research objectives, these questions are:

- What is the strategic positioning, that is the products/services offered and target market (Porter, 1985), of the various companies acting in the ICT sales and distribution channel?
- What are the most relevant competences related to the different strategic positioning?
- What are the main strategic trends affecting the European ICT suppliers?

As attention has to be paid to different subunits in the company, we employed the embedded (that is multiple unit of analysis) case studies which include the following roles of analysis:

- member of the strategic direction of the ICT supplier (for example Chief Executive Officer, managing director);
- manager of the sales/marketing area;
- manager of the technical area.

Case studies implementation

The concept of population is crucial, because the population defines the set of entities from which the research sample is to be drawn (Yin, 2003). A total of 53 semi-standardized interviews were carried out among European ICT suppliers. On the one hand, we leveraged a formally structured schedule comprising the following sections:

- general company information (that is turnover in the last years and trends, number of employees, location);
- commercial offer (that is ICT products and services offered, turnover distribution among the different kind of products and services);
- internal organization and competences (that is organizational units, number of employees in each organizational unit, competences of the employees);
- market scope (that is target industries, size of target enterprises, geographical target market, customer concentration);
- competitive landscape (that is main competitors, competitive positioning, competitive advantages);
- external trends (that is main economical, technological, legal, institutional trends affecting company business);
- strategic goals for the future.

On the other hand, due to the lack of information on this specific issue (as mentioned above, literature on ICT suppliers is scarce), we did not know all the necessary questions in advance and so developed, adapted and generated questions that fitted with the main research aims. In this way, we had the advantages of both standardized and non-standardized interviews.
We did not select the cases randomly, because, as noted by Pettigrew (1988), only a limited number of cases can usually be studied and it therefore makes sense to choose extreme situations and polar types in which the process of interest is "transparently observable". These were selected, then, because they conformed to the main requirements of the study, while representing both similarities and differences considered important for the data analysis.

In order to find the most interesting European ICT suppliers, three main sources of information were considered:

- the Politecnico di Milano, School of Management's ICT suppliers database containing approx. 200 entries;
- the databases of ICT sales partners provided by the main ICT vendors in Europe (that is HP, IBM, Acer, EMC2, Microsoft, SAP, Oracle);
- commercial database (that is Kompass).

The selection of the ICT suppliers to be analyzed was based on the following criteria:

- total turnover in 2006 above €4 million;
- number of references collected from 1,000 SMEs analyzed within the Politecnico di Milano, School of Management's Observatory dealing with the "ICT in SMEs"[1];

- a wide coverage of all the possible business models (in the selection phase the ICT suppliers' business models were only analyzed through secondary sources, such as Web sites and company documentation);
- availability to participate in the research project.

With these criteria, 53 European ICT suppliers were selected (see Table 1).

ICT operator	*Turnover 2006 (€ millions)*	*Employees*	*ICT operator*	*Turnover 2006 (€ millions)*	*Employees*
Company 1	400,00	2800	**Company 28**	12,00	140
Company 2	122,00	464	**Company 29**	11,00	70
Company 3	120,00	2500	**Company 30**	11,00	130
Company 4	100,00	1000	**Company 31**	11,00	60
Company 5	82,00	920	**Company 32**	10,80	114
Company 6	60,65	500	**Company 33**	10,00	25
Company 7	60,00	200	**Company 34**	9,70	88
Company 8	60,00	NA	**Company 35**	9,00	75
Company 9	56,00	400	**Company 36**	8,50	70
Company 10	55,00	22	**Company 37**	8,50	90
Company 11	52,10	730	**Company 38**	8,12	60
Company 12	52,00	120	**Company 39**	7,10	100
Company 13	50,00	650	**Company 40**	6,60	26
Company 14	42,50	250	**Company 41**	6,50	18
Company 15	40,00	300	**Company 42**	6,40	69
Company 16	38,00	70	**Company 43**	6,30	21
Company 17	37,00	400	**Company 44**	6,20	25
Company 18	30,00	250	**Company 45**	6,00	78
Company 19	25,00	55	**Company 46**	6,00	48
Company 20	20,00	200	**Company 47**	5,50	30
Company 21	20,00	160	**Company 48**	5,00	14
Company 22	18,00	220	**Company 49**	5,00	60
Company 23	17,00	57	**Company 50**	4,90	70
Company 24	15,00	50	**Company 51**	4,60	44
Company 25	14,75	55	**Company 52**	4,40	32
Company 26	12,59	NA	**Company 53**	4,28	15
Company 27	12,50	23			

Table 1. The Selected ICT Suppliers

Before the interviews, a pilot test was performed with practitioners. As a result, the wording of some of the questions was changed so as to make them easier to understand. All the interviews were conducted in the same way in order to have comparable results (we offered each subject the same stimulus), and were successful, as all the questions were answered by the respondents. The interviews were conducted by telephone, lasted on average one hour and were tape-recorded and transcribed. Afterwards, the transcription was approved by the interviewees.

Analysis of data and interpretation of the case studies evidence

The responses from interviewees were summarized, interpreted and tabulated from the transcripts according to the themes of the research questions. More in detail, data were encoded in two files: the central database (a simple Excel table) and a Word document containing the complete summary of the interviews. If any information remained unclear and/or we felt more data were needed, informants were contacted later with additional questions. The data analysis was conducted following two complementary approaches, and both a within-case and a cross-case analysis were carried out. The first approach seeks to generate insight (Gersick, 1988; Pettigrew, 1988), while the second enables intra-case comparisons, highlighting similarities and differences between responses.

Assessment of research quality

The validity and reliability of case studies rest heavily on the correctness of the information provided by the interviewees and can be assured by using multiple sources or looking at data in multiple ways (Eisenhardt, 1989; Yin, 2003). We have exploited multiple sources of evidence (that is interviews, questionnaires, archives). Reports were reviewed by interviewees and a protocol was written.

THE ICT SUPPLIERS CLASSIFICATION FRAMEWORK

The aim of this section is to present a classification framework of the strategic positioning of the ICT suppliers based on the results of the empirical analysis.

The classification framework uses the following traditional strategic variables (Porter, 1985):

- the *market scope* refers to the dimension (that is number of employees) of the companies in the target market. According to the European Union classification (European Commission Recommendation 2003/361/EC, 6 May 2003), four main categories were identified: micro enterprises (that is 1-9 employees) or consumers, small enterprises (that is 10-49 employees), medium enterprises (that is 50-249 employees) or large enterprises (more than 250 employees);
- the *portfolio scope* refers to the ICT products and services offered by the ICT suppliers. Five main categories were identified:
    - hardware and software infrastructure (that is network systems, desktop computers, laptops, servers, storage systems, printers, operating systems, office automation software);
    - advanced IT services (that is planning, design and implementation of complex ICT infrastructures such as Voice Over IP systems, high-end servers, storage systems);
    - management software (that is Enterprise Resource Management systems, Customer Relationship Management applications, Business Intelligence applications);
    - system integration services (that is customization and integration of software applications developed by third parties);

- business consulting (that is consultancy services focused on business process re-engineering/re-organization before the launch and adoption of critical ICT applications).

Given the two classification variables, nine different possible strategic positioning were identified (see Figure 1) which are described in the following sections.

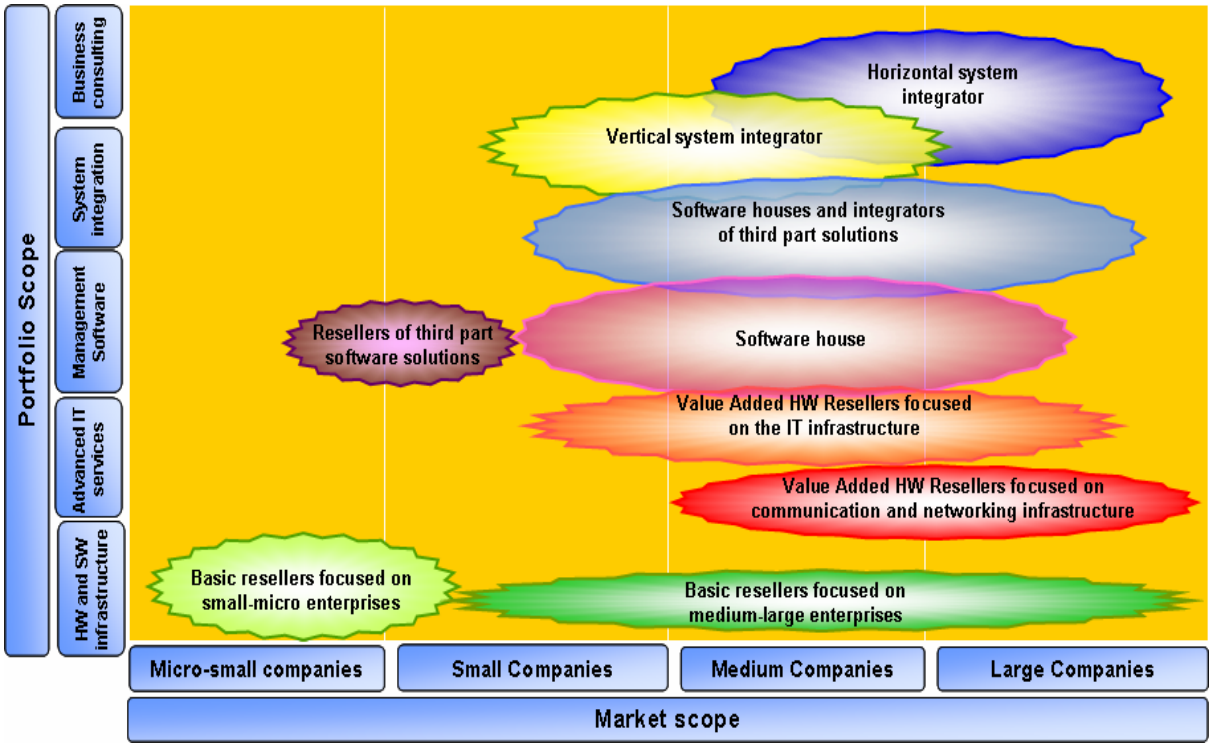

Figure 1. The Strategic Positioning of the ICT Suppliers

Basic resellers

These companies offer simple ICT products (for example LANs, desktop computers, laptops, notebooks, printers, and mono-processor servers) to micro/small enterprises or, in some cases, even to the consumers. In addition, they often supply basic software applications (for example office automation applications, operating systems, simple security systems) and basic ICT services (for example set-up and maintenance of small local networks, personal computers, mono-processor servers).

Basic resellers can be classified into two main categories in function of the target market:

- *basic resellers focused on micro enterprises*; these are small resellers which mainly target micro or small enterprises in the same geographical area (for example an industrial district). Sometimes these resellers target consumers through their consumer stores.

An example of a basic reseller is *Company 53*, an HP sales partner, which reached a total turnover of €4.3 million in 2006. *C53* markets mainly basic hardware products (that is personal computers, entry level servers, storage systems) that account for 80 percent of the

total turnover, and basic ICT services (that is configuration and installation of the marketed hardware products) representing the remaining 20 percent of the total turnover. The market comprises a large number of companies operating in manufacturing industry.

- *basic resellers focused on medium-large enterprises*, also called "corporate resellers": these are larger resellers which target their products and services to medium/large enterprises or public sector authorities.

An example is *Company 12*, an IBM sales partner, which reached a total turnover of more than €50 million in 2006. *C12* markets mainly basic hardware products (approx. 60 percent of the total turnover) basic software applications, such as office automation applications, DBMS (Database Management System) and information systems. (approx. 30 percent of the total turnover), and basic IT services (approx. 10 percent of the total turnover). The market mainly comprises companies with more than 250 employees operating in various industries, as well as local public sector authorities.

Value Added Hardware Resellers

Value added hardware resellers offer complex hardware products (for example high-level servers, storage systems, complex communication technologies) and advanced ICT services (that is design, planning, maintenance of complex ICT infrastructures), besides the supply of basic hardware and software products. They target their products and services mainly to medium and large enterprises requiring such advanced products and services, and also focus on small enterprises for the supply of basic hardware and software products.

The empirical analysis shows that these players can be classified into two categories in function of their products and services portfolio:

- *Value added hardware resellers focused on the IT infrastructure;* these players supply hardware and high-level implementation, installation and maintenance of complex IT infrastructures (that is multi-processor servers, storage systems and complex security systems).

An example is Company 19, an HP and Cisco sales partner, which reached a total turnover of more than €25 million in 2006. More than 40 percent of the total turnover refers to advanced IT services focused on the design, installation, implementation, and maintenance of complex IT infrastructures (that is servers and storage systems) for a number of large customers in the financial and manufacturing industries.

- *Value added hardware resellers focused on communication and networking infrastructure*, such as complex networking systems and Voice Over IP systems.

An example is Company 31 that offers Cisco, Citrix, and HP networking products. C31 started as a cable company and now specializes in the design and installation of complex networking infrastructures. A number of support services are also provided (for example always-on remote assistance and maintenance). In 2006 the total turnover reached more than €11 million, 35 percent from networking products and 65 percent from services.

Resellers of third party software solutions

These players offer simple software applications (that is software to manage accounting, production and warehouses) developed by software vendors (for example Teamsystem, Zucchetti and Adonix-Formula) that are easy to install at the customer's site. The target market is represented by micro/small enterprises and professionals (for example lawyers and accountants).

An example is *Company 51*, part of a larger group (a leading software house in the development of ERP, Enterprise Resource Planning, applications for SMEs and professionals), which is focused on reselling ERP, Business Intelligence and office automation applications to micro and small businesses, and in providing some installation and support services. The total turnover reached €4.6 million in 2006.

Software houses

These players develop and customize management software applications for companies in various industries. Several types of software application are developed: Web applications (for example corporate Web sites, eCommerce Web sites, Intranet applications and Extranet applications), ERP systems, CRM applications, Business Intelligence applications, Mobile&Wireless applications. The target market is medium or large enterprises. To larger companies, the software houses usually also supply complex industry-specific software applications (for example applications for the financial, banking or telecommunication industries).

There are several cases of software houses operating in the European market. Some of these offer software applications to companies operating in various industries, for example Company 9 (recently acquired by another player) which supplies ERP solutions to SMEs and professionals, and Company 15, which offers an ERP solution to the companies operating in the manufacturing industry. Others focus on more specific markets or on specific kinds of application, for example Company 25, belonging to an important group, which provides software applications to hospitals to support all medical activities, and Company 28 that supplies Mobile applications for Sales Force support (that is Sales Force Automation applications) to companies in the grocery industry.

Software houses and integrators of third party solutions

These players, besides offering self-developed software applications, supply integration and customization of management software applications developed by well-known software vendors (for example Microsoft, SAP and IBM).

An example is Company 21, a software house with a turnover of more than €20 million in 2006, which several years ago developed an ERP application targeted at the manufacturing industry (mainly Wood&Furniture, Mechanical, and Food industries). In 2005, C21 started to offer the Microsoft Navision application (now called Dynamics) in order to enlarge its product and services portfolio, and to broaden its marketing target by trying to focus on new industries, exploiting Microsoft brand awareness.

Vertical system integrators

The core business of these players is the integration of a specific (and unique) software applications developed by a software vendor. This extreme focalization results in a close partnership with the software vendor that has developed the software application. Sometimes, vertical system integrators develop industry-specific "vertical" software applications based on the standard release of the software which are subsequently promoted by the software vendor. The target market is mainly medium-size companies, often in industries for which the system integrator has developed the "vertical" software applications.

An example is Company 49, a small player (turnover of €5 million) that offers integration and customization services of an ERP solution developed by a software house. The development and customization are sometimes carried out in a joint team made of C49 and the developers. In particular, C49 has developed a vertical solution for the eyeglasses industry.

Horizontal system integrators

These players are focused on the integration and customization of various software applications developed by third party software vendors, while remaining independent from the latter (for this reason they are called "horizontal"). The target market is large enterprises.

An example is Company 17, a system integrator backed by some investment trusts. Following various acquisitions of other vertical system integrators in the last 10 years, C17 offers a broad range of integration services focused on various kinds of application: ERP systems (that is SAP, MS Dynamics), CAD (Computer Aided Design), PLM (Product Lifecycle Management) systems, software applications for the banking and telecom industries.

Their market is mainly large companies and public sector authorities, even if the strategic goal for the future is to focus on medium-size enterprise as well, offering integration services for ERP systems.

The empirical analysis shows that several ICT suppliers have a hybrid competitive positioning. For instance, some software houses or system integrators supplying large volumes of hardware products also assume the role of Value added hardware resellers.

THE ICT SUPPLIERS COMPETENCES

For each competitive positioning, the most important internal competences were analyzed. From the empirical analysis and the literature review, six main types of competence were highlighted (see Figure 2):

- *logistics,* that is competences concerning supply and management/integration with suppliers, warehousing, dispatching and shipping of merchandise, as well as pre-sales and customer care services*;*
- *basic ICT infrastructure services,* that is the ability to supply basic IT services dealing with the configuration, installation, and maintenance of simple ICT infrastructures*;*

- *advanced ICT infrastructure services*, that is competences concerning the design, planning, and implementation of complex ICT infrastructures*;*
- *software (SW) development*, that is competences focused on requirement analyses, design, implementation, integration and testing of applications developed in programming languages (for example Java, Cobol, C++ and Visual Basic)*;*
- *system integration*, that is competences in the customization and implementation of software applications (for example ERP systems, CRM applications, Business Intelligence applications) developed by software vendors (for example SAP, Microsoft and IBM);
- *business consulting*, that is competences focused on organization analysis and business process reengineering.
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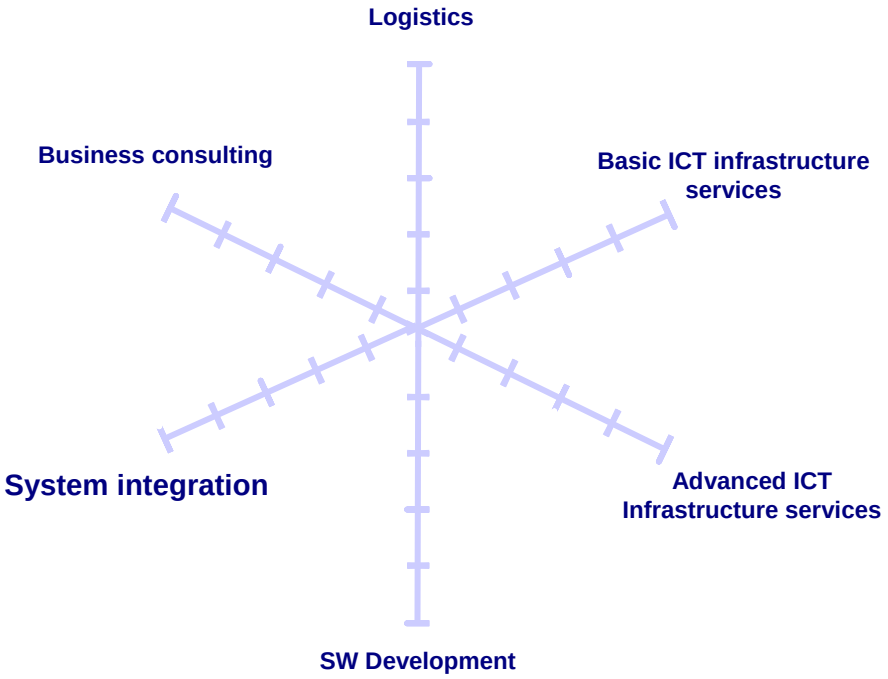

Figure 2. The Competences Mapping Scheme

On the basis of the results of the empirical analysis, the most common competence profile for each competitive positioning has been defined as in Figure 3.

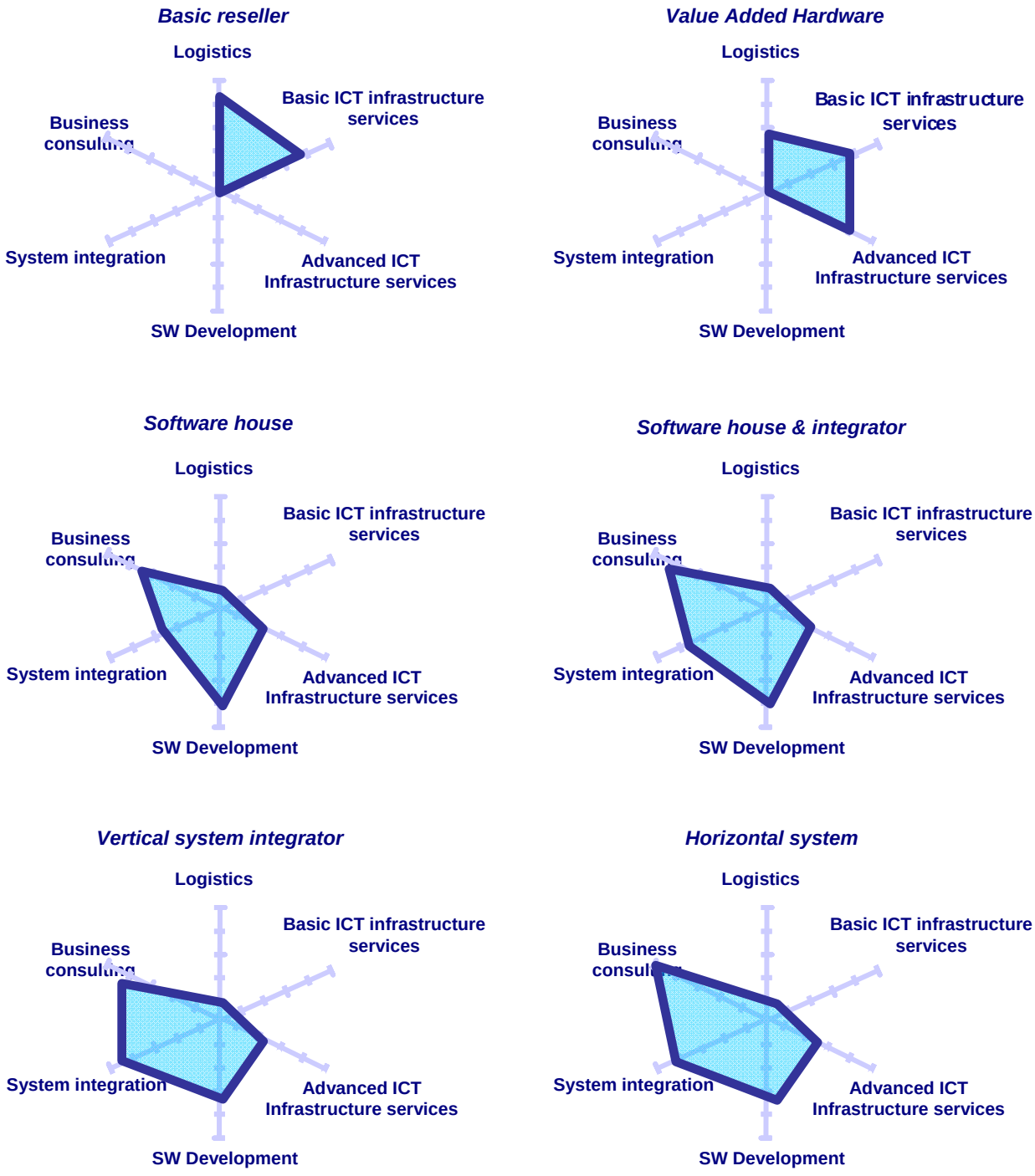

Figure 3. The ICT Suppliers Competences Profiles

Besides these competences, all the ICT suppliers need commercial and marketing skills, nature of which depends on the target market addressed (that is small, medium or large enterprises). More precisely, a supplier which targets a substantial number of micro or small enterprises needs marketing skills in analysis and segmentation, direct and tele-marketing

activities, and tele-sales. The need to reach many, geographically disparate small companies have encouraged some software houses to develop their own sales channel made up of small software resellers. These software houses have developed skills in sales-channel management, for example recruiting and selection of the resellers and training capabilities. On the other hand, a supplier focused on medium or large enterprises will need sales-technical and relationship-based skills, besides the competences related to the market analysis and segmentation.

THE MAIN STRATEGIC TRENDS IN THE EUROPEAN MARKET

The empirical analysis reveals a number of strategic trends in the European market, showing that the ICT sales and distribution channel is in a change and development phase.
The most important strategic trends, which are described in the following section, are:

- the evolution of the portfolio and market scope of some basic resellers;
- the attempt by some software houses to expand their offer through the integration of third party software applications;
- the internationalization of some software houses;
- the acquisition by software houses of some basic or value added Hardware resellers;
- the attempt by some system integrators to enlarge their target market.

The evolution of the portfolio and target market scope of some basic resellers

Basic resellers (both those focused on SMEs and large enterprises) are facing a high level of competition.
In particular, the competition for basic resellers focused on small and micro enterprises comes from three main categories of player:

- big electronic retailers (for example Mediamarket) which have started to sell to micro and small companies arriving from the consumer market;
- hardware vendors (for example Dell) which sell hardware solutions via telephone or the Internet and focus mainly on micro and small enterprises;
- some players from other nearby industries (for example telecommunications) that have started to supply basic hardware and software solutions to micro enterprises and professionals, in order to integrate and complete their core commercial offer.

For basic resellers focused on medium-large enterprises, the main competitive pressure comes from large hardware and software vendors that have started to supply products and services directly to medium/large enterprises.

Moreover, the economic margins on basic Hardware products have been decreasing significantly over the last years. The high level of competition in this market has determined two main strategic trends:

- the attempt of several basic resellers to expand and enrich their commercial proposition by offering value-added infrastructural services (that is design, planning, maintenance of complex IT infrastructures) or even management software applications. The evolution towards the Value Added Hardware Reseller model can provide greater profitability, even if this is not easy, since it requires the development of specific competences that are not common for a basic reseller. The second type of portfolio evolution (towards the

supply of management software applications) requires an even greater change in competences, and for this reason, it has often been achieved through mergers and acquisitions. An example is *Company 31*, which started as a cable installation company and then expanded its activities to include a Network Operation Center, help desk always on, and new outsourcing and remote access services.

- the attempt of some players focused on large enterprises to enlarge their target market towards medium companies. In this case, too, change is not easy, since it requires the development of marketing and commercial skills and resources in order to target a very large number of prospects effectively and efficiently.

The attempt by some software houses to expand their offer through the integration of third party software applications

In parallel with their self-developed applications, a number of software houses have started to offer integration and customization services for software, especially ERP systems, developed by well-known vendors (for example Microsoft, SAP and Oracle). The aim of this strategy is to offer a more complete commercial range to customers, leveraging software-development competences and the brand of large international vendors.

The commitment of these players in proposing the new ERP system may vary:

- in some cases, the goal of the software house is to enlarge its product and services portfolio without investing too much in the new ERP system, as its own, self-developed ERP application is considered the real "core offer";
- in other cases, the software house exploits the new ERP system to enlarge the target market. This is true for a number of software houses focused on specific industries that have started to offer the new ERP system to different, previously not targeted industries;
- in other cases again, the software house invests significantly in the new ERP with a view to replacing its self-developed application in the future.

An example is Company 31, which has started to sell and integrate Dynamics, the ERP system developed by Microsoft.

The internationalization of some software houses

Several software houses focusing on specific niche markets and offering vertical software applications (for example financial software and Mobility applications[2]) are trying to expand their geographical market by leveraging specific and vertical competences. An example is Company 25 which offers a software application developed ad hoc for hospitals. The company has successfully started to target Germany and is also trying to enter the South American market.

The acquisition by software houses of some basic or value added Hardware resellers

In recent years, a number of software houses have acquired basic or value added hardware resellers. The goal of these acquisitions is twofold:

- to integrate the product and services portfolio;

- to acquire the hardware reseller's customers and subsequently propose software applications.

The attempt by some system integrators to enlarge their target market

There is a growing interest among almost all the analyzed horizontal system integrators operating in Europe in enlarging their market by trying also to serve medium-size enterprises. This evolution presents a number of difficulties deriving from the different commercial and delivery model required for a market comprising mainly medium-size enterprises.

The creation of "ecosystems"

Various ICT suppliers with different business models and competences are trying to develop networks and partnerships (or ecosystems) in order to offer "end-to-end" solutions to company users. In many cases, ecosystems have been created through mergers and acquisitions, and in recent years, there have been a significant number of such moves in the ICT market. For example, a company, which operates in the networking industry, acquired two software houses, in order to enlarge its products and services portfolio. Moreover, a Group acquired a software house which develops an ERP system, in order to enter a new market.

CONCLUSIONS

The empirical analysis shows that several business models can be pointed out in the ICT sales and distribution channel, going beyond the traditional classifications. For each business model different competencies are required in order to create competitive advantages.

Moreover, several strategic trends and evolutions are affecting these companies in Europe, highlighting that many players are trying to develop sustainable business models in the competitive landscape. The results of the analysis can be useful to the:

- ICT suppliers, as a means to define strategic actions more effectively;
- ICT vendors that exploit ICT suppliers to market their products and services especially to SMEs, in recruiting and selecting the most suitable sales channel partners;
- corporate ICT decision makers (for example Chief Technology Officers, Chief Information Officers), to help understand the competences and the commercial offer of the different ICT suppliers and to select the most effective external partner for the company.

Notes

[1] In 2005 and 2006, the Observatory dealing with ICT in SMEs analyzed approx 1,000 SMEs and indicated their ICT suppliers (that is hardware suppliers, software suppliers and system integration services suppliers).

[2] For instance: Sales Force Automation, Field Force Automation, Warehouse management and Fleet management.

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DEVELOPMENT OF A THEORETICAL FRAMEWORK AND MANAGEMENT INFORMATION SYSTEM FOR PRISON MANAGEMENT

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ABSTRACT

Management of law and order, crime control and legal system are most challenging activities for democratically elected governments in any country. As law enforcement activities become more stringent, the prison population increases. Prisons and behavioral correction facilities engage wide range of humans from hardcore criminals to upright police officers either for detention or for monitoring purposes. These humans have different cultural, psychological, financial backgrounds and yet are expected to coexist. The judicial processes should be effective enough in bringing the matters to a logical end; however that will be possible with full cooperation from all corners. In a nutshell, there are too many roles, processes and activities involved in the overall governance related to prisons making the overall administration a complex task. To avoid fraud, corruption, undesirable incarnations and incidents of delayed justice, an effective MIS for overall prison administration is desirable. Such IT tools not only provide transparency but also tend to improve overall law and order and increased trust in governance.

There have been many attempts by various organizations, authors across the globe to model various activities related prisons through appropriate modeling. Some have developed information systems for specific aspects such as patterns of crimes, prison facilities and correctional centers. However, there is no standard framework that has been reported on data modeling and designing a comprehensive MIS for prison management as part of e-governance.

This paper examines the present legal, administrative and management processes in overall governance and administration of correctional facilities and prisons. A brief review of legal, administrative and management processes related to prisons and correctional centers as reported from different countries will also be presented. Based on the information, a theoretical framework with specific objectives will be suggested. Keeping in view of these objectives, data models and an overall information system will be designed with regard to specific objectives of reducing fraud and corruption.

Keywords: MIS, E-Governance, Prison Management Systems

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IMRPOVEMENT OF THE CUSTOMER FOCUS – THEORETICAL MODEL OF THE CUSTOMER PERCEIVED VALUE

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ABSTRACT

A high level of customer perceived value is the key to customer loyalty and to the profitability of customers and companies. It is not enough to meet the customer's needs in order to win customer loyalty. Instead the aim for companies should be to try to delight customers. Customers are delighted when they feel that the product or service not only fulfils their needs and expectations, but also gives them unexpected additional value. The aim of this research was to generate a theory for consumer perceived value which could be useful for managements trying to develop superior value so as to improve their customer loyalty. The pre-purchase consumer value was examined applying Grounded Theory methodology and by synthesizing the existing research results. The resulting theory from this synthesis consists of three main stages namely, gaining, sacrifice and purchase factors. The gaining stage has three sub-elements: substance, reputation and interaction. All these have the same four sub-categories: emotional, social, functional and economical elements. The novelty of this research Is in its treatment of customer perceived value firstly, from the perspectives of the companies – based on three functionally different factors: substance, reputation and interaction – and secondly from the perspective of the customers based on the identified subjective outcomes (i.e. emotional, social, functional and economic factors).

Keywords: consumer perceived value, customer focus, grounded theory, pre-purchase, reputation, sacrifice, substance

INTRODUCTION

The target of the companies is to succeed in a sustainable way. The customer perceived value is one of the most reliable ways to realise it. One of the basic presumptions in economics is that the enterprises strive to maximize their profits (Eskola 1996). In practice there are five possibilities; increasing the amount of customers, increasing the average purchase of the customers, increasing the purchasing times of customers, directing the customers' purchases to more profitable products and improving the productivity and profit earning capacity of enterprises.

The most effective way both in gaining new customers and keeping them and improving the enterprise profitability is to increase the customer loyalty (Reicheld 1996). Loyalty customers are more profitable. The increasing of customer loyalty is possible if the customers experience the products and services offered by the enterprise – or the benefits caused by them – better than other alternatives possibly often.

When striving to customer loyalty the enterprises should offer such products and services that the customer perceived value increases and creates loyalty. Based on this Blomqvis et al (1993) define the loyalty customer as follows: "The customer, who in time trusts in, that one enterprise is able to fulfil fully or greatest part of those of his needs concerning the products or services belonging in the enterprise's offerings." This means that the customer is loyalty to the enterprise and purchases the products or services of competitors only in exceptional case.

The customer's experience about the quality of the service and the bonds between customer and the enterprise form the customer perceived value in other words the ratio between the benefits customer has gained and the sacrifices the customer has fall into. Further the customer experienced value defines the relationship's level and solidity, in other word loyalty (Blomqvist et all 1993).

CONSUMER PERCEIVED VALUE

The consumer's buying behaviour has been examined widely and the customer's experienced value has been commonly accepted as the basis of the choice of purchase (preference). As Drucker (2002) states "The customers are willing to pay only about it what they find use of and what brings them value". What can we understand with the concept 'value'?
The concept "value" can be divided into direct value which means that the benefit is gained direct from the product or service, into instrumental value which means that you gain something you find valuable or useful by using the product or service or with help of it, and thirdly to exchange value which often coordinated with money (Nevanlinna & Relander 2006).

Woodal has found in his research that the concept value is used in very many meanings which depart from others in perspective and even contents. The concept value in business can be seen in three principle different meanings which depart from each others in perspective (Woodal 2003);

- Value added, which is a very enterprise centric point of view, with which is calculated the value added in it's products and services during the enterprise's own processes like innovations, processing, labour, energy etc (Porter 1985). Korkman states that the value is developed when using a product or service – not when producing it. The consumption is then in principle the source of the value, not the production (Korkman 2007).
- Customer lifetime value (VLC) is the value which the customer yields to the enterprise during the relationship's lifetime in other words the enterprise's own point of view about the value of the customer for the enterprise it self (Woodal 2003).
- Value for the customer or VC (Woodal 2003), consumer perceived value, (Sweeneya & Soutarb 2001)

According to Woodal (2003): "Value for the customer (VC) is any demand-side, personal perception of advantage arising out of a customer's association with an organisation's offering, and can occur as reduction in sacrifice; presence of benefit (perceived as either attributes or outcomes); the resultant of any weighed combination of sacrifice and benefit

(determined and expressed either rationally or intuitively); or an aggregation, over time, of any or all of these."

THE OBJECTIVES OF THE STUDY

The customer perceived value can be only found through observation of the customer's reality. As Drucker (2002) says "The customer's reality is so often different from the producer's." The enterprises usually know the customer's world of ideas and his or her desired value only partly or badly. The problem is that there is a lack of a tool or a thinking model, which suits in enterprise's functions but in the same time operates customer oriented.

The target in this study is to generate a theory and way of thinking to describe customer perceived value so that it would help the enterprises' management to understand their customer deeper and on the other hand could be a useful tool in developing value for the customers.

The target is to find a theory which describes the consumers' pre-purchase decision factors, which would have use in practice in enterprises and institutions quality management, R&D operations, marketing and in planning of other functions in the way that the managers could think alike consumers - customer centric – and that way offer to the consumers such benefits they were ready and willing to pay for.

In practice this means the description of value ratio and its factors which is the basis of consumer's decisions, in other words a clear consumer's decision taxonomy. So the target of this study is to define the factors which influence on the experience of consumers about a good purchase.

THE RESEARCH QUESTION

To understand the consumer's choices we have to be able to describe the consumer's decision processes. In this study the main interest is to build a theory or model to describe the consumer's decision factors and their respective relations in a way that helps the enterprise management in practice to understand their customer's choices better than today. The research question has been articulated as follows: Which are the factors of consumer's pre-purchase decisions?

THE RESEARCH METHODOLOGY

The research was carried out as a literary research. The research was based on the following theories:

1. Theories of Customer Perceived Value
    a. Porter (Porter 1985, 1996)
    b. Kotler (Kotler, 1990, 1999)
    c. McCarthy's 4P marketingmix (McCarthy 1960)
    d. Parasuraman, Zeithaml ja Berry (Parasuranam et all 1990)
    e. Fredericks, Salter (Fredericks & Salter 1995)
    f. Holbrook (Hollbrook 1999)

   g. Woodruff (Woodruff & Fisher 1996).
   h. Woodall's Model (Woodall 2003).
   i. Fishbein (Fishbein (1963)
   j. Zeithaml (Zeithaml 1988)
   k. Sweeneya and Soutarb (Sweeneya & Soutarb, 2001)
2. Multiattribute Value Theory (Liesiö, 2006)
3. Theories of Consumer's Choice (Friedman 1988)
4. Andreasen's Model of Consumer's Choice
5. Nicosia's Model of Consumer's Choice Behaviour concerning new Products
   a. Howard-Sheth's Model of Consumer's Choice
   b. Engel-Kollat-Blackwell Model
   c. Bettmanin Model
   d. Vroom's theory of motivation (Vroom 1964)
6. Other Perspectives to Consumer Perceived Value
   a. Concepts "´Quality" and "Value"
   b. Consumer's Satisfaction and Perceived Value
   c. Kano's model (Kano 1984)
7. Social Psychology and Consumer's Choice
8. Temporal Positioning

The used theories can be divided in three groups based on their scope:

1. the theories to describe the decision behaviour of the consumers
2. the theories defining the consumer experienced value
3. the theories to describe the value-ratio experienced by the consumers

The models and theories introduced above however contain the main part of constructions, categories and concepts of which the theory of consumer perceived value-ratio in pre-purchase situation has been generated.

The second group is formed of the theories defining the consumer experienced value. The meaning of the consumer experienced value in developing competition advantages is very remarkable, but it is not only the value to solve the consumer's choices – the sacrifices have as great meaning in the decision making. The theories of value have however the decisive role in generating the theory about the value-ratio.

The third perspective is that the consumer compares the value experienced to the sacrifices experienced. This is called in this research 'The Consumer Perceived Value-ratio'. The value-ratio is studied temporally in the situation of pre-purchase where the experiences are subjective expectations.

This research has been carried out according the principle introduced by Strauss and Gorbin (Strauss & Gorbinin 1988): "Although we are not generating the data we generate a theory out of the data. If we do it right, we let the data talk with those concepts which come out of it clearly understandable and representatively. Our theory, yet incomplete, yield common language (concepts) with help of which the others can get ideas and solve problems – already a small amount of understanding can do the difference."

Grounded Theory is a methodology developed by Glaser and Strauss (and later also Gorbin) mainly for sociological research and theory generating. The main principle is that we let the data itself to create the theory: searching in the data events and incidents (coding), conceptualising them, categorising them to classes, defining the central relations between concepts and classes, finding the key-category and based on it formulating an opinion for the theory (hypothesis, proposition) (Glaser & Strauss 1967, Strauss et Gorbinin 1988, Glaser 1992, Pandit 1996).

”The value of the Grounded Theory is not only that with help of it can be developed a theory but that the theory is grounded on data” (Strauss & Gorbin 1988) The Grounded Theory has eight stages (Strauss & Gorbin 1988):

1. Open coding
2. Axial coding:
3. Selective coding:
4. Theoretical saturation:
5. Defining the central core-category
6. Theoretical sampling:
7. Writing
8. Evaluation

RESULTS

The target of this research was to understand the consumer’s choices. The main interest was to build a theory or model to describe the consumer’s decision factors and their respective relations in a way that helps the enterprise management in practice to understand their customer’s choices better than today. The research question was;
“Which are the factors of consumer’s pre-purchase decisions?”

In the chosen data could be found a lot of different factors. It almost looked like every researcher should present his or her own factors. This can also be explained with different viewpoints. There were many suitable ways to categorize the concepts, and the proposed way is the summary of the found alternatives.

The first of main factors is the ‘Gaining’ divided in three components; substance, reputation and interaction. These factors describe the consumers’ experienced gaining. This concept is the customer perceived value.

The second of the main factors is ‘Sacrifice’ describing all the bother, trouble and costs consumer experiences to sacrifice.

In addition to these two earlier mentioned there are a lot of other agents which have influence in consumers’ decisions but do not belong in earlier mentioned factors. These are called in this research ‘Purchasing Factors’.

In the chosen data came out another classification for the customer perceived value. This classification divided all factors in four categories (Sweeneya & Soutarb 2001); emotional, social, functional and economical. The material, on which the research is grounded, supports

the proposition that all the mentioned main categories of the factors of consumer's pre-purchase decisions and their components could be divided in these four subcategories as shown in the figure 1.

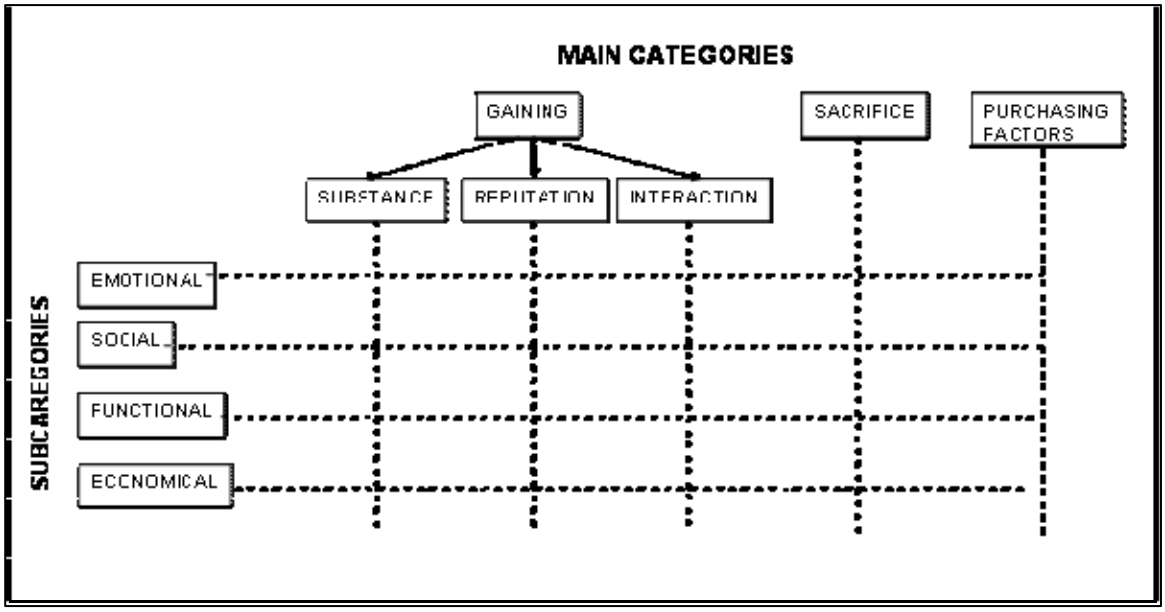

Figure 1. The matrix of categories and subcategories of consumer perceived value.

The factors affecting on the consumer's choice decision are consumer's own experiences about the value factors and thus totally customer centric. By using the Woodruff's value hierarchy (Woodruff et Fisher 1996) one can lead from the consumer's experiences product's and service's attributes for production and manufacturing. According the hierarchy the product's and service's attributes produce consequences which lead to consumer experienced benefits.

In the proposed model the customer perceived value is divided in three factors which all are clearly directable to different functions and operations in enterprises. This means they are easier to use for everyday work in marketing, development and strategies.

Substance is an outcome of products and services and their properties. So it only concerns the offering of enterprises. It answers the question WHAT. Reputation concerns the company's and its products image. It answers the question WHO. Interaction means the way to get the product or service or information about it. It answers the question HOW.

Some of the factors add the consumer's perceived value but others reduce it. Some factors have influence in the others meaning and importance.

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LUXURY IN THE INFORMATION AND COMMUNICATION TECHNOLOGY PRODUCTS

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Abstract

As the retail market for information and communications technology (ICT) has become very competitive, managers and marketers face the challenge of how to motivate consumers to pay more to purchase ICT products. This study shows that from the consumer's perspective, high-priced ICT products can be divided into at least two segments—a luxury product and a high-end product. Consumers whose shopping styles are perfection-seeking, novelty-seeking, and prestige-seeking tend to prefer a luxury product. Consumers whose shopping styles are innovation-seeking and perfection-seeking tend to prefer a high-end product. This study aims to develop an integrated conceptual framework for examining consumers' preferences for high-priced ICT products and help ICT firms to position their products.

Keywords: Shopping style, High-priced product, High-end product, Premium product, Consumer behavior

INTRODUCTION

Innovations in technology are causing three separate industries--computers, communications, and consumer electronics--to converge into one integrated industry of information and communication technology (ICT). Many software and hardware companies are expanding their product lines strategically to include such consumer electronics or telecommunication devices as music players, digital cameras, personal digital assistants, smartphones and e-book readers. Traditional manufacturers of consumer electronics are also developing new products in order to enter the ICT market.

With various players offering many innovative products, the retail market for ICT goods has become very competitive. To increase their market share and revenue, many ICT companies engage in price wars, a strategy that hurts their profits. ICT firms therefore face the challenge of motivating customers to pay more to purchase their products. To attract those customers who are willing to pay a premium price, some firms are turning to the luxury market. Acer, for example, a personal computer manufacturer, has been working with the luxury carmaker Enzo Ferrari to launch the Acer Ferrari series of laptop computers.

A second alternative to escape price wars has been to develop a high-end product that the consumer is willing to pay a premium price. ICT firms engaging such a strategy aggressively deploy the newest advances in technology to provide the ultimate high-end products possible to customers. Hypersonic, a personal computer manufacturer offering top-notch laptop

computers (US$3,450 as of 9/23, 2009 on amazon.com, listing the three most expensive) providing cutting-edge technology to astute and selective gamers, is one such company.

As a premium market emerges in the ICT sector and ICT companies increasingly see launching expensive products as a way to increase their profit margin, managers and marketers of computers and consumer electronics need to develop a thorough understanding of consumers' purchasing behavior in relation to high-priced ICT products. A successful marketing positioning strategy can help customers to perceive sufficient value in a premium good to compensate for the high price charged (Tynan, Mckechnie and Chhuon, 2009).

Previous studies have examined the concept of luxury in the context of the retail markets (e.g., Vigneron and Johnson, 2004; Wiedmann, Hennigs, and Siebels, 2009), few have investigated the concept as it applies to the ICT market. In the ICT sector, we propose that high-priced ICT products can be divided into at least two segments: luxury products that are stylish and design-oriented, and high-end products that are innovative and technology-oriented. Different customers might expect different features from luxury and high-end products.

This study aims to discuss luxury and high-end products in the ICT sector and to examine factors that drive customers to purchase those products. The theoretical discussion and empirical findings deepen understanding of these factors in the following ways: (1) by providing a broader perspective for looking at the luxury ICT market; (2) by developing an understanding of consumers' shopping styles in relation to luxury and high-end ICT products; and (3) by making strategic recommendations for enhancing the development of luxury or high-end ICT products.

CONCEPTUAL FRAMEWORK AND HYPOTHESES

The luxury ICT market

The luxury market is a significant segment of today's retail markets. Although luxury consumer demand in the West appears to be waning due to the credit crunch, property crash and a slowing world economy, the appetite for luxury brands is growing elsewhere in the emerging economies of China, India, and Asia (Tynan, Mchechnie and Chhuon, 2009). In the past, luxury goods such as the finest jewelry, sports car, or yachts, were the preserve of the privileged few, but now, the concept of luxury has a broader application in the marketing field and indicates premium products in most categories, such as clothing, food, or travel. Luxury has become as luxurification of the commonplace (Berry, 1994), and has become more affordable for many middle-market consumers (Silverstein and Fiske, 2001). Luxury is increasingly about experience and authenticity, and the old values of tradition and nobility have become less important (Yeoman and McMahon-Beattie, 2006).

Silverstein and Fiske (2001) suggest that a confluence of business factors and social forces fuels the rise of luxury consumption. On the business side, manufacturers now have the capacity to produce more goods than consumers demand; therefore, they have to differentiate their products from those of competitors and believe that the luxury market is an attractive segment for making profits. At the same time, owing to the rise in disposable income for the

middle classes, consumers have started to trade up; middle-income earners are willing to pay premium prices for products and services that possess higher levels of quality, taste, and aspiration than other goods in the same category (Yeoman and Mcmathon-Beattie, 2006). At least until the very recent global financial crisis, some consumers purchase goods and service which meet not only their physical needs but also their emotional needs (Silverstein and Fiske, 2001). This need convergence of manufacturer and consumers has resulted in a rise in consumption of luxury products.

The luxury market has been expanding most significantly in several Asian countries (Nueno and Quelch, 1998). For instance, TNS (2008) estimates that by 2014, China will become the largest luxury goods consumer market in the world, accounting for a 23 percent share in the global market. Because of this trend, luxury brands that

feature high prices, prestigious names, and international markets play an increasingly important role in profit generation for many international corporations.

The luxury market in the ICT sector is also booming; the market for mobile phone handsets is such an example. As the market for mobile phone handsets has matured and as technology has become less of a differentiating factor, mobile phone makers are starting to target the luxury market. Increasing numbers of mobile phone makers and designer brands enter independently or jointly the luxury mobile phone market. Vertu is one such example. A wholly owned subsidiary of the mobile phone manufacturer Nokia, Vertu declares itself the world's first luxury mobile phone maker and prices its first devices at a staggering US$21,240 (Wired, 2002). Another example is that of the mobile phone manufacturer LG collaborating with the fashion brand Prada to launch luxury phones. ABI Research (2008) forecasts that revenues from luxury- branded handsets will increase to more than $43 billion by 2013.

In many categories of goods, such as that of fashion clothing and accessories, consumers might view most high-priced products as luxury ones, a concept related to prestigious names, stylish designs, and precious materials. However, in high-tech industries such as the ICT sector, some innovative products are high-priced but lack stylish designs and are made without precious materials. It is innovation and technology that make the product high-end; therefore, not all high-priced ICT products are viewed by customers as luxury ones, as they would be in the fashion or accessories sectors. Thus, when ICT firms intend to develop high-priced products, the luxury product is not the only positioning segment they think about in the high-priced market.

In addition, a high-priced product does not simply mean a special product item; it represents a meaningful strategic approach to increase brand equity. Such a strategy, however, has not always met with great success, so manufacturers face the challenge of how to position and develop their products effectively. A technology player's ability to identify the nature and expected behavior of buyers in the niche consumer segment and to understand and respond to their needs will be crucial for the successful development of high-priced products. Thus, to gain a deeper understanding of what motivates target customers to pay premium prices is important to ICT marketing managers.

Overty and Lee (2006) indicate that consumer choice is the result of multiple dimensions of consumption value, and preference is to influence future consumer outcomes, including intentions, willingness to buy and word-of-mouth, they demonstrate that the multiple value dimensions contribute to preference and future intentions. Based on the framework, we assume that there are at least two reasons for customers' choice of high-priced ICT products, one is the preference for luxury, and the other is the preference for high-end performance. The makers of luxury products usually increase product value through the use of stylish designs, precious materials, or prestigious brand names, whereas high-end ICT products usually embed the most innovative and state-of-the-art specifications within utilitarian features. **Hypothesis 1. The constructs of consumers' preference for luxury products and preference for high-end products are different in the ICT sector.**

Consumers' preferences for luxury ICT products

Over the past few years, many ICT manufacturers have worked to upgrade the quality of their products as well as their brand images. With luxury goods in demand, some ICT firms are trying to create luxury lines with unique products so that they can attract customers with the products' design or special-edition features. Although luxury ICT products have so far represented only a small fraction of overall market sales, the consumer's increasing desire for differentiation combined with the profitability of such products is boosting the presence of these products in the market.

Arghavan and Zaichkowsky (2000) propose that psychological benefits are the main factor distinguishing luxury products from non-luxury products. Vigneron and Johnson (2004) define luxury brands as goods of which the simple use or display brings the owner esteem, apart from any functional utility. Nueno and Quelch (1998) define luxury brands as those whose ratio of functionality to price is low, while the ratio of intangible and situational utility to price is high.

We apply the definition of luxury brands by Nueno and Quelch to its understanding of luxury ICT products and assume that one reason an individual may be willing to pay a relatively high price for a particular ICT product is simply that it is a luxury product. **Hypothesis 2. The more a customer prefers a luxury ICT product, the more she/he is willing to pay a high price for this product.**

Consumers' preferences for high-end ICT products

In contrast, some manufacturers in the high-tech market focus less on enhancing products' luxury features and instead focus more on developing incremental innovations and state-of-the-art specifications in their high-end models in order to upgrade the quality, performance, or usability of their products. When ICT firms launch these innovative ICT products, they position these products as high-end models and price them at a premium, as they attempt to recoup their development costs, but firms may lower the price over time; the smartphone is one such product. The pricing strategy for a high-end product is different from that for a luxury product, for which the price level must be maintained to retain prestige value.

Differing from radically innovative products that focus on breakthrough technologies, a high-end product offers not only new technologies but also a guarantee of the product's quality. Consumers do not look at all innovative products as high-end ones if there is a perceived risk in terms of the product's quality. Some consumers will not purchase a new technology until a high-end model with a good quality guarantee has been launched; they are then willing to pay a relatively high price to buy that innovative product.

We define the preference for high-end ICT products as a customer's intention to choose a product with innovative and top-quality specifications when she/he purchases an ICT good and proposes the hypothesis. **Hypothesis 3. The more a customer prefers a high-end ICT product, the more she/he is willing to pay a high price for this product.**

Consumers' shopping styles

Researchers have long discussed the importance of knowing why people choose a particular product during a selection process. Walsh, Hennig-Thurau, Wayne-Mitchell, and Wiedmann (2001) suggest that psychographic segmentation can effectively identify product preferences. Because the purpose of this study is to investigate the factors involved in consumers' preferences for luxury or high-end ICT products, we use psychographic segmentation for this purpose.

Consumers' decision-making styles (in short, shopping styles), like lifestyles, have been a prominent area of interest in consumer behavior studies using psychographic segmentation. Sproles and Kendall (1986) define the shopping style as a mental orientation characterizing a consumer's approach to making choices and state that one or more specific shopping-style dimensions may influence consumer choices. Tai (2005) suggests that an understanding of shopping styles is important to marketing because they determine consumer behavior and are relatively stable over time; therefore, they are relevant for market segmentation and useful for this study.

Sproles and Kendall (1986) develop a Consumer Styles Inventory (CSI) by dividing its scale into eight central decision-making dimensions that influence consumers' shopping styles: perfectionism/high quality consciousness, brand consciousness, novelty-fashion consciousness, recreational value, price-value consciousness, impulsiveness, confusion from too many choices, and brand loyalty. We have adapted and modified some of these dimensions and several others in order to gain further insight into consumer shopping styles in the context of high-priced ICT products.

Perfection seeking, novelty seeking, and prestige seeking are drivers of luxury ICT products

Among the eight consumer shopping styles in the CSI, perfectionism/ high quality consciousness may be the most important reason consumers purchase luxury ICT products. Sproles and Kendall (1986) identify the perfectionist consciousness as a shopping decision style that characterizes the segment of consumers who are extremely concerned about product quality and inclined to buy luxury brands mainly because of their perceived excellence in

quality and performance. We adapt the definition of perfectionism/high quality consciousness to the perfection-seeking style and examine it in this study.

In a large-scale study, Gentry, Putrevu, Shultz, and Commuri (2001) find that consumers do not necessarily buy luxury brands just for the caché of their conspicuous brand names, but more often because of the superior quality reflected in that name. The literature on luxury consumption emphasizes the importance of leadership in quality to ensure the perception of luxury (e.g., Quelch, 1987; Garfein, 1989; Roux, 1995). **Hypothesis 4. The customer's perfection-seeking shopping style has a significantly positive effect on his/her preference for a luxury ICT product.**

The novelty-seeking shopping style might be another reason a customer purchasing a luxury ICT product. Novelty seeking is the desire to seek out the new and different (Hirschman, 1980). In the CSI, novelty seeking is not limited to technological innovations. Sproles and Kendall (1986) broaden the scope of novelty to the concept of fashion and indicate that consumers who are conscious of novelty and fashion will find seeking out new products pleasurable, will be likely to shop less carefully and more impulsively, and will be less sensitive to price. Thus, we consider that the novelty seeking will influence the preference for luxury good. **Hypothesis 5. The customer's novelty-seeking shopping style has a significantly positive effect on his/her preference for a luxury ICT product.**

According to the marketing literature on factors driving the purchase of luxury goods, the prestige-seeking shopping style might be another driver influencing the purchase of luxury ICT products. Some studies have used the concept of prestige to discuss luxury consumption. Chao and Schor (1998) reveal that luxury brands can convey status and prestige. Vigneron and Johnson (2004) conclude that prestige brands have five perceived values: they are conspicuous, unique, social, hedonic, and high quality. Prestige consumption is similar to status consumption, but it is conceptually distinct from conspicuous consumption because it is not merely the purchase of prestigious products to display wealth and prosperity. It is also different from materialism, which involves the acquisition of goods for their own sake (Eastman and Flynn, 1999; O'Cass and McEwen, 2004).

Based on the above discussion, we define the prestige-seeking shopping style as belonging to the segment of customers who are concerned about the conspicuousness, uniqueness, social nature, hedonicity and quality values when they purchase an ICT good. We assume the effect of prestige-seeking tendencies on luxury preference. **Hypothesis 6. The customer's prestige-seeking shopping style has a significantly positive effect on his/her preference for a luxury ICT product.**

Perfection seeking and innovation seeking are drivers of high-end ICT products

On the other hand, if some brands not perceived of by consumers as luxury brands plan to develop premium models of ICT goods, they can embed their high-priced products with innovative specifications and convince consumers that those products will also offer high quality. The consumer's perfection-seeking style may drive him/her to choose a high-end product. **Hypothesis 7. The customer's perfection-seeking shopping style has a significantly positive effect on his/her preference for a high-end ICT product.**

The innovation-seeking shopping style may also be an important factor influencing the preference for high-end products. As discussed above, manufacturers usually embed innovative specifications in their high-end products so that they can charge higher prices. The innovation-seeking style belongs to the segment of customers who are very concerned about innovations in the product. The innovation-seeking style is different from the novelty-seeking style because the innovation-seeking style focuses more on the product's technological features. Several studies have demonstrated that novelty seeking is an antecedent to innovation-seeking (e.g., Hirschman, 1980; Roehrich, 2004); therefore, we assume that the novelty-seeking style will influence the innovation-seeking style. **Hypothesis 8. The customer's innovation-seeking shopping style has a significantly positive effect on his/her preference for a high-end ICT product; Hypothesis 9. The customer's novelty-seeking shopping style has a significantly positive effect on his/her innovation-seeking shopping style.**

On the basis of the above analysis, we hypothesize the integrated framework of choice of high-priced ICT products as follows (see Figure 1).

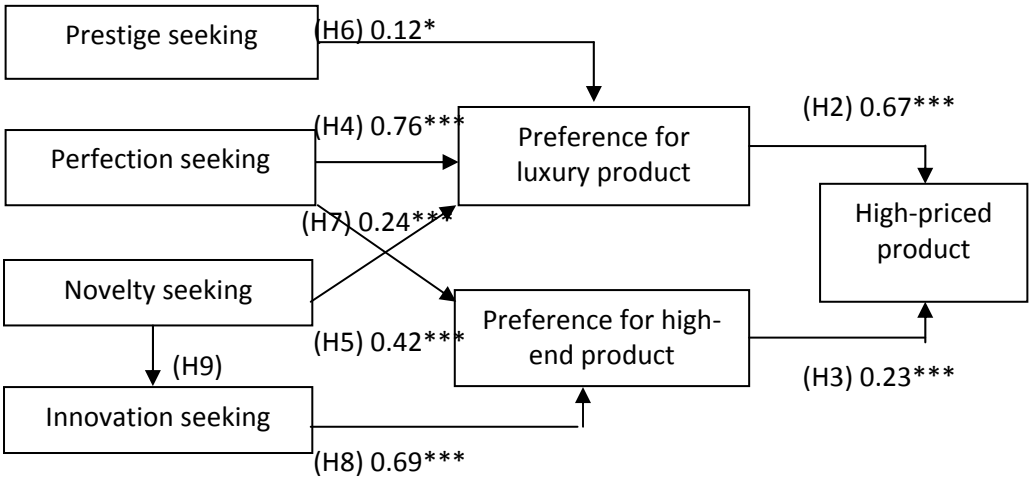

Figure 1. Research model and Results of SEM analysis
Note: *Significant at a 0.05 level **Significant at a 0.01 level ***Significant at a 0.001 level

RESEARCH METHODOLOGY

Instrument development

An empirical study was administered to test the model. To generate the questionnaire, multiple-item scales were developed on the basis of previous studies to measure the relevant constructs. The corresponding items of each construct are described in Table 1. All of the items were initially tested using five graduate students who are experienced ICT goods consumers; they were asked to list items that correspond to the measured constructs. The most frequently mentioned items were included in the instrument. To reduce the possible ambiguity of the items in the questionnaire, a small-scale pilot study was conducted. All questionnaire items were based on a 5-point Likert scale anchored between "strongly agree" and "strongly disagree," and the results led to several changes in the wording of the questionnaire.

Sample collection

The survey was conducted between July and September of 2008. Six hundred questionnaires were distributed to the participants of open enrollment courses or evening classes at a university in Taipei, none of whom were traditional students. Most of the participants worked during the day and studied at night or on weekends. Although the sample is clearly not representative of the population at large, such a sample is often selected by researchers for luxury studies (e.g. Kapferer, 1998; Eastman, Goldsmith, and Flynn, 1999). In addition, young professionals with higher education levels are also often selected by researchers to form the samples for technology adoption studies (e.g. Shim, Ahn, and Shim, 2006; Shim, Park, and Shim, 2008). Another survey shows that the majority of Chinese consumers of luxury products are aged between 20 and 40 years; they are considerably younger than those in the U.S. and Europe, although younger does not mean richer. This segment is willing to spend a greater portion of their income on luxury goods than those in the U.S. and Europe are willing to (Debam and Svinos, 2008). Because this study intends to help ICT firms motivate customers to pay more, and middle class consumers have embraced luxury brands in Chinese society, the sample group is considered effective for this study.

For each question, respondents were asked to circle the response that best described their level of agreement with the statement. Three hundred and forty-five complete questionnaires were collected, yielding a valid response rate of 58%. Of those respondents, 56% were female, 44% were male, and the majority (73%) had monthly incomes greater than the 2007 minimum monthly wage in Taiwan. The profiles of the valid respondents are shown in Table 2.

Table 1 Constructs and corresponding items

Constructs	Items
Willingness to pay for high priced products	1. When shopping for an ICT product, the product I choose is usually in the higher price range. 2. When shopping for an ICT product, I will choose a high priced one.
Preference for luxury ICT products	1. When shopping for an ICT product, I will choose a luxury brand. 2. When shopping for an ICT product, I will choose the finest one. 3. When shopping for an ICT product, I will choose a premium one.
Preference for high-end ICT products	1. When shopping for an ICT product, I will choose one with high-end specifications. 2. When shopping for an ICT product, I will choose one with high performance. 3. When shopping for an ICT product, I will choose one with high-end accessories.
Prestige seeking	1. When shopping for an ICT product, I will choose one that represents my personal image. 2. When shopping for an ICT product, I will choose one that demonstrates my lifestyle and taste. 3. When shopping for an ICT product, I will choose one that associates with my social status.
Perfection seeking	1. When shopping for an ICT product, I will choose one that is well made. 2. When shopping for an ICT product, I will choose one with high quality.
Novelty seeking	1. When shopping for an ICT product, I will choose the one with the latest style. 2. When shopping for an ICT product, I will choose the newest model in the market.
Innovation seeking	1. When shopping for an ICT product, I will choose an innovative one. 2. When shopping for an ICT product, I will choose one that has latest-generation technology.

Scale validity and reliability

According to measurement development theory, a well-accepted instrument can be determined by (1) construct reliabilities, (2) the convergent validities of measures associated with individual constructs, and (3) the discriminant validity between constructs (Hulland, 1999). Thus, evaluations of the psychometric properties of the measurement model in terms of reliability, convergent validity, and discriminant validity were conducted.

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 and Berstein, 1994). As shown in Table 3, the internal consistency values of all the constructs in the model exceed or equal this recommended threshold.

Table 2 Descriptive statistics of the respondents' characteristics

Measure	Items	Frequency	Percent	Remark
Gender	Male	150	43.5	
	Female	195	56.5	
Age	Under 25	53	15.4	
	25-29	105	30.4	
	30-34	78	22.6	
	35-39	51	14.8	
	40 and up	58	16.8	
Monthly income (NT$)	Under 20,000	92	26.7	
	20,001-35,000	102	29.6	
	35,001-50,000	85	24.6	
	50,001-65,000	38	11.0	
	65,001-Up	28	8.1	
Occupational category	Executives	11	3.2	Taiwan's minimum monthly wage was NT$17,280 (US$533) and average monthly income was NT$44,414 (US$1,383) in 2007.
	Manager	34	9.9	
	Professional	97	28.1	
	Staff or sales	42	12.2	
	Self-employed	4	1.2	
	Freelance	12	3.5	
	Unemployed	48	13.9	
	Housewife	4	1.2	
	Student	47	13.6	
	Others	46	13.3	
Total		345	100	

Convergent validity is the extent to which varying approaches to construct measurement yield the same results (Campbell and Fiske, 1959). Convergent validity was evaluated for the measurement scales using two criteria suggested by Fornell and Larcker (1986): (1) all indicator factor loadings should be significant and exceed 0.70, and (2) average variance extracted (AVE) by each construct should exceed the variance due to measurement error for that construct.

Table 3 Construct Means and Internal Consistencies

Construct	Number of items	Mean	Cronbach Alpha
Willingness to pay for high priced ICT products	2	2.83	.81
Preference for luxury ICT products	3	2.54	.90
Preference for high-end ICT products	3	3.18	.90
Prestige seeking	3	3.37	.85
Perfection seeking	2	3.29	.70
Novelty seeking	2	2.98	.87
Innovation seeking	2	3.28	.82

Note: All constructs are measured on a five-point scale with the anchors 5=strongly agree, 4=agree, 3=neutral, 2=disagree, 1=strongly disagree

The results, illustrated in Table 4, indicate that all loadings are significant (t-value >1.96) and, except for three items, are larger than 0.7. Additionally, the average variance extracted values fall between 0.53 and 0.78, exceeding the minimum value of 0.5 for good internal consistency as suggested by Fornell and Larcker (1986). Thus, the evidence reveals satisfactory convergent validity.

Table 4 Significant levels of items loading (Completely Standardized Solution)

Loading	Item 1	Item2	Item3
Willingness to pay for high-priced ICT products	0.81 16.88	0.85 17.99	
Preference for luxury ICT products	0.91 21.52	0.85 19.37	0.85 19.21
Preference for high-end ICT products	0.90 20.76	0.87 19.91	0.82 18.23
Prestige seeking	0.86 18.67	0.90 19.85	0.70 14.22
Perfection seeking	0.69 13.15	0.77 14.66	
Novelty seeking	0.91 20.74	0.84 18.46	
Innovation seeking	0.87 18.82	0.83 17.92	

Discriminant validity assesses the extent to which a concept and its indicators differ from another concept and its indicators (Bagozzi, Yi and Phillips, 1991). To assess the discriminant validity of the proposed constructs, the AVE method was used. Fornell and Larcker recommend that the square root of the average variance extracted from a construct should exceed the square correlation between itself and any other construct. Table 5 shows that AVEs are greater than 0.52, which is the highest possible squared correlation between construct pairs. Thus, the evidence reveals satisfactory discriminant validity.

Table 5 Average variance extracted and discriminant validity

Construct	PreS	PerS	NS	IS
Prestige seeking (PreS)	0.62			
Perfection seeking (PerS)	0.31	0.53		
Novelty seeking (NS)	0.11	0.28	0.78	
Innovation seeking (IS)	0.13	0.31	0.52	0.72

Note: Diagonal elements represent the average variance extracted (AVE), while off diagonal elements represent the correlation squares among constructs. For discriminant validity, the AVE should be larger than correlations.

DATA ANALYSIS AND RESULTS

Analysis of the measurement model

A confirmation factor analysis (CFA) with LISREL 8.5 (Jöreskog, 2000) was conducted to assess the fitness of the measurement model. The purpose of testing the measurement model is to determine whether the measures possess satisfactory psychometric properties (Lou, Lou, and Strong, 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 and Bonett, 1980), an adjusted goodness-of-fit index (AGFI) (Bentler, 1980), a comparative-fit index (CFI) (Bentler, 1988), a normed-fit index (NFI) (Bentler and Bonett, 1980), a standardized root mean square residual (SRMR) (Bentler and Yuan, 1999), and a root mean square error of approximation (RMSEA) (Browne and 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, Anderson, Tatham and Black (1998) suggest that a RMSEA value lower than 0.08 is an acceptable value for fair fit. The overall results of this study suggest that the measurement model provides a satisfactory fit to the data (see Table 6). A similar set of fit indices was used to examine the structural model (see Table 6) and shows acceptable fit values with GFI at 0.91, AGFI at 0.87, NFI at 0.93, NNFI at 0.94, CFI at 0.95, SRMR at 0.064, and RMSEA at 0.070. The overall results suggest that the structural model also provides a satisfactory fit.

Table 6 Fit indices for measurement and structural models

Goodness-of-fit measure	Recommended value	Hypothesized model		
		Measurement	Structural	Fit evaluation
GFI	>0.90	0.92	0.91	Good/Good
AGFI	>0.80	0.88	0.87	Good/Good
NFI	>0.90	0.94	0.93	Good/Good
NNFI	>0.90	0.95	0.94	Good/Good
CFI	>0.90	0.96	0.95	Good/Good
SRMR	<0.08	0.055	0.064	Good/Good
RMSEA	<0.05	0.068	0.070	Fair/Fair

Hypotheses testing

Although the discriminant validity among the constructs in this study demonstrates to a satisfactory degree, we have also used a factor analysis to test the discriminant validity in order to explore the difference between preferences for luxury products and those for high-end products. A principal component analysis with oblique rotation by SPSS 10.0 was performed; the result shows that two factors are extracted (see Table 7) and supports the hypothesis that the preference for luxury products and the preference for high-end products are different (H1).

Table 7 Principal component analysis with oblimin rotations.

Scale items	Factor 1 (Preference for high-end ICT products)	Factor 2 (Preference for luxury ICT products)
Item 1	**.951**	3.720E-02
Item 2	**.952**	4.928E-02
Item 3	**.776**	-.172
Item 4	.205	**-.768**
Item 5	-3.267E-02	**-.962**
Item 6	-5.901E-02	**-.947**

Note: Rotation converged in 8 iterations.

We proceeded to examine the proposed hypotheses by performing a path analysis. Figure 1 shows the standardized path coefficients between constructs as well as square multiple correlation (SMC) values for each dependent variable. According to Bollen (1989), the SMC value is the percentage of explained variance and is equivalent to R^2 in linear regression.

As expected, we find that the preferences for luxury and high-end products have significantly positive effects on the willingness to pay for a high-priced ICT product; H2 and H3 are supported. As for the drivers of preference for luxury products, the shopping styles of perfection seeking, novelty seeking and prestige seeking have significantly positive effects on the preference for luxury products; H4, H5, H6 are supported. Moreover, the perfection-seeking and innovation-seeking shopping styles have significantly positive effects on the preference for high-end goods; H7 and H8 are supported. In addition, the novelty-seeking style has a positive effect on innovation seeking, H9 is supported. The model explains 67% of the variance in the construct of high-priced ICT products, 76% of the variance in the construct of luxury products, and 68% of the variance in the construct of high-end products. Figure 1 shows the standardized path coefficients between constructs as well as the SMC values for each dependent variable.

DISCUSSION

The results of the above data indicate that consumer' perspectives of high-priced ICT products can be divided into at least two segments: a preference for luxury products, and a preference for high-end products. For the customers who prefer a luxury product, the values of novelty, prestige, and quality are determinants of a luxury ICT product; in contrast, for

those consumers who prefer a high-end product, the values of innovation and quality are determinants of a high-end ICT product.

If an ICT firm plans to develop luxury products, it has to demonstrate leadership and a long-term commitment to quality; otherwise, consumers might reject the brand and its products. In addition, because consumers expect luxury products to offer novelty value, ICT firms need to focus their efforts on developing new product designs for luxury products. This finding might explain why luxury ICT products are usually developed with stylish designs; they offer customers novelty value. Furthermore, making customers feel that they are gaining prestige when they own and use the products is another driver for customer choice of a luxury ICT good.

In addition to luxury products, some customers are willing to pay a relatively high price for high-end ICT products because of their innovations and quality. As with luxury products, high-end products have to offer quality to their target customers, but those target customers of high-end products are concerned more with innovation value than with prestige value. When marketing to customers who tend to prefer high-end products, an emphasis on the new technology will capture the target consumers' attention and arouse their desire to purchase a high-end product.

In contrast to those innovative products that attract innovators with radical innovations whose performance reliability or quality may have not been proved, high-end technology products with the innovations must pay attention to guaranteeing the product's quality in terms of performance, reliability, and usability. Some customers will often wait for high-end products to be launched before trying new technologies.

LIMITATIONS AND IMPLICATIONS

Certain limitations are inherent in this study. The first limitation is that the sample is composed of adult students of only a local university, so there may be a sampling bias. Although several previous empirical studies of luxury have also used university students as subjects to investigate consumer behavior (e.g., Vigneron and Johnson, 2004), a large scale of sampling is usually suggested. Bakewell and Mitchell (2006) indicate that male and female decision-making styles vary. Thus, the second limitation is that certain demographic variables--such as sex, age, or income level--may be moderate variables in the model but are not considered in this study, further extended research or cross-validation studies should be conducted. Additionally, the findings are the result of a survey in a specific country, so they might be limited to the local cultural context. The study asks respondents about their perception or shopping preference with regard to ICT products in general instead of a particular category, such as personal computers or mobile phones. This implies that consumers will have similar preferences on their purchases of different ICT goods; the implicit assumption should be tested in further research.

Despite these limitations, we show that from the consumer's perspective, quality and novelty are the very basic values of high-priced ICT products what can be divided into at least two segments--luxury products and high-end products--and each type has different drivers of consumption. The consumers whose shopping styles encompass perfection, novelty and

prestige seeking prefer luxury ICT products. This finding may explain why some luxury ICT products offer only simple and basic functions but place a lot of emphasis on quality commitment, stylish design, and brand image; they do this because these attributes satisfy the target customers of luxury ICT products more than technological attributes do. On the other hand, high-end product seekers are more technology and performance features oriented.

However, luxury products and high-end products might not be the only two segments in the high-priced ICT market; some high-priced ICT products could be positioned between the luxury and high-end concepts. Some premium products, like digital home theater systems belong to this positioning. These premium ICT products might not be as fashion-oriented as luxury products are and do not have as great a need to offer multiple innovative functions as some high-end products do, but they do have to adopt the latest innovations on the critical functions to offer the best quality and craftsmanship value to target customers.

We integrate consumers' needs and shopping styles to establish a multi-dimensional model for both academics and practitioners who want to better understand consumers' behavior in terms of why they are willing to pay a high price for a particular ICT good. These findings may also serve as a basis to successfully create, market, and monitor luxury brands or high-end products. The main contribution of this paper is the integrated conceptual framework for examining consumers' preferences for high-priced ICT products, which may be useful to researchers and marketers who wish to develop marketing strategies to improve their products' value for different segments of consumers.

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GREEN CLOTHING AND ECO-FASHION: A GROWING SUSTAINABLE MARKET FOR SME'S.

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ABSTRACT

Objective *– This study attempts to gain knowledge about consumer attitude towards organic clothing and organic clothing stores (retailers) and to see whether there is any potential this might have for young entrepreneurs. Here we have tried to evaluate the current state of consumer awareness and knowledge in Malaysia.* ***Design/methodology/approach*** *- The survey was conducted using mall-intercept personal survey whereby potential respondents were approached and were requested to fill up the likert-based questionnaire. The questionnaire was designed especially to elicit consumers' buying pattern and their views on organic clothes. Consumers were asked open frame questions on their agreements and disagreements. Reliability tests were conducted to check the internal consistency of measurement items and the Cronbach's alpha was calculated to show that there was high correlation between the items. Pearson correlation tests were also used to examine the individual relationships between the independent variables and the dependent variable (intention to buy organic clothes), and subsequently Multiple Linear regression (MLR) tests using stepwise regression method were conducted to find which determinants could explain the intention to purchase organic clothes. This is just a basic research done regarding consumer's attitude and awareness towards organic clothing and how it enhances the growing market for Small and Medium Enterprises. The local eco-entrepreneurs also find taking up a social responsibility to create awareness and encourage consumers to buy eco-friendly products.* ***Findings –*** *The data obtained from the survey were analyzed using Demographic Analysis of respondents, Chi-Square, ANOVA and Correlation Analysis to examine possible results that brings to the understanding of consumer knowledge, belief, perceptions and willingness to purchase and wear organic clothes.* ***Research Limitations*** *– the sample was restricted to a single geographic area in Malaysia and further the number of respondents may not portray the population responses with regard to organic clothes consumption.* ***Practical implications*** *– As Malaysians become more concerned about environment, the green consumer category will continue to grow. It is important for businesses to recognize this phenomenon and capitalize on the emerging market for environment friendly goods and services. Green Entrepreneur promotes the welfare of local people, hence he can be re-designated as Social Entrepreneur*

Keywords: green consumers, consumer power, environment, SME's, social entrepreneurship, Malaysia, business idea, eco tourism, organic clothing.

1. INTRODUCTION

We spend a lot of money on clothes, often driven by the desire for something fresh, new and trendy. We want to look young, attractive, and successful. Clothes are now becoming increasingly disposable. The EPA estimated in 2003 that there was 10 million tons of clothing and other textile waste thrown away. Clothes that come home in bags, get worn a few times, and then a shoved to the back of the closet and forgotten. To address this problem, some entrepreneurs are rethinking the clothes they are making and looking for ways to waste less, recycling existing clothes to give them a new life.

Wearing something green is a new fashion statement. Organic cotton is a major improvement over conventionally grown cotton, reusing clothing we already have is even greener. In the U.S. events are held where people bring their old clothes, swap them, or modify them at sewing stations with help from skilled workers. The old worn-out dresses are trimmed, cut, re-sewed, re-mend, and re-fashioned. This concept is spreading throughout the globe now.

Many people have drawers and closets full of old T-shirts that they don't wear but also don't want to throw away. Businesses are finding creative new ways to recycle such T-shirts to make a quilt, hand-bags and purses. Opportunities for recycled clothing are tremendous now. There are huge lot of old discarded clothes which can be re-invented at a green clothing business unit. This unit can be a Small and Medium Enterprise (SME) set up by a focused entrepreneur. This is how he can become a *Green Entrepreneur* in the clothing business.

Why do consumers go 'Green'? And what empowers consumers to select Green/organic Clothing items? Consumers' all over the world are facing a lot of changes in their consumption pattern in the last two decades. Demand towards products is driven by convenience and habit which in turn is hard to change. But consumers have scanty knowledge of the link between their consumption choices and growing market for local businesses as well as environmental consequences. Malaysia which is passing through the intermediary stage of development is facing with tremendous challenge in ensuring sustainable business development and environmental consciousness. The increase of the environmental consciousness has had a thoughtful effect on consumer behaviour, with the green product market expanding at a remarkable rate (Bhaskaran et al 2006). Therefore in the last few decades there has been an increase in production and consumption of organically produced products in the US and it has filtered in the Asian countries as well. Organically produced products are seen to have less impact on the environment.

Common beliefs and attitudes of the consumers and their awareness on environmental issues (Government awareness programmes) is basically the main reason. The western countries market has also done a broad generalization regarding demographic characteristics of green customers which has an impact on their buying behaviour. But an empirical study done here is ideal to evaluate the reasons on the whole. Every entrepreneur and marketer knows that material goods and services serve multiple purposes to consumers. Purpose is to satisfy basic needs such as subsistence and protection. In the last two decades consumers have become more environment and health conscious. The trend has led to more independent businesses and entrepreneurial ventures focused towards green consumers. In clothing products, the

environmental friendly clothing is termed as "Organic" clothing and is considered healthy (Chinnici et. al, 2002).

The product information is more important to a green consumer rather than a catchy advertising campaign. Even the hospitality industry with ecotourism falls under this banner. Green consumers lead to eco-friendly businesses and thereafter create and develop a new community of social entrepreneurs. Hence we find a paradigm shift from eco-entrepreneurs to social-entrepreneurs

In December 2000, the National Organic Standards Board of the U.S. Department of Agriculture (USDA) established a national standard for the term "organic". Organic Clothing is defined by how Clothing should be produced without the use of sewer-sludge fertilizers, most synthetic fertilizers and pesticides, genetic engineering (bio-technology), growth hormones, irradiation and antibiotics to plants. A variety of agricultural products can be produced organically, including fresh farm produce, grains, meat, dairy, eggs, and processed clothing products. "Organic does not mean "natural". There is no legal definition as to what constitutes "natural" Clothing. However, the Clothing industry uses the term "natural" to indicate that a Clothing has been minimally processed and is preservative-free. Natural clothing can include organic clothing, but not all natural clothing are organic in nature. Americans have become increasingly concerned about environment. Studies have shown that almost 62% to 77% Americans have joined the environmental movement from 2004-2006 (Can be seen in the Sierra Club membership). More people are making their homes energy efficient, driving more fuel efficient cars, focusing more on recycling, and buying products that are healthier and less harmful to society and the environment. This has given boost to independent businesses and state owned businesses dealing in environment friendly products. Local businesses focusing on green products have emerged as a growing business sector.

Significance of 'Green' in Clothing business:-

- ***Eco Fabrics / Organic Clothing***

For the last few years humans have realized the disastrous effects of plastic bags on the planet. Plastic bags have been stuffed in our lands via landfills, in our animals – plastic bags and plastic pieces were found in the stomach of several cows in India and have even managed to form an island – there is a large mass of discarded plastic waste floating in the Pacific Ocean too.

A lot has been done in an effort to get rid of plastic bags and bottles. Many corporate organizations and governments have attempted to them. But at the end of the day it boils down to the individual, not regulations, that will solve this problem (or any other for that matter, but that's another topic for another day!) As an individual we have the sole right to choose. And our decisions can make the difference to the planet, one bag at a time.

So what's the alternative? What constitutes an "eco bag and eco clothing"? It is made up of Eco fabric. Eco fabrics have always been around in the form of cloth and other sustainable materials that were used in ancient times. Fortunately a number of hip, fashionable and earth-

friendly people have come on strong to save their planet and oceans without compromising on the cool factor. They patronize eco friendly products and propagate the same.

Organic clothing is made of all-natural, non-synthetic materials and is a part of the organic agriculture movement. This movement emphasizes farming and processing that work with nature and help minimize air, soil and water pollution. Organic clothing materials come from plants that have not been radiated genetically modified or treated with synthetic or chemical pesticides. Organic Clothing fabric may be processed in any of the following ways:-

1. Natural and Sustainable Fabric like Organic Cotton, Organic Wool, Organic Silk, Hemp
2. Recyclable or renewable material like Bamboo, soy and Tencel, wood pulp product
3. "POP," fabric made from recycled plastic soda bottles

- ***Eco Fashion***

Eco-Clothing and Eco-Fashion is devoted to the future of clothing and textile design. It showcases and supports designs which do not only contemplate cut, form, and drape, but also the garment's social and environmental impact, from the cultivation of its fibers to its use and disposal. Globally Labour Laws and Environment Protections Laws have to be adhered to in dealing with Eco-Fashion and all Eco-products. Recycled products are also used in Eco-fashion i.e. re-invent clothes to reduce waste.

In today's fashion era, designers all over the world are making a marked statement with Eco-fashion or Green fashion, making clothes that best suit the environment. These 100% organic fabrics are grown without pesticides or herbicides made from synthetic products. Not only this, these 100% organic fabrics are treated without chemical dyes or bleaches. Today clothing made from organic fiber's such as organic cotton, hemp, soy silk, or bamboo are largely in fashion and widely used. For example Eco fabric is made with hemp plant? Hemp plant is produced without any insecticide and this plant requires very little water to grow. The plant also doesn't require any artificial fertilizers or synthetic herbs to grow quickly and densely. Not only this, the long and sturdy fibers of the plant make it last much longer and durable in nature.

The organic hemp plant has another characteristic too. It absorbs equal amounts of CO2 during its growing phase that will be released later when the plant is burnt for fuel or other purposes, and does not contribute to the green effect. However, due to organic properties of this plant, it is possible to substitute hemp for other material, thus reducing the effect of water pollution to a large extent. A non-combustible and non-toxic product in nature, hemp if cultivated in large quantities helps in conservation of natural resources.

- ***Green washing***

It means the fibers must be grown at certified organic farms, and they can't be blended with synthetics or dyed or bleached with chemicals.)

- ***Organic Dry Cleaning***

It's likely that our drycleaners use PERC, a petroleum-based solvent that is a known carcinogen. Drycleaners sometimes use DF-2000, a hydrocarbon solvent that is harmful to the environment. If one has intends to look for a clothing care process that makes less of an ecological impact, they can try green cleaning which is CO2-based, or opt for steam cleaning their clothing. Wet cleaning, a water-based process, is PERC-free but is not safe for all fabrics.

2. OBJECTIVES of THE STUDY

This study attempted to gain knowledge about consumer attitude towards organic Clothing products consumption and to see whether there is any potential this might have for changing their behaviour. The rationale for carrying out this study is that consideration for the environment could come only from well informed citizens who are aware of, and fully committed to their rights to a quality health and environment. Here we have tried to evaluate the current state of consumer awareness and knowledge in Malaysia.

The specific objectives of the study are –:

1. To gain knowledge on the local consumers awareness and attitude towards organic Clothing – consumers are among those who :-
    i. Have made their purchases along with organic clothing products.
    ii. Consumers who never purchased any organic products
    iii. Those who have been dedicated Green Consumers i.e. organic clothing buyers and consumers for a long time.
2. Investigate the reasons which may influence the intention of buying organic Clothing products.
3. Analyse how Green consumers “promote” Green Markets i.e. environment friendly product markets.
4. How “Green consumers” lead to the birth of “Green Entrepreneurs” who finally show signs of building a “Social Entrepreneur’s” profile.

3. LITERATURE REVIEW

As early as 1965, consumer’s attitude towards pesticide use in farms was explored (Bearler and Willitis, 1968; Sachs et al., 1987). Methods used to explore these topics have been varied, included mail and phone surveys. According to the research, there are number of reasons that consumer choose to purchase organic Clothing products, as well as some barriers. Reasons of buying would be grouped according to general and commodity-specific concerns (Yiridoe et al. 2005). Examples of concern include food safety, human health, environmental impact, whereas commodity attributes included taste , freshness and packaging (Yiridoe et al., 2005). Surveys have identified additional positive attributes that consumer associate with organic food products which include improved taste (Davies, 1995), they are better for environment (Lea and Worsley, 2005).

Empirical evidence shows that consumer’s difficulty in locating environmentally directed products is partly due to lack of information (Brown and Wahlers 1998). Research related to consumer attitudes and preferences for organic products shows that these products are

perceived as healthier than conventional alternatives (Chinnici et al., 2002; Harper and Makatouni, 2002). Consumers do not always buy sustainable products as consequences of environmental concern or to benefit the community or due to personal beliefs but mainly to give priority to health, to be part of the social group, to distinguish from others and to accomplish the need to try out new technologies (Vermier and Verbeke, 2004).

To the best of our knowledge very limited research has been done pertaining to consumer attitudes towards organic product in Malaysia, and what effect it will have on the up-coming businesses and the transformation of environmental friendly businesses to finally show concern for the society at large. Hence there is an advent of Social Entrepreneurs. Love for nature and environment will lead to care for the society as well. We also see the consumer's knowledge on government action towards healthy and organic products is on a very limited scale. The results could be used by the government, budding entrepreneurs and NGO's (Non Governmental Organisations) to tap a business opportunity, plan marketing strategies, design proper sales channel and target it to these group of consumers. With awareness creation by the government sector this group of consumers will increase.

Over the last few decades many researchers in Malaysia have studied the SME's in Malaysia in different fields of interest. For example micro-credit (Sudin and Bala, 1994; Moha Asri, 1997, Rosman *et al*. 2004) , franchise (Abu Bakar and Rohaizat, 2003), business strategy (Mohd Rafi and Syed Ihsan, 2002), human resources management (Wyer and Mason, 1998; Hooi, 2006), and information technology (Moha Asri, 2002; Foong, 1999). The environment 'green' business related researches have been done in a qualitative way (Mohd.Rafi, 2010) and few researches on Green consumers and Organic Food (Naila Aaijaz, Mohd. Dahlan, and Ghazali, 2009). But no specific research related to Organic Clothing and Eco-fashion has been done which sites this as a huge SME opportunity for young entrepreneurs.

4. RESEARCH DESIGN (RESEARCH METHODOLOGY)

The survey was conducted using mall-intercept personal survey. Potential respondents were approached while they were shopping in supermarkets located in 3 different locations within Kota Bharu. The supermarkets were Mydin (Kubang Kerian), Billion, KB Mall and Tesco. Prior to data collection, the availability of organic clothing within these locations was confirmed. The respondents were requested to fill up the questionnaire and to return it back immediately to the researcher. As a result, a total of 104 questionnaires were collected. The questionnaire was designed especially to elicit consumers' buying pattern and their views on organic products. Consumers were asked open frame questions on their agreements and disagreements. We used Likert Scale (1 = almost always,, 2=to a considerable degree, 3=occasionally, 4=seldom and 5=never). This is just a basic research done regarding consumer's attitude and awareness towards organic clothing and how it enhances the growing market for Small and Medium Enterprises. The local eco-entrepreneurs also find taking up a social responsibility to create awareness and encourage consumers to buy eco-friendly products. The following statistical tests were applied to analyse the data collected :-

i. Reliability tests were conducted to check the internal consistency of measurement items.

ii. Cronbach's alpha was calculated. It's a tool to observe reliability of scales. Cronbach's alpha determines the internal consistency or average correlation of items in a survey instrument to gauge its reliability.
iii. Pearson correlation tests were used to examine the individual relationships between the independent variables and the dependent variable (intention to buy organic products).
iv. Multiple Linear regression (MLR) tests using stepwise regression method were subsequently conducted to find which determinants could explain the perception and intention to purchase organic Clothing products

Finally we arrive at the The Green Consumer Information Paradox, which supports the contention that perceptions towards organic products depict the strongest relationship with the buyer's intention to buy organic clothing followed by the buyer's belief that by using organic product he is contributing to preserving the environment. The researchers here contend that this environment friendly attitude of consumers will give rise to eco-entrepreneurs and subsequently will culminate into evolution and rise of social entrepreneurs. Hence the following hypothesis:-

Hypothesis formulation :-

1st Hypothesis

H0 : Customers having environmental perception intend to buy Green Clothing.

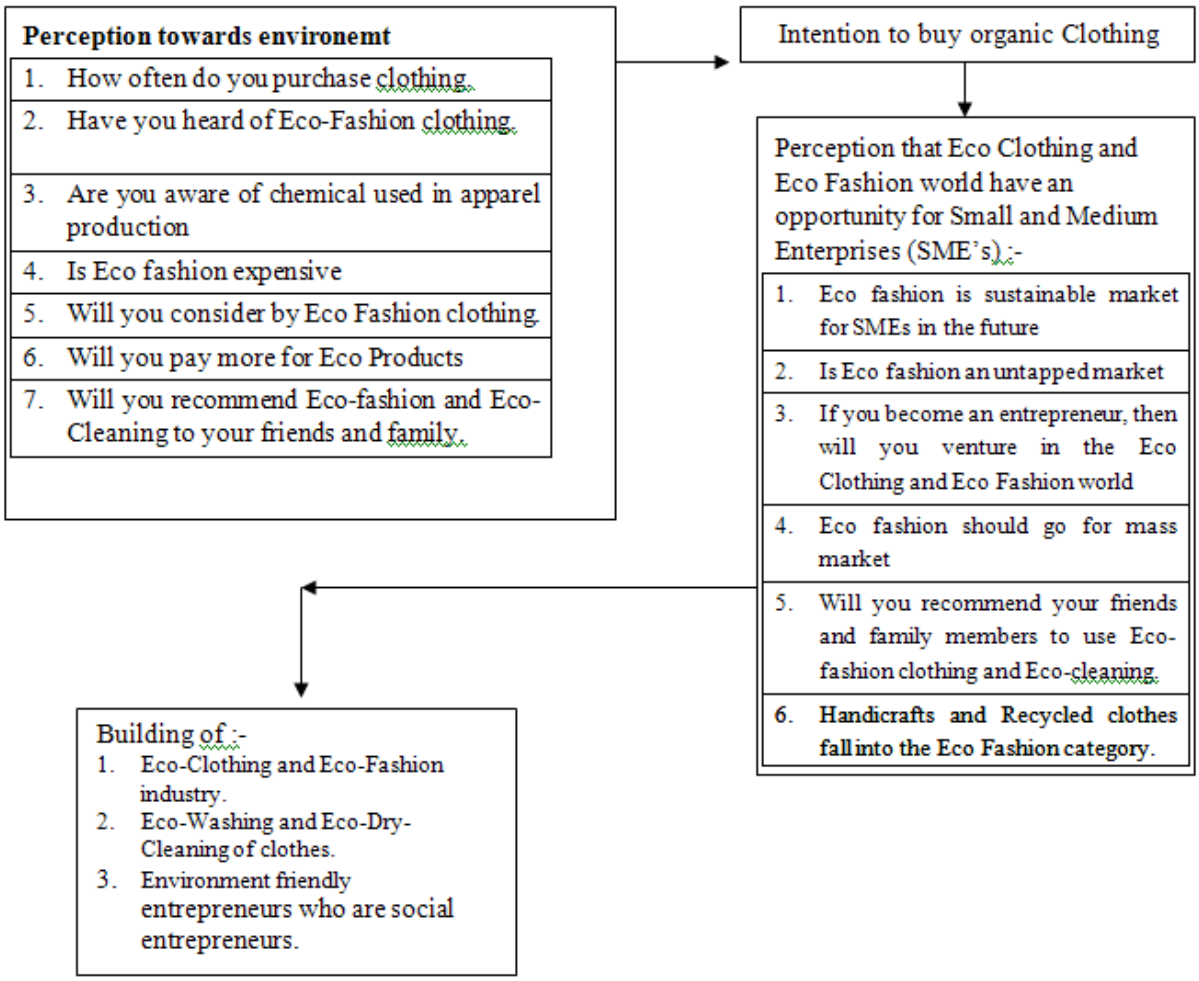
H1: Customers having environmental perception do not intend to buy Green Clothing

2nd Hypothesis

H0: Customers having environmental perception have an inclination to become green SME entrepreneurs.

H2: Customers having environmental perception do not have an inclination to become green SME entrepreneurs.

Conceptual Framework and Hypothesis formulation
FIGURE – 1



5. RESEARCH ANALYSIS and FINDINGS

Reliability Test Analysis (Scale Alpha) / Cronbach's alpha

The Reliability Test results as seen in Table 1 below reveals that the reliability are satisfactory as Cronbach's alpha exceed 0.70 (Nunnally, 1978). Cronbach's alpha measures how well a set of items (or variables) measures a single uni-dimensional latent construct. When data have a multi-dimensional structure, Cronbach's alpha will usually be low. Technically speaking, Cronbach's alpha is not a statistical test - it is a coefficient of reliability (or consistency). Cronbach's alpha can be written as a function of the number of test items AND the average inter-correlation among the items. Below, for conceptual purposes, we show the formula for the standardized Cronbach's alpha:

$$\alpha = \frac{N \cdot \bar{c}}{\bar{v} + (N-1) \cdot \bar{c}}$$

Here N is equal to the number of items, c-bar is the average inter-item covariance among the items and v-bar equals the average variance. One can see from this formula that if you

increase the number of items, you increase Cronbach's alpha. Additionally, if the average inter-item correlation is low, alpha will be low. As the average inter-item correlation increases, Cronbach's alpha increases as well. This makes sense intuitively - if the inter-item correlations are high, then there is evidence that the items are measuring the same underlying construct. This is really what is meant when someone says they have "high" or "good" reliability. They are referring to how well their items measure a single uni-dimensional latent construct. Thus, if we have multi-dimensional data, Cronbach's alpha will generally be low for all items. In this case, we run a factor analysis to see which items load highest on which dimensions, and then take the alpha of each subset of items separately.

Table – 4.1 (a) : Standardised Confirmatory factor loadings (Perception and Entrepreneurial inclination towards Green Clothing and Eco Fashion)

	Construct	Items	Cronbach Alpha
	Perception towards Environment	7 items	
1.	How often do you purchase clothing.		-.321
2.	Have you heard of Eco-Fashion clothing.		.346
3.	Are you aware of chemical used in apparel production		.428
4.	Is Eco fashion expensive		.334
5.	Will you consider by Eco Fashion clothing.		.833
6.	Will you pay more for Eco Products		.673
7.	Will you recommend Eco-fashion and Eco-Cleaning to your friends and family.		.682
	Entrepreneurial Inclination	6 items	
1.	Eco fashion is sustainable market for SMEs in the future		.752
2	Is Eco fashion an untapped market		.685
3.	If you intend to become an entrepreneur, then will you venture in the Eco Clothing and Eco Fashion world		.746
4.	Eco fashion should go for mass market		.708
5.	Will you recommend your friends and family members to use Eco-fashion clothing and Eco-cleaning.		.752
6.	Handicrafts and Recycled clothes fall into the Eco Fashion category.		.298

Note : All factor loadings are significant at p=0.01

Table – 4.1 (b) (i) Reliability Statistics (Perception of Organic (Green) Clothing.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.690	.687	7

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
How often do you purchase clothing	16.955	17.521	-.321	.532	.777
Are you aware of chemical used on apparel production	16.705	12.119	.428	.376	.648
Will you consider buying Eco-Fashion clothing	17.345	11.624	.833	.839	.570
Will you pay more for Eco products	17.220	11.188	.673	.779	.582
Is Eco fashion expensive	17.405	12.785	.334	.633	.674
Have you heard of Eco fashion	16.395	10.914	.346	.561	.695
Will you recommend Eco Fashion and Eco-Cleaning to your friends and family	17.405	11.398	.682	.744	.584

Interpretation of Reliability Analysis of Perception of Organic (Green) Clothing

Cronbach's Alpha can take values between 0 and 1. The closer to 1, the more reliable the scale of our variable. Table 4.1 (b) (i) reveals reliability are satisfactory as Cronbach's alpha exceeds 0.69. When we examine the Corrected Item – Total Correlation we find that "How often do you purchase clothing" variable has the lowest value (-0.321) and Cronbach's alpha for the overall scale of our variable is 0.690. If we delete this item, the Cronbach's Alpha 'if Item deleted column' shows that the overall reliability will increase to 0.777. Judging from this, deletion of this item will definitely increase our reliability much higher, hence we decided to delete it and retain rest of our items**. We can see that all the items are around 0.7. In general most researchers agree that 0.7 is acceptable so the scale of our "Perception of Green Clothing" is acceptable.**

Table – 4.1 (b) (ii) Reliability Statistics - Entrepreneurial inclination

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.848	.851	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Should Eco-fashion go for mass market	12.890	13.495	.708	.836	.811
Handicrafts and Recycled clothes fall into the eco-fashion category	12.890	15.656	.298	.246	.881
Is Eco_fashion an untapped market	12.705	13.506	.685	.826	.814
Eco Fashion is a sustainable market for SME in the future	12.580	13.280	.666	.537	.817
Will you recommend Eco Fashion and Eco-Cleaning to your friends and family	12.705	13.174	.752	.763	.802
If you intend becoming entrepreneur, will you venture in the Eco-Fashion or Eco-Cleaning	12.255	11.196	.746	.749	.802

Cronbach's Alpha can take values between 0 and 1. The closer to 1 the more reliable the scale of our variable. Table 4.1 (b) (ii) reveals reliability are satisfactory as Cronbach's alpha exceed 0.80. When we examine the Corrected Item – Total Correlation we find that "Handicrafts and Recycled clothes fall into the Eco Fashion category." This variable has the lowest value (0.298). Cronbach's alpha for the overall scale of our variable is 0.848. If we delete this item, the Cronbach's Alpha if Item deleted column shows that the overall reliability will increase only slightly to 0.881. Judging from this, deletion of this item would not increase our reliability much, hence we decided to retain all our items. We can see that all the items are around 0.7. **We can see that all the items are around 0.7. In general most researchers agree that 0.7 is acceptable so the scale of our "Entrepreneurial Inclination towards Eco Clothing" is acceptable.**

Data Analysis

The data obtained from the survey were analyzed using Chi-Square, ANOVA and correlation analysis to examine possible results that brings to the understanding of consumer knowledge, belief, perceptions and willingness to purchase and consume organic Clothing. All statistical analyses were using SPSS package version 16.0.

Analysis of Findings

Demographic Analysis of the Respondents

Two hundred respondents participated in the survey. Majority were male 69 %

Refer Table 4.3.1 (a) and the majority of the respondent's (31.5%) age ranged from 25-30 years. The sample was predominantly Malaysian nationals (87%) with ethnic races - Malays (62%), Chinese (12.5%), Indians (12.5%) and Others (26%). Most respondents (37.5 %) were married and (19%%) were married with kids. 44% respondents had experienced some chronic skin illness themselves and 56% respondents' family members had suffered from some chronic skin illness earlier. Table 4.3.1 (a) demonstrates the summary of sample demographics.

Table 4.3.1 (a) Demographic Profile of Respondents (n=200)

Items	Number	Percentage (%)
Gender		
Male	138	69%
Female	62	31%
Nationality		
Malaysians	174	87%
Non-Malaysians	26	13%
Ethnicity		
Malay	124	62%
Chinese	25	12.5 %
Indians	25	12.5%
Others	26	13%
Age		
18-24	50	25%
25-30	63	31.5%
31-40	37	18.5%
41-50	37	18.5%
51 and above	13	6.5%
Marital Status		
Single	62	31%
Engaged	25	12.5%
Married	75	37.5%
Married with Kids	38	19%
Level of Education		
Diploma	28	26.9 %
Bachelor	39	27.9 %
Master	26	25 %
PhD	12	11.5 %
Others	05	4.8 %
Occupation of respondents		
Administration	15	7.5%
Academics	54	27%
Sales & Marketing	19	9.5%
Accounts	6	3%

Medical Doctor	27	13.5%
Engineer	12	6%
IT/Technical job	17	8.5%
Student	35	17.5%
School Teachers	15	7.5%
Family Income per month		
RM 2000 under	76	38%
RM 2000-5000	49	24.5%
RM 5000-8000	12	6%
RM 8000-12000	50	25%
RM 12000-15000	6	3%
RM 15000 and above	7	3.5%
Respondent suffered from any skin illness		
Always	0	0%
To a considerable degree	24	12%
Occasionally	48	24
Seldom	25	12.5
Never	103	51.5%
Family suffered from any chronic skin illness		
Always	0	0%
To a considerable degree	12	6%
Occasionally	37	18.5%
Seldom	63	31.5%
Never	88	44%

(b) Buying Pattern of Organic Products

The respondents were asked to indicate their Apparel buying behaviour related to organic clothing. Category 1, 2 and 3 are those who never bought (non users) any of organic products and they made up to almost 87% of the sample. That is only 13% had bought and used Organic clothing in the past. It somehow signified that the sample captured unequal number of organic product users and non users. Table 4.3.1 (b).

Table 4.3.1 (b) Respondent's category of Organic Clothing Buyer

Category	Organic Clothing Buyer	Frequencies	Percentage
1.	I have not bought organic clothing in the past and I am not thinking about buying organic clothing now.	38	19 %
2	I have not bought organic clothing in the past and I am thinking about buying in the near future.	112	56 %
3	I have not bought organic clothing in the past and I am definitely planning to buy organic clothing in the future.	24	12 %
4	I used to buy organic clothing, but I no longer buy them, I might start buying them again in the future.	12	6 %
5	I buy organic clothing on most, not all trips to the market place	14	7 %

(c) Pearson's R Test of Correlation

Pearson correlation tests were used to examine the individual relationships between the independent variables

(i) Relationships between Perception variables of Green Clothing and intention to buy Organic products :-

The above table of correlation shows that there is significant relation existing between intend to buy eco clothing and all other independent variables as 'r' is ranging from 0.336 to 0.774, p=.000 i.e. p> 0.05). Therefore all variables have a positive correlation and are associated with 'intention to buy Eco-clothing'. So we should not reject our 1st null hypothesis i.e. customers having environmental perception will buy eco-clothing. The tests indicate that 2 independent variables 'Will you pay more for eco-products', and 'Will you recommend Eco-Clothing and Eco-Cleaning to your family and friends'are significantly related to intention to buy organic products. However the strength of the relationship varies from weak to strong. Table 4.3.1 (c)(i) shows the summary results.

(ii) Relationships between independent variables and Inclination to become entrepreneur in the Eco Clothing and Eco fashion world.

The above table of correlation shows that there is significant relation existing between intend to buy eco clothing and all other independent variables as 'r' is ranging from 0.354 to 0.812, p=.000 i.e. p> 0.05). Therefore all variables have a positive correlation and are associated with 'inclination to become entrepreneurs in Eco Clothing SMEs'. So we should not reject our 2nd null hypothesis i.e. customers having environmental perception will buy eco-clothing. The tests indicate that 2 independent variables 'Eco-Fashion is a sustainable market for SMEs in the future, and Will you recommend Eco-Clothing and Eco-Cleaning to your family and friends' are significantly related to inclination to become entrepreneur in the eco-Clothing and eco-fashion world. However the strength of the relationship varies from weak to strong. Table 4.3.1 (c)(ii) shows the summary results.

Table 4.3.1 (c)

(i) Relationships between the Independent variables and Intention to buy Organic Products

(ii) Relationships between independent variables and Inclination to become Entrepreneur in the Eco Clothing and Eco fashion world.

(i)	Relationships between Perception variables of Green Clothing and intention to buy Organic products		
	Dependent Variable		
1.	Will you consider buying Eco Fashion clothing.		
	Independent Variables	Pearson's R Test of Correlation Sig. (1-tailed)	*P value (significance)
1	How often do you purchase clothing.	**-.327**	**Insignificant variable cancelled**
2	Have you heard of Eco-Fashion clothing.	**.366**	**.000**
3	Are you aware of chemical used in apparel production	**.475**	**.000**
4	Is Eco fashion expensive	**.583**	**.000**
5	Will you pay more for Eco Products	**.858**	**.000**
6	Will you recommend Eco-fashion and Eco-Cleaning to your friends and family.	**.774**	**.000**
(ii)	Relationships between independent variables and Inclination to become an entrepreneur in the Eco Clothing and Eco fashion world.		
	Dependent variable:-		
1.	If you intend to become an entrepreneur, then will you venture in the Eco Clothing and Eco Fashion world		
	Independent Variables:-	Pearson's – R Test of Correlation Sig. (1-tailed)	*P value (significance)
1.	Eco fashion is sustainable market for SMEs in the future	**.603**	**.000**
2	Is Eco fashion an untapped market	**.510**	**.000**
3.	Eco fashion should go for mass market	**.517**	**.000**
4.	Will you recommend your friends and family members to use Eco-fashion clothing and Eco-cleaning.	**.812**	**.000**
5.	Handicrafts and Recycled clothes fall into the Eco Fashion category.	**.354**	**.000**

***Correlation is significant at the 0.01 level (1-tailed)**

*** p value is significant at <.05**

(d) Multiple Linear Regression Tests

Multiple Linear regression (MLR) tests using stepwise regression method were subsequently conducted to find which determinants could explain the intention to purchase organic clothing products. The advantage of step-wise regression is that it will take the significant variable first and keep the other variables in reserve and next another significant variable will be included. By this iteration method, the R^2 values will be given stepwise so that one can observe the contribution of each independent variable to the model.

(i) Intention to purchase organic clothing products

Table 4.3.1 (d) (i) Variance explained by factors - purchase intention of organic Clothing (Summary)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.915[a]	.838	.834	.2911

a. Predictors: (Constant), Will you recommend Eco Fashion and Eco-Cleaning to your friends and family, Are you aware of chemical used on apparel production, Is Eco fashion expensive, Have you heard of Eco fashion, Will you pay more for Eco products

b. Dependent Variable: Will you consider buying Eco-Fashion clothing

Table 4.3.1 (e) (i) : Factors predicting purchase intention of organic Clothing products ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	84.846	5	16.969	200.314	.000[a]
	Residual	16.434	194	.085		
	Total	101.280	199			

a. Predictors: (Constant), Will you recommend Eco Fashion and Eco-Cleaning to your friends and family, Are you aware of chemical used on apparel production, Is Eco fashion expensive, Have you heard of Eco fashion, Will you pay more for Eco products

b. Dependent Variable: Will you consider buying Eco-Fashion clothing

Table 4.3.1 (f) (i) : Factors predicting purchase intention of organic Clothing products (Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.137	.090		1.532	.127
	Have you heard of Eco fashion	.053	.019	.106	2.826	.005
	Are you aware of chemical used on apparel production	.117	.023	.167	5.039	.000
	Is Eco fashion expensive	.167	.027	.235	6.262	.000
	Will you pay more for Eco products	.390	.036	.504	10.842	.000
	Will you recommend Eco Fashion and Eco-Cleaning to your friends and family	.158	.039	.194	4.092	.000

a. Dependent Variable: Will you consider buying Eco-Fashion clothing

(a) dependent variable : Intend to purchase organic Clothing.

Interpretation of MLR (Multiple Linear Regression) in Test (i).

In the first iteration, perception '*Have you heard of Eco Fashion*' is the first independent variable which enters the model and it produces a R^2 of 19% as shown in Table 4.3.1 (f)(i). In the second iteration – '*Will you recommend Eco Fashion and Eco Cleaning to family and friends*' enters the model which adds to the R^2 by 39%. The R^2 improves by 20% because of this variable.

The dominant factors in purchase intention towards organic clothing products are given in the Table 4.3.1 (f). Here "t" value is important for interpretation. In the first iteration, the "t" value was 2.826 and significant. This "t" value is the error level present in the model which takes purchase intention of organic clothing as dependent variable and perception towards organic clothing '*heard about Eco fashion*' as the independent variable. In the second iteration when perception towards organic clothing factor is added to consumers '*aware on chemical use on apparel*' on organic clothing being environment friendly, the 't' value for increases up to 5.039 and the 'Is *Eco fashion expensive'* option shows a 't' value of 6.262. This 't' value decrease (or error level decrease) is not only because of addition of organic clothing as environment friendly factor but also because of the interaction or the joint contribution of perception towards organic clothing factor and consumers awareness on organic Clothing being environment friendly factor. Similarly the 't' value further increases in the fourth iteration where it is 10.842 (increased) for perception factor, then it decreases in the fifth (last) iteration to 4.086 for '*Will you recommend to family and friends*' on environment friendly factor. Hence the first and last factors are less significant. These imply

that the contribution of the model improves further. The result suggest that an individual who is also an organic Clothing buyer perceived that factors that influences him to buy organic Clothing products are his perception '*Will you pay more for eco product*', perceived that it is environment friendly '*Aware of chemical use*' and customer is aware that '*Eco products are expensive*' also.

(ii) Inclination to become an entrepreneur in the Eco-clothing and Eco-Fashion world.

Table 4.3.1 (d)(ii) Variance explained -factors in purchase intention of organic Clothing - Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.866[a]	.749	.743	.6140

a. Predictors: (Constant), Will you recommend Eco Fashion and Eco-Cleaning to your friends and family, Handicrafts and Recycled clothes fall into the eco-fashion category, Eco Fashion is a sustainable market for SME in the future, Is Eco_fashion an untapped market, Should Eco-fashion go for mass market

b. Dependent Variable: If you intend becoming entrepreneur, will you venture in the Eco-Fashion or Eco-Cleaning

Table 4.3.1 (e)(ii) : Factors predicting purchase intention of organic Clothing products ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	218.363	5	43.673	115.844	.000[a]
	Residual	73.137	194	.377		
	Total	291.500	199			

a. Predictors: (Constant), Will you recommend Eco Fashion and Eco-Cleaning to your friends and family, Handicrafts and Recycled clothes fall into the eco-fashion category, Eco Fashion is a sustainable market for SME in the future, Is Eco_fashion an untapped market, Should Eco-fashion go for mass market

Table 4.3.1 (f) (ii): Factors predicting inclination to become an entrepreneur in Eco-clothing and Eco-fashion world - Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.466	.170		-2.743	.007
	Eco Fashion is a sustainable market for SME in the future	.359	.063	.278	5.683	.000
	Is Eco_fashion an untapped market	-.111	.118	-.081	-.941	.348
	Should Eco-fashion go for mass market	-.092	.125	-.065	-.739	.461
	Handicrafts and Recycled clothes fall into the eco-fashion category	.145	.053	.111	2.737	.007
	Will you recommend Eco Fashion and Eco-Cleaning to your friends and family	1.052	.069	.759	15.259	.000

a. Dependent Variable: If you intend becoming entrepreneur, will you venture in the Eco-Fashion or Eco-Cleaning

Interpretation of MLR (Multiple Linear Regression) in Test (ii).

In the first iteration, inclination '*Eco Fashion is a sustainable market for SME in the future*' is the first independent variable which enters the model and it produces a R^2 of 63% as shown in Table 4.3.1 (f)(ii). In the second iteration – '*Is Eco-fashion an untapped market' enters the model and* adds to the R^2 by 118%. The R^2 improves by 55% because of this variable.

The dominant factors in inclination to become entrepreneur in Eco-clothing and Eco-fashion are given in the Table 4.3.1 (f)(ii). Here "t" value is important for interpretation. In the first iteration, the "t" value was 5.683 and significant. This "t" value is the error level present in the model which takes '*inclination to become entrepreneur in Eco-clothing and Eco-fashion world*' as dependent variable and '*Eco fashion is a sustainable SME market in the future*' as the independent variable. In the second iteration when '*inclination to become entrepreneur in Eco-clothing and Eco-fashion world*' factor is added to consumers '*Is Eco-fashion an untapped market'* , the 't' value for the 2nd iteration decreases to -.941 and the 'Should *Eco-fashion go for mass market'* option shows a 't' value further decrease to -.739. This 't' value decrease (or error level decrease) is not only because of addition of '*Eco-fashion should go for mass market*' but also because of the interaction or the joint contribution of '*Is Eco-fashion an untapped market'and 'Eco-fashion go for mass market'*. Similarly the 't' value further increases in the fourth iteration where it is 2.737 (increased) for inclination factor, then it increases further in the fifth (last) interation i.e. 15.259 for '*Will you recommend to family and friends*' on inclination factor. Hence the second and third factors are less significant. These imply that the contribution of the model improves further. The result

suggest that an individual who is also an organic clothing buyer will have an inclination to recommend to family and friends and finds Ec-fashion being a sustainable SME market in the future and will be inclined to become an entrepreneur in the Eco-fashion world.
Discussion and Inference of The Green Consumer Information Paradox

Result indicated that perceptions towards organic products depict the strongest relationship with buyer's intention to buy organic products followed by the buyers belief that by consuming organic product he is contributing to preserving the environment. Yiridoe et al. (2005) has admitted that some of the general concerns with regard to consumer's perception towards organic product include safety, environmental impact, human health, taste, nutritional value and visual appeal. The other factors i.e. belief that a product is safer and availability of product information also support the intention to buy organic products. However, other factors i.e. awareness about availability of product (location) were found to be insignificantly related to the intention to use the product. Studies have shown that most significant factors affecting nature is not the official government policy but public awareness or public concern for environment. It can be argued here, that, consumers who are increasingly concerned and realized the essentials of environmental issues are considered as "Green Consumers"; those consumers who make their buying decisions at least partly on the basis of personal environmental criteria.

6. RECOMMENDATIONS

(a) Manufacturing for, and Marketing to the Green Consumers – reverse side of the coin.

In the 20th and 21st century, the entrepreneur or person who invests and runs his own business for Green Consumers can be termed as Eco-Entrepreneur. That is the entrepreneur who is environment friendly. In other words, he is an organic products' farm owner who delivers the highest standard in product integrity to his customers. Understanding consumer behaviour is critical to any entrepreneur. Hence the inference of this study is highly useful to an eco-entrepreneur or a prospective eco-products entrepreneur. For the Green Entrepreneur the stakes are high. Taking the research study inference i.e. The Green Consumer Information Paradox he can plan all environmental campaigns – from building public awareness to driving organic product sales. To be successful in this market it is important to tie the product's environmental attributes to the lifestyles of the target customers.

(b) Eco-Tourism
As Malaysians become more concerned about environment, the green consumer category will continue to grow. It is important for businesses to recognize this phenomenon and capitalize on the emerging market for environmentally friendly goods and services. Eco-tourism is becoming very popular in Malaysia. It is also a service which is environment friendly. Customers interested in eco-tourism want to enjoy nature's offerings and are ready to pay more to preserve and protect the environment.

(c) Paradigm Shift from Eco-entrepreneurship to Social Entrepreneurship
Despite the exciting opportunities of the green consumer market, eco-entrepreneurs must not neglect the traditional consumer values:-
1. Price Factor – Few will pay extra for greener (organic) environment friendly products.

2. Quality factor – many may not like green products – less effective.
3. Convenience – only minimal inconvenience will be tolerated by consumers of green products.
4. Availability – very few customers will go out of the way to purchase green products.

Finally we can say that Green Entrepreneur promotes the welfare of local people, hence he can be re-designated as Social Entrepreneur. Many researches can be done to study the impact of Green Consumer on the growth of Green Entrepreneurs and finally Social Entrepreneurs.

7. LIMITATION and FUTURE RESEARCH

The limitations of this study is that the sample was restricted to a single geographic area in Malaysia. Further the number of respondents may not portray the population responses with regard to organic-clothing consumption. Therefore additional studies will be necessary to better discriminate between consumer groups to determine which segments are most appropriate to market and to promote organic clothing as a way of building sustainable consumption pattern for the future. Since consumers' perception towards organic Clothing product has a strong correlation with the intention of buying organic clothing, therefore it is wise to further investigate the details of how consumer perceived the organic clothing. This will help marketers with better selling point when promoting these products to the public at large. Many awareness creation activities should be held and showed among the younger generation consumers in their early age. It should be done before they reach the stage where their consumption pattern becomes their habit, and determines their future identity and self values.

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ENVIRONMENTAL MANAGEMENT OF AN INDUSTRIAL SECTOR: THE CASE OF ITALIAN DRINKING WATER SUPPLY

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ABSTRACT

The drinking waters industry is recording a growth rate three times superior compared with other beverage compartments, becoming a dominant market and moving conspicuous business. The growing interest towards this sector is the result of changing in eating habits and lifestyles that encourage the consumption of health and well being products. As a consequence, spring waters have become large consumption beverage, because of consumers consider them healthier than tap water, and they have caused the enlargement of packaging waste. The analysis of environmental issues of life cycle of a product, from cradle to grave illustrates the massive negative effects of this sector on the environment and social organization. The objective of this note, which is the first part of a wider research still in progress, is to analyze the most important considerations that have promoted the huge increase of consumption of bottled drinkable water reducing tap water utilization. Subsequently, applying the international methodology Material Flow Analysis (MFA), the authors investigate the sustainability of bottled and tap water sector from cradle to the consumption phase. The preliminary results allow proposing different industrial strategies, in particular as regard waste management.

Keywords: water system, bottled water, tap water, environmental management system, waste management.

INTRODUCTION

Due to massive promotional efforts, bottled water compartment marks a sharp consumption increase about three times more than other beverages and it makes up the largest portion of the beverage industry with huge turnover. Bottled water consumption is definitely higher than beer and sweet soft drinks consumption. According to Global Drinks, in 2008 worldwide bottled water consumption accounted for 218 billion litres. Even though the majority of bottled water market is made up by Europe and United States of America with the highest per capita consumption, Asian and African markets are growing and will become soon target of future competition strategies. In Europe, Italy shows the highest per capita consumption, about 200 liters/year (L/y), with a 2008 turnover equal to 2,300 million Euros although a negative market trend (- 2%) compared to 2007. Worldwide, Arab Emirates holds the consumption record with approximately 300 L/y.

In 2008, Italian market operates with 189 sources and counts 321 brands [2]. Dominant corporations with very large market share; besides high advertising budget brand leader companies drive domestic industry, several regional ones successfully entered local market often with private label [2]. Thus, there is the possibility of choosing among a wide array of products whose peculiarities and differences are not well perceived by the consumer who is often perplexed and confused.

Eating habits and lifestyles changing that incentive the health and well-being products consumption causes bottled water growing interest, as many advertising companies promote in their campaigns [3]. Moreover food safety worry, increased after some public health jeopardizing events, makes the consumers suspicious towards tap water quality and safer to bottled water. Therefore, if in the past bottled water use was motivated by its therapeutic utility, currently it is a widely used beverage. Italian regulation allows several "water product" sales: mineral water, potable water, table water and spring water [6]. This is a serious problem; because often consumers consider these terms synonymous and ignoring the differences (chemical-physical ones) among them simply associate bottling to safety. In this paper with the expression *bottled water* we refer to mineral, table and spring water while, *tap water* indicates water distributed by public water system (for example Apulia water system).

To choose bottled instead of tap water also reflects consumer's lack of confidence towards ground water pollution or contamination during capitation and transportation. These elements are at the base of several bottled water-advertising campaigns, which make the direct capitation one of the principal factors to ensure water safety and purity. Obviously it does not mean that, in an absolute sense, bottled water is free from potential contamination and polluting agents because by law, drinking water, is constantly checked and analyzed in order to guarantee high safety standard [1-3-4].

A serious problem linked to the bottled water consumption exponential growth is the amount of packaging waste increases [9-10]. The wrong packaging waste management does not match waste policies efforts to minimize environment impacts. Based on total bottled water consumption (281 billion L) and an average weight of PET bottle of 30-35 g we estimate that, on a yearly basis, 5-7 million of tons (Mt) of plastic packaging waste are produced. They are very often sent to landfills or treated into incinerator plants with a huge resources loss and significant environmental impacts.

Glass or PET (Polyethylene Terephthalate) mono-use bottles represent a sort of quality and hygiene warranty for consumers, and in the same time, they are a strategic innovation and marketing tool for producers. Not by a chance, competition among bottled water companies is mainly played on packaging and design. Environmental evaluation linked to different phases of water life cycle, from natural sources to consumer tables, shows real negative environmental and social impacts of this industrial sector.

OBJECTIVE

The goal of this study is to analyze the sustainability of industrial sector of drinkable water focusing on the issues of waste generation (mainly plastic and glass bottles) and natural resources consumption and to propose different industrial strategies. This note presents the

findings of different studies carried out in the sectors of bottled water and tap water for describing the material basis of two sectors and making comparison of the results. After the introduction, the note presents the methodology of the research describing the main results of the investigation in the sector of bottled and tap water and summarizing the main findings of this investigation in the conclusion paragraph.

MATERIALS AND METHODS

The first step of analysis is the study of the changes happened into eating habits and lifestyles, which make possible the exponential growth of bottled water market. Subsequently, it has been focused one of the main problem of drinkable water system that is the disposal of the related packaging (plastic bottle). For scrutinizing the performance of drinkable water systems, the diagram flows of bottled water and tap water have been studied. The result of this first phase of Material Flow Analysis (MFA) was a summary picture of different phases for capturing, processing (for instance filling or potable treatments) and delivering water to family. Hence, a collection of data regarding the material and energy consumption has been carried out. In order to gather information, a review study of company reports, interviews with managers and visits to administrative individuals have been conducted. The data gathered has been compared with data from national and international literature. The analysis of energy, water, and waste flows and their external effects has allowed making a representation of their environmental performance.

In the final step of our analysis we discussed critical points of these chains and we focused on waste management issues and strategies to reduce environmental burdens.

BOTTLED AND TAP WATER MATERIAL FLOW ANALYSIS

As mentioned above, we carried out the MFA of two systems of drinkable water: bottled and tap. In both studies, the MFA analysis regards one cubic meter (m^3) of water, and electricity consumption figures are converted into primary energy value MJ (million of Joules) based on conversion factor of 9 MJ/kWh.

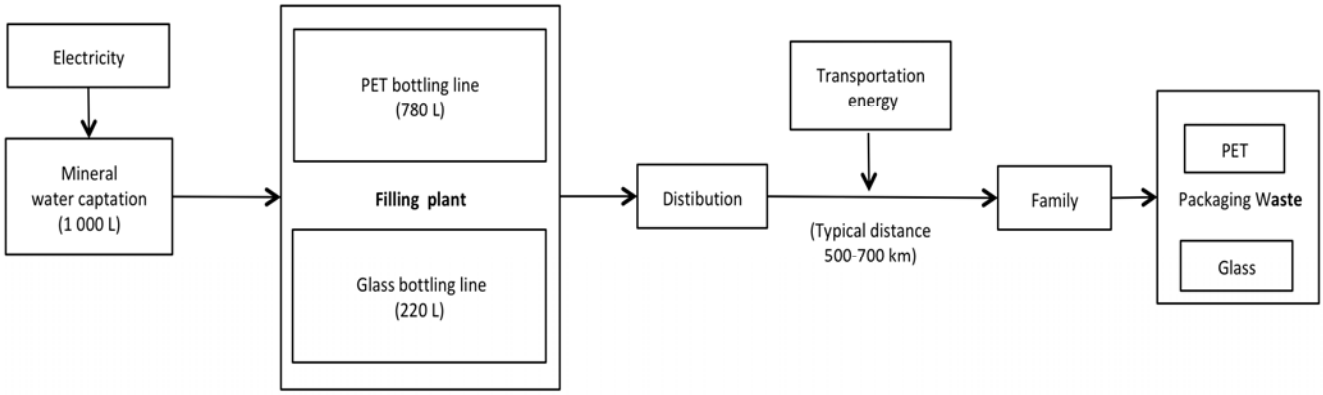
The analysis boundaries are all phases between natural sources (catchment) and family (consumers) as figures 1 and 2 show.

Bottled water case study

As concerning bottled water compartment, the analysis starts from water catchment by natural source directly bottled into a filling plant (Figure 1). At this step of our research we have not gathered enough data to estimate the typical distance between natural water sources and filling plants and considering that the sources are very often close to plants, the authors do not included energy input related to this point. We underline that, according to European Economic Community (EEC) and Italian laws “natural mineral water” utilization (catchment) must occur near to the spring itself and the same water must be bottled pure as it is not performing any drinking treatment (otherwise it cannot be defined “natural mineral water”) [6-7]. No chemical-physical treatments are made before bottling because they are directly complies with low parameters included into Italian drinking water dispositions. According to

the law it is allowed carbon dioxide adding. Water extraction and possible stocking must occur with methods and materials able to avoid surrounding environments contamination. Water is usually withdrawn, based also upon source features, by lifting pump systems whose energy input is lower than 2 kWh/m^3 of water. The next phase is diversifies according to bottle raw materials: PET and glass.

Figure 1 – Diagram Flows of one cubic meter of bottled water (PET and glass bottles).
Source: personal elaboration by the authors



The substantial difference between these two is bottle production phase. In the first case, bottling plant involves bottles production from PET performs, filling, capping and labelling. If glass bottled is employed, the process starts with bottles usually washing and sterilizing before following the same steps of PET bottles. Filling plant also includes secondary and tertiary packaging that is blisters assembly and palletizing. Finished and packed product subsequent distribution is basically performed by trucks, with 15 t loading capacity and 4 km/L fuel consumption and crossing distances are very different. Sometimes it is distributed non-over its regional boarders (250-300 km), often is spread all over the country (800-1,000 km). For bottled water compartment, logistic plays a primary role due to very high freight costs (economically and environmentally), to medium customers brand fidelity level and to competition often based only on purchasing price. In this analysis we considered that the typical distance from filling plant and urban distribution platform ranges from 500 km to 700 km.

Bottled water PET bottles.

As already said, a PET filling plant produces itself PET bottles. The line includes blowers to give PET preforms different capacity and shapes. When PET pre-forms are delivered to filling water plant site they are ready to be placed into the blowers or they are first sterilized with ozone also to strengthening bottle structure. So made bottles are filled, capped and labelled. They are then sent to secondary packaging to be grouped and assembled in LDPE film handled blister. These blisters are then placed on wooden pallets (tertiary packaging), which allow easy stocking, loading and unloading operations. Material and energy consumption related to all phases are gathered from literature and companies and calculation have been made considering that in Italy 78% of bottled water is in PET bottles and the remaining quota in glass ones (22%). Leader PET bottle size is the 1.5 L one, used for

approximately 74% of whole volume bottled in PET, followed by 2 L (about 16%) and by 0.5 L (6%). Other sizes like 0.2-0.33-0.75 L have a marginal importance (4%) even if, due to outdoor bottled water consumption increase, a rising is previewed. For this reason, they have not been considered in this analysis. We have not included ozone treatment and subsequent washing because it is assumed that PET pre-forms are made for direct use. Pallets wood weight is also not counted because pallets are used to moving packed bottles only and generally reused several times. In order to provide the market a set of 780 L (split into 520-570 bottles) total material input is equal to 25-33 kg. The total energy used for bottled water capitation, bottling and packaging is equal to 190-205 MJ (equal to 0.26 MJ/L).

Bottled water GLASS bottles.

In glass bottling line too it is possible to receive glass bottles already sanitized (certified) and proceed directly to the filling phase. Otherwise, these bottles can be treated using ozone or other detergents. The bottles out of the sanitation section are filled, capped and labelled. Then, they are grouped in PE crate or in cardboard blister with or without handles (secondary packaging). Crates or cardboard blisters are then placed on a wooden pallet (tertiary packaging) useful for stocking, loading and unloading operations.

Material and energy consumption related to all phases of this line has been obtained considering that in Italy 22% of bottled water is bottled in glass bottles. Most diffused glass bottle size is the 1 L one and, also in this case, other sizes, above all 0.33-0.75 L, have a marginal importance and they have not been considered in this analysis. Figure 1 also refers to 220 glass bottles of which total material input is 105-121 kg, excluding pallets wood because they are only used to moving packed bottles. Distribution phase follows the same assumptions made for PET system. The total energy used for 220 L of bottled water capitation, bottling and packaging is equal to 55-60 MJ (equal to 0.27 MJ/L).

Distribution.

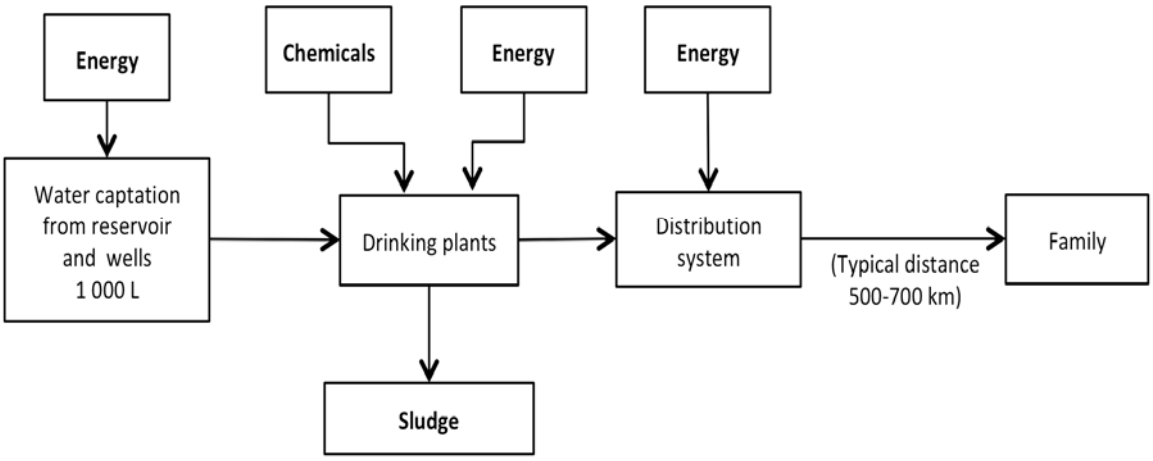
Common assumptions for PET and glass bottles are based, as already mentioned, on a typical distance (500-700 km), which is considered significant. This is the distance from a filling plant and its distribution chain. Trucks with 15 t loading capacity and 4 km/L fuel consumption compose transportation system. To transport 1 m^3 of bottled water 290-435 MJ of energy are required of which 205-315 MJ (80%) related to 780 L of PET bottles and 85-120 MJ to 220 L of glass ones.

Tap water case study.

Tap water. Water for human consumption, supplied by different aqueducts, is mainly used for household. It is well known that water is the best natural solvent; this is the reason why very often natural water are not “pure” or contaminant free. Many substances may be diluted in water; often they are not harmful but yet healthy, sometimes even in microscopic percentage they may be seriously toxic for human being. To define water *drinkable* it has to be colorless, odorless, impurities and contaminants free and with a good taste. Good taste is experienced by our senses while microorganisms and health toxic polluters are evaluated by lab tests according to national and EEC regulations [6-7]. When tap water parameters do not comply

with required standards, it will be treated in water drinking plants through specific chemical-physical processes unlikely bottled water. That being stated, it is possible to identify a sort of "production cycle" also for tap water including water catchment, chemical-physical treatments (upon quality evaluation) and subsequently distribution and consumption (figure 2).

Figure 2 – Diagram Flows of one cubic meter of tap water



Source: personal elaboration by the authors.

Natural water catchment means to collect surface and underground water, conveying it to natural or artificial basins where it will be quality controlled, and a) pumped right into distribution pipeline (unusual); b) diluted or mixed with other water in order to match required standards; c) pumped to water drinking plants. Subsequently, water eligible for human consumption will be pumped into pipelines of different length in order to reach consumption sites. In a drinking plant input water is pre sanitized, several times filtered and again sanitized. So treated water is drinkable and it is directly pumped into distribution pipelines or water storage basins. This water has been treated with chlorine dioxide and sodium hypochlorite as disinfecting agents, quartz gravel and vegetal active carbon as filtering agents. Required quantity of agents is 0.5-1.3 kg/m^3 of water. Usually water drinking plants also have a sludge treatment unit (0.3-0.7 kg/m^3), main process byproduct, where they are dried and then sent to appropriate landfills. Electric energy is used for lifting pumping system and for water chemical–physical treatments. The last ones account to about 10% of the whole amount of energy used up to final pipeline input.

Distribution

As well as for bottled water, also for tap water distribution is the hardest phase to determine in terms of material and mainly energy costs. Difficulty arises from numerous variables affecting energy cost calculation. For instance orography and supplied areas extension have a direct influence on presence/absence of lifting pumping systems. It is well known that in aqueduct water circulate because of water fall and/or pumping systems depending on what just mentioned. Based on available data, we estimate that to lift 1000 L of water for a height

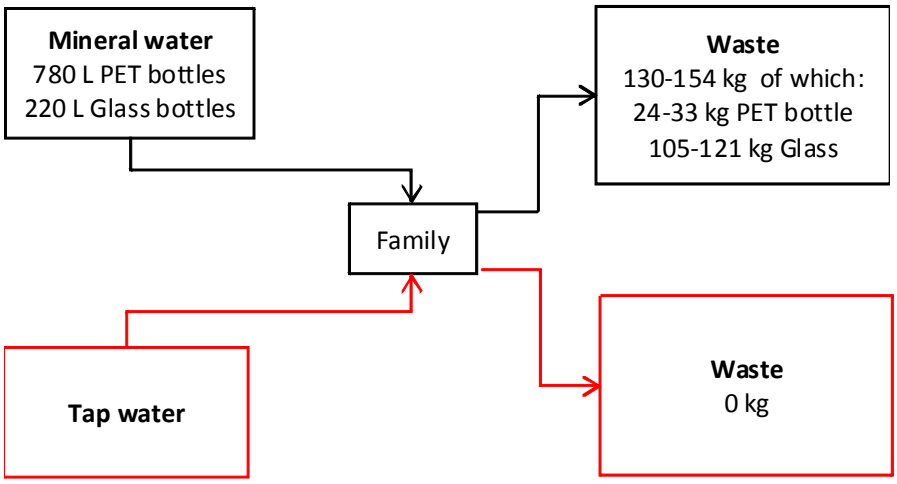
of one meter 0.007-0.01 kWh (kWh/m^3·m) is necessary. In this preliminary phase of the present study we have considered that tap water distribution system is included in a distance (drinking plant-family) of 500-700 km and the maximum height to surpass is 150 m. So that, to make 1000 L of water available to families, we calculate that 1.1-1.6 kWh are needed.

CONCLUSION

Material basis of economic sector provide a tool capable to assess sustainability of the economic activity itself. On this basis it is possible to evaluate related environmental impacts and critical points. Assuming that drinking water is a not substitute good showing a demand always higher, it is necessary to find the right sustainable supply mix between bottled and tap water. Data show that bottled water sector requires a material input extremely higher (130-154 kg/m^3) than tap water (0.5-1.3 kg/m^3). The amount of energy for the whole bottled water (PET and glass) life cycle estimated is 530-700 MJ/m^3 and in the case of PET bottles it is almost equally split between bottling and distribution phases. Tap water energy input is equal to 15-20 MJ/m^3. Similar studies show the same result [5].

The most critical point of bottled water compartment is waste generation (figure 3), basically all the involved packaging. Tap water instead does not need packaging therefore its biggest impact is indirect because it depends on production of electricity necessary to deliver drinking water to families. Tap water distribution systems energy consumption is proportional to supplied area size and orography, in vast and mountainous regions it requires more energy. Data also show that basically people drink bottled water according to reasons very different from the ones should motivate such a choice. It is a matter of fact that bottled water is preferred for organoleptic reasons and often because it is a new life styles symbol [3]. Heavy competition among current numerous brands could be negative for consumers, because they do not evaluate main quality standard when selecting a products, considering instead other secondary aspects that might be dangerous. So that, it is necessary to incentivize consumers to make much more conscious chooses to select products more environmental friendly.

Figure 3 - Solid Waste family production related to bottle or tap water consumption



Source: personal elaboration by the authors.

To make possible conscious consumer chooses it is necessary to reorganize a relevant industrial sector of international economic system, bottled water one, towards solutions more sustainable like:

- Promoting the implementation of new packaging strategy, re-design them using biopolymers and/or making bottles lighter. This means to have, at the end of the packaging life, a different quantity and quality of waste to treat;
- Providing for the creation of an efficient system for packaging recycling. Reorganizing and improving the infrastructural logistics to facilitate the effective recycling rate, which is potential, elevated. A European Directive dated 2008 allows the use of regenerate plastic material into food sector [8]. Its application is not diffused in all the European member states; in Italy for instance it is still not possible. The aim of this directive is to encourage the growth of a new market for this secondary raw material;
- Encouraging bottled waters short chain to reduce transportation costs and related environmental impacts and to make possible the social and economic local development due to the presence of water sources.

As concerning tap water the main critics point is energy costs. First of all it is necessary to increase the efficiency of lifting pumping systems to reduce the energy input during all the phases of tap water chain. Furthermore, it is also necessary to reorganize the energy mix used to produce electricity enlarging renewable energy sources role. No less important is the loss of water during distribution phase. There is, often, a big difference between water entered in water pipeline and water arriving to families. This means that better is the efficiency of the whole tap water system bigger will be its contribution to the environmental in terms of natural resources (water) and energy.

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BRAND PERSONALITY AND PSYCHOGRAPHIC APPROACH FOR PARTY IDENTIFICATION, VOTING BEHAVIOR, AND VOTING INTENTION

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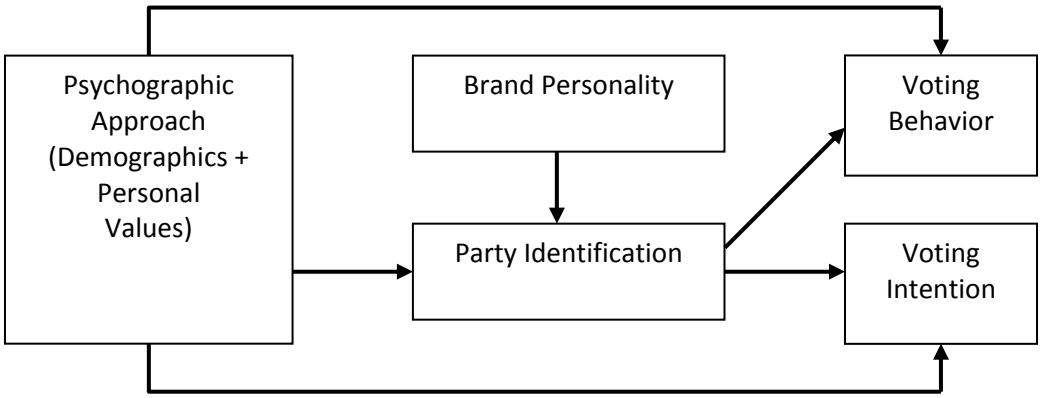
ABSTRACT

Branding is one of the most imperative assets of an organization. Recently, research findings recognize political party identification as brands. Though the literature of brand personality has been focusing on commercial brands, only a paucity of studies consider the arena of political branding. On the other hand, market segmentation plays a significant role in the entire field of marketing. Who (i.e., demographic segmentation), what (i.e., image and status), and why (i.e., personal values) refer to three bases of identifying market segments. In order to advance the knowledge of political branding in the marketing discipline, an empirical study on the relationships among psychographics, brand personality, political party identification, voting behavior, and voting intention is conducted. The purposes of this study are as follows: (1) to understand the relations among psychographics, party identification, voting behavior, and voting intention, (2) to identify the connection between brand personality and party identification, (3) to investigate the correlations among party identification, voting behavior, and voting intention. Statistical analysis methods include AHP, factor analysis, and logistic regression.

Keywords: Brand Personality, Psychographics, Party Identification, Voting Behavior, & Voting Intention.



Postulated Model of this Study

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REGIONAL DIFFUSION FOR TIED PRODUCTS IN GREEN CONSCIOUS CONSUMERS

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ABSTRACT

We demonstrate that independent aftermarket replacement component remanufacturers are able to help competing manufacturers establish their market share with our suggested decisions. We model the market, in capturing its behavior fluctuation, as an agent-based modeling and appeal to evolutionary game theory in the light of innovative diffusion process with network externality and green consciousness social imitation, in microscopic and dynamic emergent perspectives. We show that both market share and long term profitability of a tied product firm, with inferior market share, indeed can be raised significantly by applying our suggested price-protection-distribution decisions at specific timing.

Keywords: consumer choice, social imitation, technology adoption, replicator dynamics, network externality, agent-based modelling

1. INTRODUCTION

Some tied product manufacturers enjoyed extraordinary high profit margin from the associated replacement components as the existence of monopoly created by their product designs and corresponding intellectual property laws. It is socially beneficial, however, for environmental consciousness, to reuse these replacement components, instead of shredding back to raw materials.

In current situation, original manufacturers oppose any compatible replacement components sold in the market since third party remanufactured products cannibalize their anticipated high profit. On the other hand, direct and indirect demand externality has proved to be able to increase the market share for a market with multiple competitors. Despite of the anticipated monumental profit in a monopolist case, having full reward with singleton market share can not be foreseen since strong competition occurs between existing primary product manufacturers [?,?,?,?].

Given the premise of profit maximization during the new product diffusion along the time and spatial regions, we are dealing with a joint pricing and product protection decision problem in this paper and several questions are raised. Should the original manufacturers accept the existence of remanufacturing? If it does, how to control the profit cannibalization at specific time and region in order to gain the maximal market share and long term profit?
We tackle the problem of optimal price-protection-distribution decisions by carefully establishing the relation between market share and consumer behavior, typically, a consumer choice model, from the perspective of each individual consumer in a green segment social network. In particular, we incorporate the factor of green consciousness social imitation in

the consumer choice model, and attempt to construct a framework of competition in the system product market. We model the market, in capturing its behavior fluctuation, as an agent based modeling and appeal to evolutionary game theory in the light of innovative diffusion process with network externality and social imitation, in microscopic and emergent perspectives.

In this paper, we demonstrate the optimal price-protection-distribution decisions for each original tied product manufacturers to maximize their profits in a competitive market of interacting, in both spatial and temporal dimensions. With the help of our proposed model we show that a tied product firm with inferior market share can invert its position if a carefully designed mix of decision is followed at the right timing and an agglomerative clustering of product distribution is arranged at the initial launch phase. In this case, both market share and long term profit indeed can be raised significantly. We finally give suggestions and managerial implications for tied product firms in setting effective operations providing customers in green segment grow to dominance.

2. OPTIMAL MODELING AND DESIGN

There are three decision variables in our model,

- Pricing (p_i): the retail price in US dollars of the original replacement component from firm i. Prices are set based on market strength and the prices of competitors [?].
- Protection (β_i): the tolerance of firm i for remanufacturing. $0 \le \alpha_i \le 1$. $\beta_i = 0$ represents the highest level of tolerance; $\beta_i = 1$ represents no tolerance at all. Optimum tolerance level can increase the spread of information about a product through the market and to gain market share, thereby preventing major losses in profitability [?].
- Initial Distribution Scattering (α): it refers to the initial distribution of green conscious users.

Define the tied product usage $\{ij\} = \{i : i = 1,\ldots,n\} \times \{j : j = 1,\ldots,m\}$ of each consumer as the outer product set of the product used and the operation employed. Each consumer continues to use a piece of replacement component for a period of time, e.g. a certain product life cycle (PLC). Within a replacement component's life cycle, consumers continue to use the same replacement component. Once the component has been used for longer than its PLC, consumers must once again make purchase decision.
The persuasion stage: when a replacement component exceeds its PLC, the consumer does not immediately make a purchase decision. Rather, they will consider and observe for a while, considering the replacement component they have been using and what other nearby consumers are currently doing, i.e., performing social imitation. Once the consumer makes a decision on what replacement component they will use next time, the persuasion stage is concluded.

The implementation stage: consumers' choice of new exploitation strategies depend on computed conditional probability of product firms' marketing strategies, which comprises product utility and choices of other consumers nearby.

We first attempts to construct a model of tied product market using spatial simulation and evolutionary game theory. The model incorporates operational mix and consumer behavior in an market. We attempts to find each firm's optimal operational mix for maximizing its own profit under the assumption that other firms are able to response to the best operation. Each tied product firm creates a mix involving pricing, protection, and distribution, to maximize profits in a market of interacting consumers. The marketing strategies of each firm also interact, so each must consider the reactions of other firms before any operation decision.

Different combinations of decisions affect the utility that consumers attain by choosing to obtain product j from tied product firm i. This therefore affects the choices that consumers make purchasing in obtaining tied product. In the market, a tied product firm's market share and profitability is decided by the number of consumers choosing operation j for its tied product. Of the exploitation strategies available, retail purchase benefits both a firm's profitability and its market share.

The effects of social imitation are limited to the total numbers of people using the four exploitation strategies who are laterally adjacent to a consumer k. Each consumer k makes the decision on which operation to use as in Eq.1, which shows the probability that the consumer will change their decision to j for a product i [?].

$$\Pr_j = \frac{\exp(\lambda f_{ij} b_{ij})}{\sum_{j=1}^{3} \exp(\lambda f_{ij} b_{ij})} \tag{1}$$

Where λ is a sensitivity parameter. b_{ij} represents the impact of social imitation, that is the total number of neighbors local to k using operation j. $\Pr_j$ is the probability that a consumer k will change their decision to j for a product i. Based on the maximal expected value of utility, Eq.2 therefore determines the final decision of a consumer k for choosing original replacement component, remanufactured replacement component, or not using any product.

$$j^* = \arg\max_{j=1,..,3} \{E_t \Pr_j^k(t)\} \tag{2}$$

Where j^* represents the best choice of operation for a consumer k in terms of her or his maximized utility. With the aforementioned two-stage diffusion process, it will affect other consumer exploitation strategies made thereafter. A tied product firm's market share and income at time t are determined by the number of people using their tied product and purchasing their tied product, respectively.

In an market, a tied product firm i strives, directly, to maximize its profit through its pricing for original replacement component. From the retail, income must be subtracted the fixed costs of development, multiplied by the number of users of retail versions and δ^t. δ is the discount factor. In this model, the discount factor is fixed. The profit functional also includes the cost of IPR (Intellectual Property Right) protection ($\theta\beta^2$)[?]. This is the cost of deterring

remanufactured replacement components in the market, and is the inverse of the degree of tolerance. The cost is low when the firm adopts a relaxed, tolerant strategy, whereas the cost is high when the firm does not tolerate remanufacturing. We are seeking a proper level of price and protection to maximize the profit for each firm i as Eq.3.

$$\max_{p_i,\beta_i} \delta^t (p_i - \theta\beta^2) x_{i1} \tag{3}$$

Where δ is the discount factor, $0 < \delta < 1$.
p_i is the price of original replacement components for firm i.
x_{i1} is the total number of consumers using firm i's product at ESS.
θ is the cost of IPR protection.
Each consumer in the market derives a different subjective degree of satisfaction from a particular tied product because of the decision they follow [?]. Consumers' considerations include both the intrinsic utility of the tied product and network effects. $f_{ij} > 0$ represents the utility that a consumer obtains by purchasing tied product from firm i using operation j. $X_{ij}(t)$ represents the number of consumers at time t using tied product from firm i obtained via operation j.Motivated from [?] we have derived the utility functions as Eq.4 to Eq.6.

$$f_{i1}(x_{i1}(t),t) = I_{i1} + W_i^{(1)} x_{i1}(t) - W_i^{(2)} x_{i3}(t) - W_i^{(3)} \log(x_{i4}(t)) - W_i^{(4)} p_i \tag{4}$$

Eq.4 shows the utility obtained by a consumer k on purchasing original replacement components from firm i. It involves the sum of the intrinsic utility, network externalities and price of the tied product. In addition, when most consumers in the market make a different choice, the intrinsic utility obtained by a consumer purchasing original replacement components from firm i becomes lower. High levels of remanufacturing also reduce the utility of purchasing the original replacement components.

$$f_{i3}(x_{i3}(t),t) = I_{i3} + W_i^{(7)} x_{i1}(t) + W_i^{(8)} x_{i3}(t) + W_i^{(9)} p_{i1} - \beta_i C p_{i1} \tag{5}$$

Eq.5 shows the utility obtained by a consumer k on using remanufactured replacement components from firm i. It is the sum of the intrinsic utility and network externalities of the tied product plus any incentive applied by the government agencies. As the number of consumers using the tied product increases, and as the price of original replacement components rises, the utility of remanufactured replacement components also goes up.

$$f_{i4}(x_{i4}(t),t) = V x_{i4}(t) + \frac{W_i^{(9)}}{x_{i1}(t) + W_i^{(10)}} \tag{6}$$

Eq.6 shows the utility obtained by a consumer k by not purchasing any tied product or making other choices. As the number of consumers using original replacement components rises, the utility of making another choice decreases.

However, in the modern market, tied product firms rarely reveal the results of market share surveys in the publicity. Consumers therefore have no way to accurately gauge x_{ij} – the number of consumers using tied product from firm i – when gaining their utilities. In this paper, the replicator dynamics Eq.7 is used to estimate the numbers of consumers using one particular tied product (x_{ij}), the way the market is evolving, and the state of the market in the future. In this equation, as part of evolutionary games, if the fitness function of a product brings higher than average utility to consumers, then the proportion of consumers using the product will gradually increase; if the utility is lower than average, the proportion will decrease. The speed of these market changes will depend on the size of the gap between the fitness function and the average. When the proportions of consumers using x_{1j} to x_{nj} reaches an evolutionarily stable state (ESS), then there will be no further changes [?]. The estimate of consumers concerning numbers of consumers using each tied product can, in turn, be entered into Eq.4–6 and all corresponding utilities are able to calculated thereafter. Note that the fitness function in replicator dynamics Eq.7 is similar to the utility functions in Eq.4–6 but x_{ij} , the population density, is used instead.

$$\frac{\dot{x}_{ij}(t)}{x_{ij}(t)} = f_{ij}(x_{ij}(t),t) - \bar{f} \quad j = 1,\ldots,4 \tag{7}$$

Where $\bar{f} =$ average fitness and x_{ij} represents the proportion of consumers in the entire market purchasing firm i's tied product through operation j, as guessed by the consumer. $\dot{x}_{ij}$ represents the proportion changing over time of consumers in the entire market purchasing firm i's tied product through operation j, as guessed by the consumer and changes over time. As all players learn through replicator dynamics, if an equilibrium state is reached, this state is called an evolutionarily stable strategy (ESS). An ESS is equivalent to a Nash equilibrium in a rational game [?].

3. NUMERICAL ANALYSIS AND DISCUSSION

To find the optimal decision, our model has been validated on an numerical basis. The parameters $W_i^{(r)}$, I_{ij} used in this numerical analysis are chosen by the maximization problem Equ.8. The characteristics of tied product products and consumer judgments of their relative quality, compatibility and complexity are then devised, with the values of $W_i^{(r)}$, I_{ij} .

$$\max_{W_i^r, I_{ij}} \sum_{t=0}^{\infty} \delta^t (p_i - \theta\beta_i^2) X_{Buy_{(i,t)}} \tag{8}$$

Subject to
ESS exist,
Eigenvalues of Jacobian Matrix
in Replicator Equation ≤ 0

The model is also used to test the effects of different distributions of early adopters and compare different results. By observing the evolution trend with time (changes in numbers of users over time) and the spatial distribution patterns (entropy difference).

In a tied product market with homogeneous competition, consumers make choices based on their subjective awareness and preferences. In the fitness functions in Eq.4–6, all parameters other than x_{ij} are seen as externally determined. Their values are set according to market conditions, and when an ESS emerged, this paper find the solution to the optimization. Thus the optimal values of $W_i^{(r)}$, I_{ij}, for maximizing profitability are found.

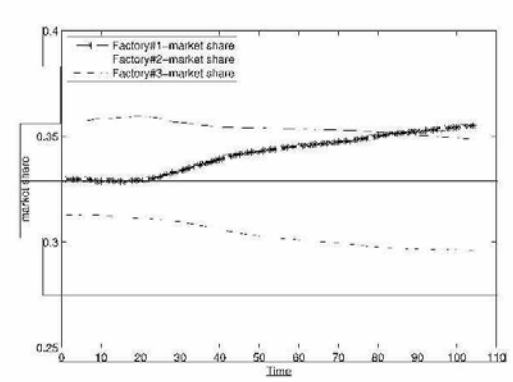
The optimal values of $W_i^{(r)}$, I_{ij}, are used to set the initial parameters, with each product available on the market and consumers' judgments of their quality, compatibility and complexity. The experiments show that x_{11}, x_{12}, x_{21}, x_{22}, x_{31}, x_{32} could coexist when the pricing (p_i) is between 55 and 64; and protection policy between 0.15 and 0.85. Adjusting the initial values, operational mix and parameters lead to different ESS's.

During the introductory phase the three firms employ a lower pricing for their original replacement components ($p_1 = p_2 = p_3 = 54$). They increase the utility of the original replacement components to attract consumers in order to gain market share. The network effects for firm 1 in this period are stronger than those for firms 2 and 3: $W_1^{(1)} > W_2^{(1)} > W_3^{(1)}$. Thus firm 1 achieves a large increase in a proportion of customers buying its original replacement components through a suitable mix of low prices, high quality OEM tied product and an appropriate IPR protection. This means that in the introductory phase, firm 1 is able to achieve a higher market share than other firms and higher profits.

During the growth phase the three firms all use high prices ($p1 = p2 = p3 = 61$) to improve profitability. For firm 1, the increase in price reduces the utility of the original replacement components for consumers, which also reduces the utility of using remanufactured version of the firm 1's product. This means that the rise in the fraction of the market using original replacement components from firm 1. The number of people using remanufactured replacement components from firm 1 also gradually declined. This means that firm 1's market share rises slowly in this phase (see Figure 1).

During the mature phase, the three firms use midrange prices to attract consumers ($p_1 = p_2 = p_3 = 57$). After the end of the PLC, firm 1's market share is above 35%, and at this point the firm implements a strict anti-reproduce policy, which couples with the price and results to a diminish of the utility of using remanufactured replacement components from firm 1. The utility of the original versions goes up, so at this point the numbers of people using remanufactured replacement components from firm 1 falls.

In terms of market share, firm 1's network functions are stronger that the other firms, so there network effects are $W_1^{(1)} > W_2^{(1)} > W_3^{(1)}$. Firm 1 is thus able to attract more consumers, and its market share rises continually.



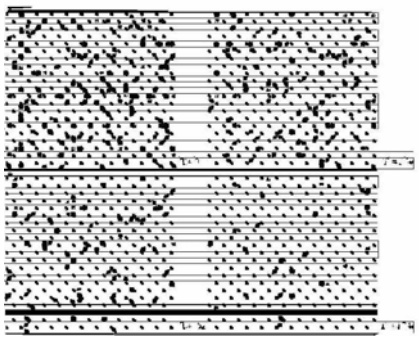


Figure 1. Market share Figure **2. Market evolution (scattered distribution)**

In addition to the operational issues, we also concern with whether the distribution of early adopters within the market affects the diffusion of the product. We carry out several experiments, and find that early adopters in a scattered distribution leads to different diffusion pattern than early adopters in a clustered distribution. In this paper, distribution refers to the clustering of users due to green segment social imitation. Figures 2 show the distribution of users of tied product from firm 1 (black dots) over time (t=now). Over 104 cycles (1 cycle=1 week), each consumer makes purchase decisions, and the differences in patterning are apparent.

In the consumer's decision process, the impact of social imitation and network externalities is large. When early adopters fall in clustered distributions, their interconnectedness is higher, so the speed of spatial diffusion is faster. This allows firm 1's original replacement components to swiftly gain market share. Finally, the firm is able to achieve strong interlinking throughout the market and a decisive market advantage.
These figures show that when early adopters of tied product from firm 1 are clustered, firm 1 's original replacement components diffuses quickly through the market. When the early adopters are scattered, the diffusion retards. The distribution of early adopters is an extremely important factor in the speed of a product's diffusion through the market.

4. CONCLUSIONS

The contribution of this paper is on the right decision of price, protection, and distribution for tied product firms, taking consideration of both social imitation and network externalities, and basing on consumer purchasing behavior. In previous works, there is no way to quantitate network externality appropriately. Consumers have been unable to accurately determine market shares. This paper attempts to find consumers' estimation about the market size by the help of evolutionary game theory.

A firm at stable market leader stage need to concentrate on regular marketing device. If a firm at a startup position, an aggressive tool or deterrence for competitors can be applied. Reproduction and remanufacturing tolerance can be considered to employ temporally before market share getting bigger and stronger.

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OPPORTUNITIES IN THE MARKETS FROM TECHNOLOGY AND LOGISTICS POINTS OF VIEW

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ABSTRACT

Shipping industry globally is a significant air polluter. The fuels used in shipping industry nowadays have high exhaust gas emission. Therefore alternative energy sources are needed. Though there is possibilities to use less polluting fuels, costs of those are high. Therefore price competitive alternative fuels are needed. Liquefied natural gas could be one alternative towards more environmental friendly engines and production.

The main goal of the research was to investigate if there is genuine interest towards the use of liquefied natural gas as a fuel and what where the critical issues in the use and operation of it. The aim was to find out these and then find solutions to make it more interesting and make possible customers more risk acceptant towards new technologies. As the new product innovation already exists and is functional, the main issues seem to be the predictability of future logistics and prices.

The research is a mixture of empirical and theoretical study and the approach is mainly action-oriented, as the aim is to get a comprehensive understanding of the topic. The theoretical part of the study concentrates on new product development and to innovations progress to a successful market product. Important thing is to sense and respond to customers' needs and then develop the critical areas. The empirical data was collected with questionnaires that were sent to experts in the field of shipping industry and possible customers. The results of the study revealed a direction of development and areas that needed improvement.

Keywords: New product development, Technological development, Innovation, Decision-making, Critical factor –index

INTRODUCTION

The importance of sustainable development and more environmental products and production is getting more and more important these days. Therefore companies search and develop new innovations to create new business opportunities in these fields. The shipping industry is also facing the same demands as other industries. The fact that shipping industry is a significant air polluter requires actions.

In example the sulphur oxide (SO2) emission in Europe's seas were 3.3 million tonnes and 250,000 tonnes of nitrogen oxide (NOx) in year 2000. The problem is same all-around the world and without legislation the level of exhaust gas emission can be expected to rise. Therefore the International Maritime Organization (IMO) and the European Union (EU) have made legislations about sea pollution. The following figures represent the emissions of SO2 and NOx from 2000-2020. The figures reveal how the emissions would grow without legislation and what are then the aims and possible results of implementation of legislation on European soil. (11)

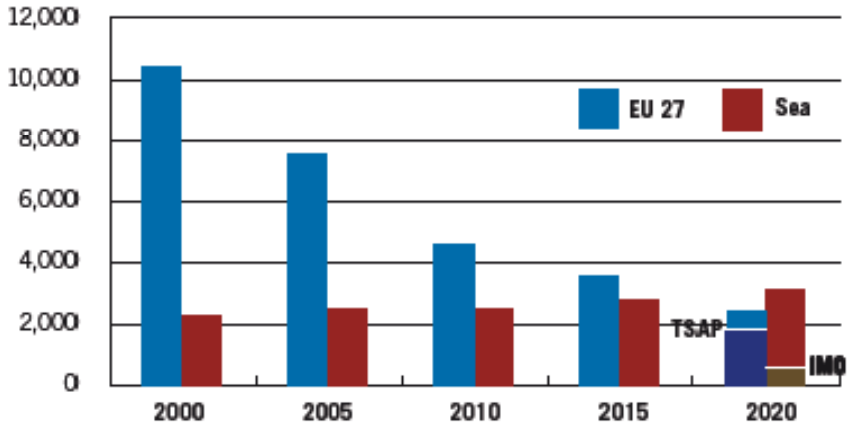

Figure 1. Emissions of SO2 in 2000-2020. (11)

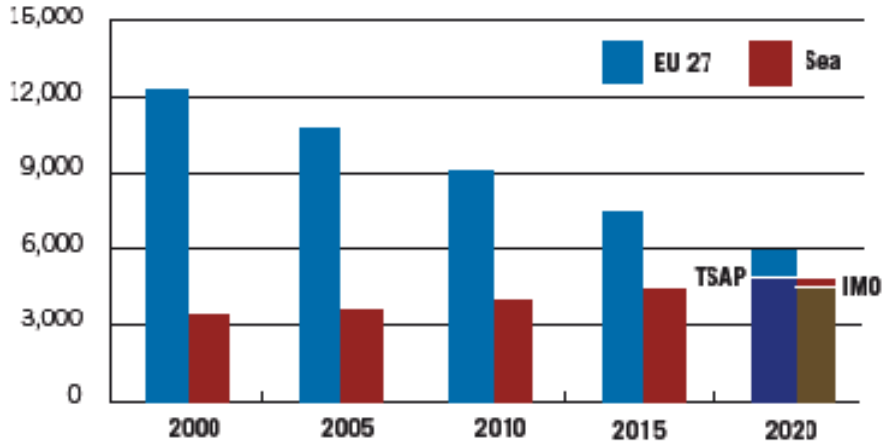

Figure 2. Emissions of NOx in 2000-2020. (11)

In the figures the abbreviation EU 27 means "emissions from land-based sources in all EU-countries (incl. domestic shipping)", Sea means "emission from international shipping in European sea areas," TSAP means "target in line with the EU Thematic Strategy on Air Pollution from September 2005" and finally the abbreviation IMO means "expected outcome from implementing the preliminary IMO-agreement from April 2008" (11).

The legislations of the IMO and EU are demanding and in order for the shipping industry to answer those demands, they have to take actions. Innovation of new technologies to use alternative fuels is needed. However these tighter legislations come to action quite soon and it is important to already start using alternative fuels or other equipment to clean the exhaust gas emissions. There already exists other alternatives as Light Fuel Oils, but the prices of these are not very competitive. (11)

Liquefied natural gas (LNG) is one alternative that would fulfill the legislations and be more environmental friendly fuel. LNG is natural gas that is cooled down to the temperature of -162°C. During this process also the volume reduces about 600 times, making it possible to use it as a fuel in ships. Though the technological possibilities for this exists in forms of engines, the use of it requires modifications in the ships, as the tanks and engine rooms are different in comparison to oil. However with good designing the use of liquefied natural gas could be reality in also already exiting ships and not only in new-built ships. (10: 47.)

Environmental legislation of sea pollution

In Europe there are two main organizations to set legislation against sea pollution and these are the IMO and the EU. The IMO sets international standards to regulate shipping industry. The Marine Environment Protection Committee (MEPC) is a part of the organization that sets legislation to prevent pollution from ships. The MARPOL (marine pollution) convention is an environmental convention in which the emission legislations concerning ship pollution are decided. (6,7,8)

Legislation for the Prevention of Air Pollution from Ships was adapted to MARPOL 73/78. This regulation sets limits for SOx and NOx exhaust gas emissions nowadays and in the future. With this legislation the allowed emission levels will reduce gradually with a certain timeline to be fulfilled. Violations against the legislations of MARPOL 73/78 are considered to be punishable under the law of the Party or the flag State. (7,8)

The legislation set in the MARPOL's convention also involves an opportunity to create specific SO2 emissions control areas (SECA). On these areas the exhaust gas emissions are even tighter than elsewhere. In Europe the Baltic Sea was the first one to become SECA in 2006 and after that also the North Sea joined in year 2007. The following figures will represent the timeline to reduce SO2 exhaust gas emissions globally and in SECAs. Figure 4 represent the limitation for NOx emissions, which are explained in the so called three-tier structure. (11)

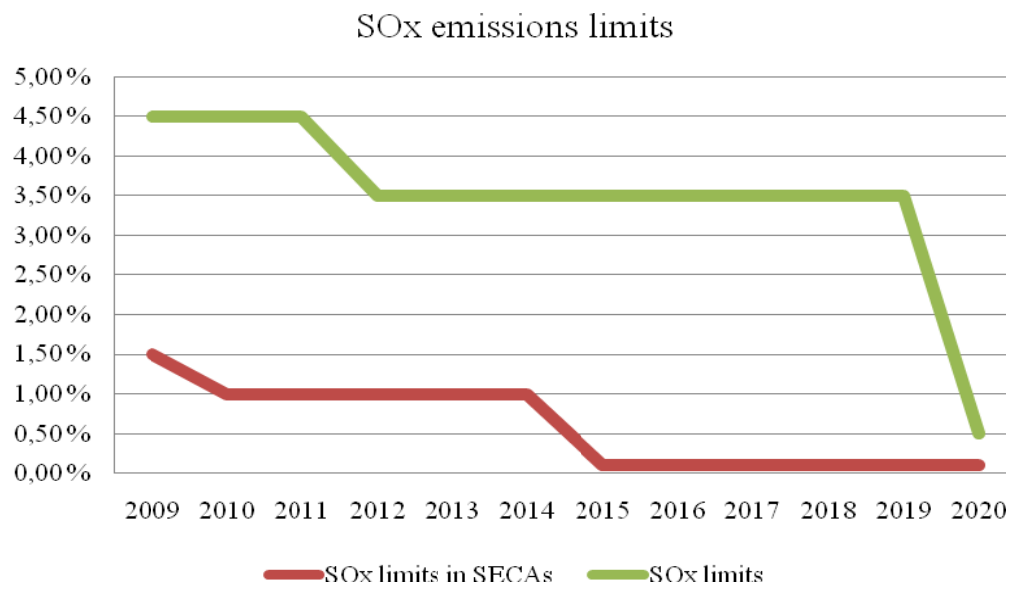

Figure 3. SOx emission limits. (8)

The SO2 limitations have to decrease significantly on SECAs as well as globally. The timeline for global exhaust gas emission reduction however is longer. The fact however is, that with LNG these figures could be achieved. The limitation for NOx emissions set by the IMO depends much on the construction year of the ship. The limitation is tighter for new-built ships then for already existing ships.

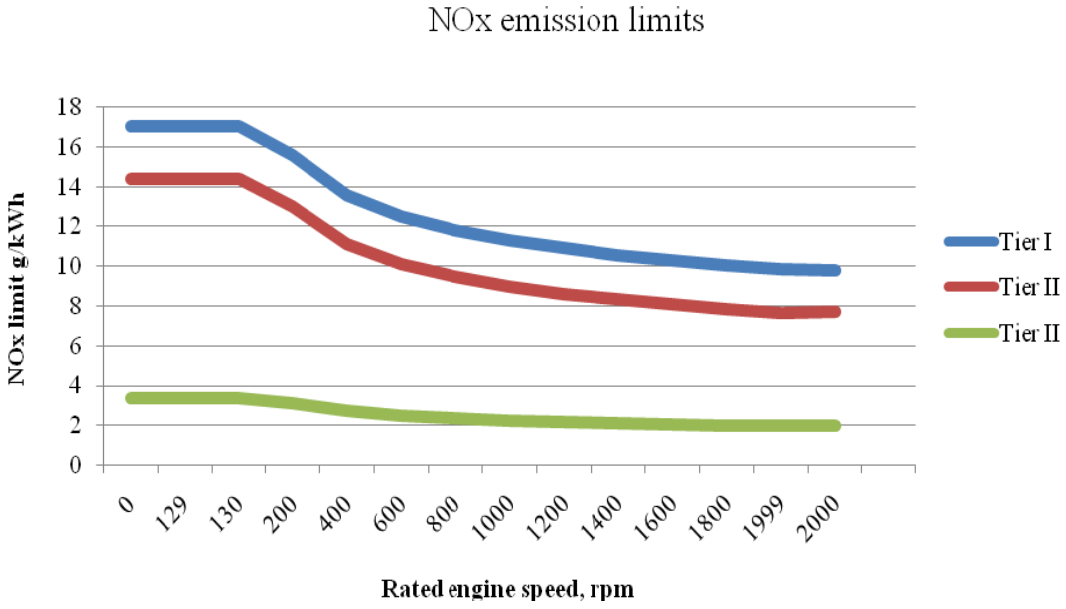

Figure 4. NOx emission limits. (15: 16–17.)

As for already existing engines installed on a ship constructed on 1st of January 1990 until 1st of January 2000 the NOx limitation is 17.0 g/kWh. Ship built after this date belongs to the three-tier structure. The Tier I regulation applies to diesel engines that are installed to ships that are constructed "on or after 1st of January 2000 and prior to 1st of January 2011". (15: 16.) The NOx emission limit for this is 17.0 g/kW. (15: 16.)

Tier II applies on diesel engines installed on ships that are constructed on or after 1st of January 2011. The allowed exhaust gas emission level of NOx will be reduced to 14.4 g/kWh. Tier III is a regulation that applies to engines that are installed on ships that are constructed on or after 1st of January 2016. Then the NOx emission limit will be reduced to 3.4 g/kWh. However this applies only if the ship operates at SECA. Outside SECAs the limits of Tier II apply. (15: 17.)

The above legislations are set by the IMO, but on Europe also the EU has set legislation against sea pollution. EU has set directives such as the EU's directive 1999/32/EC that concerns the reduction of sulphur content of certain liquid fuels and the directive 2005/33/EC that concerns sulphur content of fuels amending the previous directive 1999/32/EC. With these directives the aim is to control the sulphur amount in fuels used and sold on European soil as well as to decrease the amount of SO2 exhaust gas emissions. The following table represent when a certain EU's stated limitation comes to force. (4,5)

Date	**Limitation:**
1.7.2000	To make every possible step to stop usage of gasoil with content of SOx more than 0,2%
1.1.2003	To make every possible step to stop usage of HFO that contain more than 1,0 % of SOx
11.8.2006	SOx content of marine fuels in ships in the Baltic Sea is limited to 1,5%
11.8.2006	SOx content of marine fuels in passenger vessels that have regular route on the area of EU is limited to 1,5%
11.8.2006	SOx content of marine gas oils that is sold in EU to 0,1%
11.8.2007	SOx content of marine fuels in ships in the North Sea and English Channel is limited to 1,5%
1.1.2008	To make every possible step to stop usage of gasoil with content of SOx more than 0,1%
1.1.2010	SOx content of ships on inland waterways and at berths is limited to 0,1%
1.1.2010	SOx content of marine diesel oils that is sold in EU to 1,5%

Table 1. EU's limitations for SOx emissions. (4,5)

These legislations set by the IMO and the EU is the main reason to look and start using more environmental friendly alternative fuels. LNG could be one alternative as the technology to use it exists. The main problem however with the use of it seems to be price and logistics. There is not much information about the price, but it is expected to be on acceptable level.

About logistics, there however is some knowledge since as LNG is cooled down natural gas the pipeline infrastructure of natural gas provides possibilities to import LNG to terminals in

harbors. Also the fact that LNG -terminals and small hubs are planned to be built in harbor provide opportunities for shipping industry. In Europe there are many locations, where terminals and hubs are planned and though nowadays many hubs or terminals do not exist, the future looks promising.

The purpose of the research

The meaning of this research was to find out the critical factors that influence customers risk acceptance and willingness to use more environmental fuels. The main idea was to find out if there is genuine interest, as the topic of environmental fuels is on everybody's mind, there are still few that are willing to take the first step. Finding out the critical factors will help to develop right areas and also increase the interest and information needed in right places.

The research was focused on the area of Europe and in more specific to the SECA areas in European soil. The study is focused on this area, since the emissions legislation is tighter there and the need for more environmental fuels already exists in that area. Though the legislation is going to get tighter on other areas as well, they still have time to think their actions. A research and usage of alternative fuels on SECAs will probably give answers for shipping industry in all other places as well.

In order to find solutions and answers for the research questions and for the decision making process of whether this is actually a technology worth improving and developing an empirical data was collected with questionnaires sent to experts in the field of this technology, possible customers as well as for possible suppliers of liquefied natural gas. Since the research is done in different groups the comparison of results is also important, as it will reveal do these groups see things the same way or where there is lack of knowledge or interruption in the information sharing. The approach in this research is mainly action-oriented, as the aim is to create a comprehensive description and understanding of the subject. (9: 256.)

RESEARCH STRATEGY AND THEORETICAL FRAMEWORK

The meaning of the research was to find critical factors in making liquefied natural gas a successful marketable product. The research was made with questionnaires among different experts in the field of shipping industry. As the interesting thing is, how to make shipping industry more interested in this alternative fuel and also aware of the possibilities that new technologies provide to them.

The theoretical framework used in this research is based on a new product development from innovation and decision-making to market opportunities. The theory provides a path for new product to enter market successfully. Though the market is in need of alternative energy sources as the chief economist Dr Fatih Birol from the International Energy Agency (IEA) has stated, the use of new fuels and the introduction of those to the market demands research and risk acceptance from shipping industry. The main reason for need of alternative fuels is, as Dr Fatih Birol has said: "One day we will run out of oil, it is not today or tomorrow, but one day we will run out of oil and we have to leave oil before oil leaves us, and we have to prepare ourselves for that day." (2)

The market is therefore in general need of new innovations and ways to reduce exhaust gas emissions. In fact the shipping industry is already able to get engines that run on liquefied natural gas as a result of product innovations. As previously the strategy in companies was to make and sell, it is moving towards sense and respond. Nowadays it is more important to know what the customers want in order for a product to succeed in the market. However in many cases the customers do not really know what they want. Therefore innovations are usually combinations of both technology push –model and market pull –model. The innovation of using liquefied natural gas as a fuel could be seen as an interactive model of innovation. (1, 16)

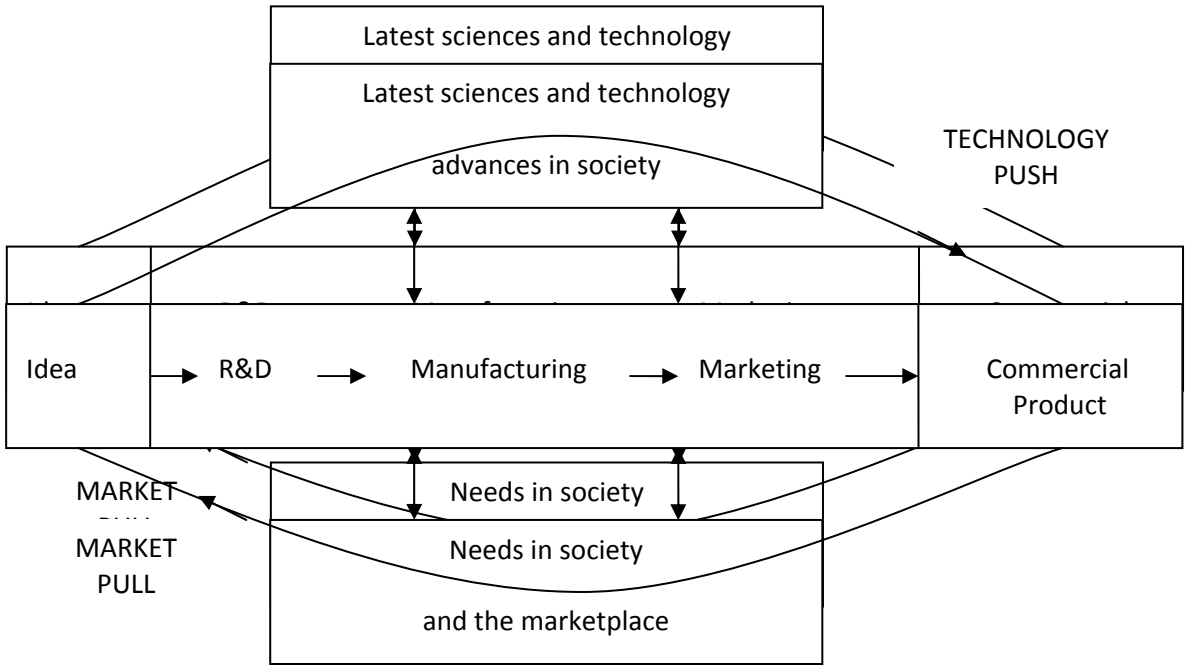

Figure 5. Interactive model of innovation. (16)

In new innovations critical is the success of those on the market. New products success on the market is not obvious and it requires effort. The following figure represents the factors that influence a new product success on the market. The success of an innovation depends on many things, but the importance of these factors differs between sectors. The coordination and balance of all factors is the key to a successful innovation. There are not any straightforward advices in which way the product will succeed in a 100 percentage certainty. The success is always a factor of many things, but the things listed below and shown in the figure will be beneficial and give an advantage. (14: 36.)

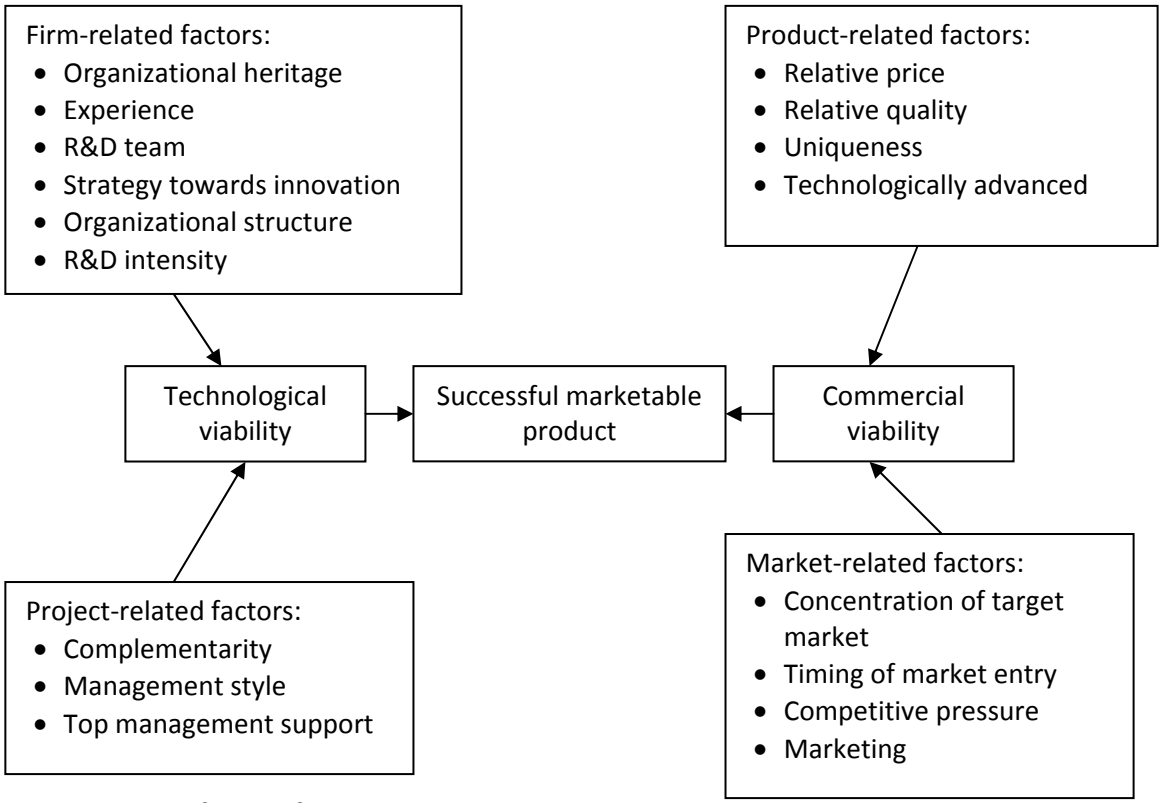

Figure 6. Critical factors for innovation success. (16: 82.)

Roy Rothwell (1996) has also investigated what affects the success of innovations. There are several things that influence the success of a new product and many of those can be achieved with good planning and communication. He has found out that there exist project execution factors and corporate level factors that influence the success:

1. "Good internal and external communication
2. Treating innovation as a corporate wide task
3. Careful planning and project control
4. Efficiency in development work and high quality production
5. Strong market orientation
6. Provide good technical service for customers
7. Effective product champions and technological gatekeepers
8. Development of human capital
9. Cross project synergies and inter-project learning
10. Commitment and support for innovation from top management
11. Long-term corporate strategy with associated technology strategy
12. Long-term commitment to major projects
13. Corporate flexibility and responsiveness to change
14. Acceptance of risk by top management
15. Innovation-accepting, entrepreneurship-accommodating culture"

(14: 36.)

As entering the market the effort of the companies to take into account the factors affecting the success of product on the market are important, but also the time of entry is important. This is where the product life cycle is a good tool. Every product on the market has a certain cycle and usually older product will gradually decrease in profits. This also means that companies have to the entire time make new product available on the market. Innovation is a way for the company to stay competitive on the market. (17: 124.)

The product life cycle tool has five stages: introduction, growth, maturity, saturation and decline. The change of product to different stages is due to customers' needs, technological development and competition. This tool makes it easier to observe the situation of already existing products and the need for new ones. (17: 126–127.)

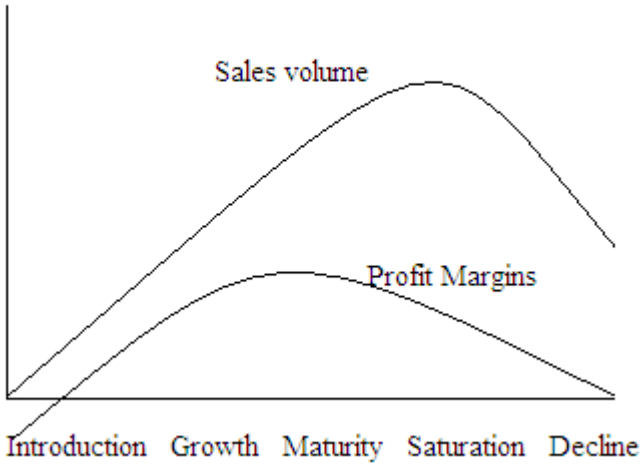

Figure 7. Product life cycle. (17: 126.)

In all the stages that have been introduced already involve a decision-making process in them. The decision-making processes in new product development and in market entry are important. In every stage of from discovery to the launch is important to stop and discuss and analyze. The stage-gate™-model is a useful tool in this, since it manages a new product to market efficiently. In this model there are different gate points or decision-making points. In these points resources are allocated, the decision of going on are decided and i.e. the project is scored to a certain criteria it should meet in the next gate. (3: 358.)

In every way different decision-making tools and models are useful and beneficial as it opens up discussions. With communication and discussion it is possible to end poor projects in the beginning and also in general have a more in-depth analysis of the product. Communication is in many cases key to successful product as it allows different sectors in companies to share their knowhow and therefore the decisions are usually of high quality. (3)

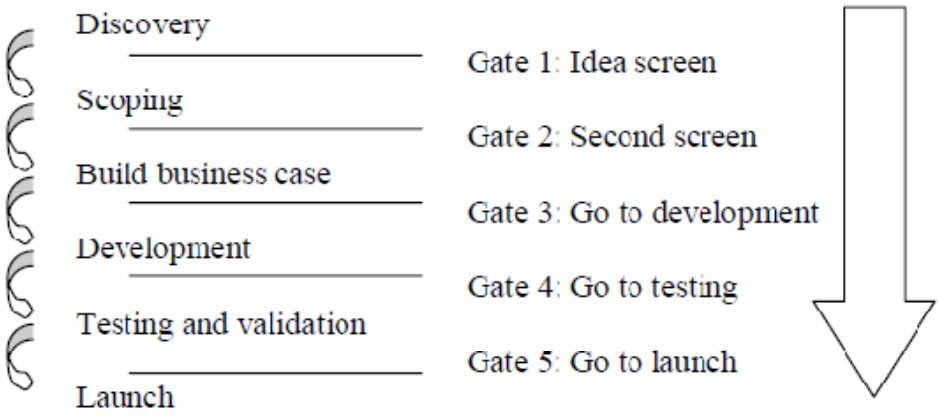

Figure 8. Stage-gate™-model. (3: 356.)

The most important thing in making new products and innovation interesting and successful on the market is all about the communication and background work. The product has to be something that customers want and therefore sensing and responding to customers' needs is essential. In background work technical studies, assessments and also market studies are relevant and important. When the decision making is based on the right and comprehensive information and understanding, the product is more likely to succeed.

In this case the situation on the market was sensed with questionnaires. The analysis of the results had both qualitative and quantitative features. The first part of the questionnaire contained open questions which were then analyzed qualitative and the second part of the questionnaire contained critical factor index (CFI) –questions, which were analyzed quantitatively according to that method.

CFI is a way to find out what are the critical factors in a certain field of study and that gives companies the possibility to develop right areas. The CFI questions contained 10 different attributes that it measured. In these questionnaires they were asked of their expectation, experiences and direction of development of the attributes. (13: 3.)

	Scale: 1 = low, 10 = high		Direction of development in 2016 compared to 2009		
Attribute	Expectation (1-10)	Experiences (1-10)	Worse	Same	Better
Attribute 1					
Attribute 2					
Attribute 3					

Figure 9. Model of the CFI questionnaire. (13: 3.)

In the preliminary analysis the standard deviations and averages are calculated. These figures are then later on used in the further analysis. (13: 3.)The first method is the gap analysis,

which compares expectations and experiences. It will help to identify whish experiences are more insignificant in comparison to expectations and in that way it reveals development areas. Then the importance index of attributes is calculated in order to find what the respondent see most important. This is calculated for every attribute so that the average of expectation is divided with 10. The direction of development index is calculated after this and it will reveal how the respondent think the development is going to proceed. If the direction of development is going to be positive the value is below 1 and if the direction of development is expected to be negative the value is above 1. (12: 318-319.)

All the formulas used in the further analysis reveal some areas of development, but the actual CFI –formula involves all the figures gotten in the above analyses and in that way it will give comprehensive results. The smaller the value of the attribute in the CFI is the more critical it is. (12: 319.)

$$CFI = \frac{\text{SD of expectation} \times \text{SD of experience}}{\text{Importance index} \times \text{Gap index} \times \text{Direction of development index}}$$

(12: 319.)

RESULTS AND ANALYSIS

The response rate of the questionnaires remained quite low being 39 %. Though the response rate was low, the results gotten from different research groups supported each other and gave an answer about the direction of the development. Possible customers and experts in the field of this technology seemed to have quite similar view of the LNG market and the results of analysis show a certain direction of development, even though the research target groups in total were quite small and response rates low. They have same ideas on the matter that LNG is more suitable for new-built ships than for already existing ship market and the reasons for this were quite similar, mainly the space problem and the costs of modifications.

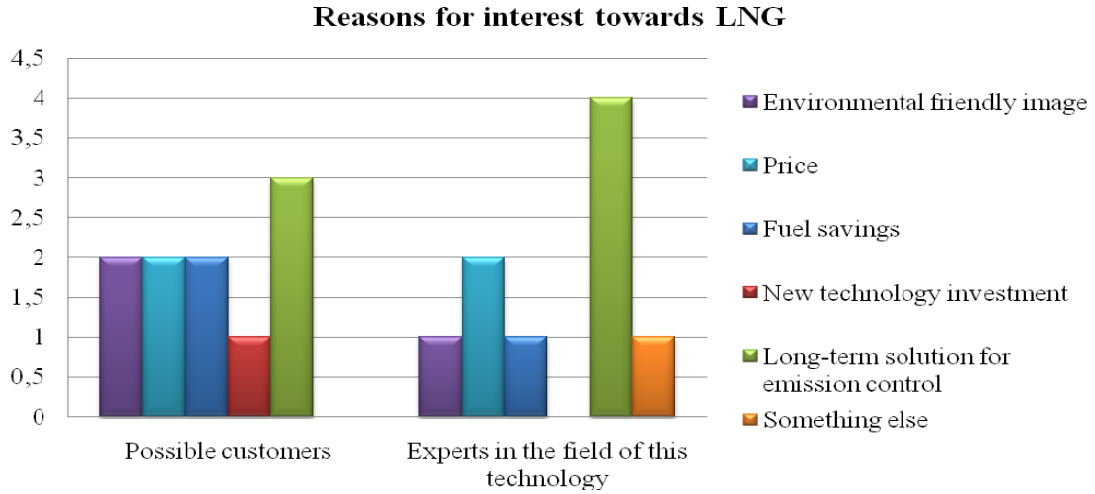

Figure 10. Reasons for interest towards LNG.

The reasons why possible customers would see LNG as an interesting choice are quite the same from both their and experts points of views. The main reason for interest towards LNG

is the ability to have a long-term solution for emission control. The second reason that these both groups see as a reason is the price. Also suppliers of LNG see the environmental and economical benefits of LNG as good reason for its use. Possible customers saw also the possible fuel savings and the ability to give more environmentally friendly image as important reasons. However, the main reason is the fact that with the use of LNG they are able to fulfill the emission legislation in long-term.

In many ways the results of these groups coincide and both groups see the same problems with the use of it. As the results gotten from the analysis of possible customers' questionnaire revealed that they would need education in the matters concerning the use of LNG, experts in the field of this technology acknowledged this too.

Experts and possible customers also had same opinion on the fact that the use of LNG is most efficient and realistic on new-built ships. The main reasons for this were that the rebuild of already existing ships was seen too expensive and difficult. There should be more experience and information of the costs for this to be more realistic. The following figure will show how the answers distributed in these questions.

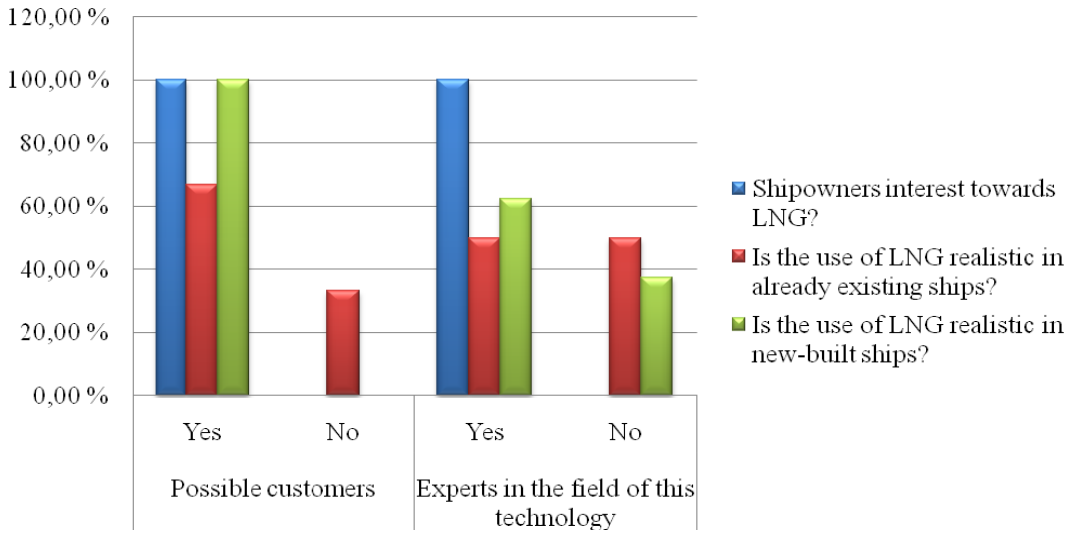

Figure 11. Compared results of possible customers and experts.

In general possible customers have positive opinion on the use of LNG and are very interested in its use. However they do not see the use of this realistic for already existing ship. If the response rate would have been bigger, I believe that this would show even more clearly. In general all the groups are interested of LNG, but more information of infrastructure and costs are needed, for possible customers to dare to take the risk.

The qualitative analysis results of different groups resulted in quite similar views and they saw price and the missing infrastructure at the time biggest obstacles. The CFI analysis supported the results gotten with the qualitative analysis and also the results of different groups had similarities, even though the respondents look the problem from different perspectives.

Both of these groups had 10 different attributes in the CFI-questionnaire that concerned different perspectives in the use of LNG. These attributes concerned the logistics, information sharing, quality, price of LNG and competitive fuels as well as the future.

Nr.	*Attribute for possible customers*	*Attribute for expert in the field of this technology*
1	logistics	logistics
2	information sharing	information sharing
3	information sharing	information sharing
4	quality of technology	quality of technology
5	quality of technology	logistics
6	price	price
7	price	price
8	price	price
9	future	future
10	future	future

Table 2. CFI attributes.

The analysis of these attributes revealed the following results. Some attributes that were asked from the possible customers are empty, since the respondents did not feel that they had enough knowledge to answer those and they were uncertain of those. This already reveals that the subject is new and customers do not have information and knowledge about this.

Possible customers				
Attribute	Development index	Gap index	Importance index	CFI
1	0,99	1,02	0,1	0,00
2	0,99	1,10	0,35	1,25
3	0,99	1,10	0,5	2,09
5	0,33	1,20	0,5	3,37
9	0,99	1,00	0,6	2,69

Table 3. CFI analysis of attributes asked from possible customers.

Experts in the field of this technology				
Attribute	Development index	Gap index	Importance index	CFI
1	0,99	1,13	0,48	9,96
2	0,99	1,03	0,68	3,24
3	0,99	1,08	0,65	6,18
4	0,25	1,07	0,73	4,29
5	0,99	1,15	0,53	7,87
6	0,75	1,08	0,53	1,76
7	0,99	1,00	0,53	17,57
8	0,99	1,00	0,53	21,36
9	0,99	1,05	0,70	2,76
10	0,99	1,10	0,43	11,64

Table 4. CFI analysis of attributes asked from the experts in the field of this technology.

The following figure represents the results of CFI-analysis. It reveals the most critical areas for development and is the most comprehensive method to measure what are the essential things I comparison to other indexes. The smaller the CFI value of the attribute is the more critical it is. (Ranta et al. 2007: 319.)

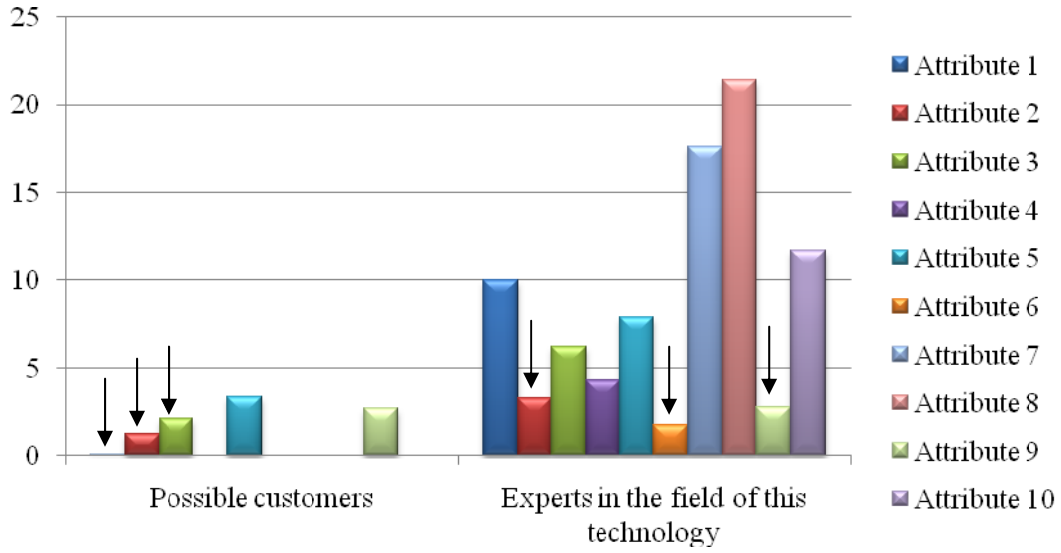

Figure 12. Critical factors.

The critical factors for possible customers were attributes 1, 2 and 3 which concerned logistics and information and knowledge sharing. The critical factors on experts' opinion were attribute 2, 6 and 9 which concerned the information sharing ability, price and future. As these groups look this matter from different perspectives the results do coincide quite well. Both see the information sharing critical, as well as logistics. However on experts' point of view also price and future will reveal more. Though I believe that with good knowledge

sharing those issues can be overcome. Awareness of new technologies will increase the interest towards them as well as the risk acceptance.

TEST OF APPLICABILITY AND EVALUATION OF RESULTS

The use of LNG seems to be very interesting alternative as seen from the perspective of all the results gotten. However there are still many problems with it. The logistics is a major problem for possible customers, since even though there is LNG -terminals being build; there is not much information about those at the moment. It also seems that the possible suppliers are not that willing to answer the questions as the market is still under development. The future will reveal more of these.

Possible customer and experts seem to have quite similar view of the market as they see it very potential for new build, but in many cases too expensive for already existing ships. That also means that in order to promote retrofit market it would need experience of these conversions and their costs and benefits in opposite to new build ships.

The actions of possible suppliers will be important in the future as the buildup of an infrastructure will be critical. The information that suppliers and experts possess should be distributed for possible customers. Awareness of these plans and possibilities makes the use of LNG more realistic for possible customers also.

One critical thing that the results revealed was the fact that education of both customers and experts is needed. The main issue to develop is the competence of experts informing possible customers about LNG. That is the group that will then also affect the education of customers, but if they have uncertainty of this, it is obvious that also the customer remains uncertain. As Roy Rothwell (1996) has stated, the things that affect the innovation success are “good internal and external communication” and “development of human capital” (Rothwell 1996: 36). These are also the areas that need development so that experts are able to professionally promote this technology for possible customers.

CONCLUSION

The response rate and size of research target groups remained quite low and that of course decreases the reliability of this study. Still the answers gotten will show future direction of this industry and the use of LNG. The results revealed that in many cases people do not know enough of LNG or do not want to reveal their plans yet, since the market is developing.

There seems to be very wide interest towards alternative and more environmental fuel. Still a development in many areas is needed to make it more realistic. At the moment the market for LNG is limited, due to lack of knowledge. The future, however, seems very positive and I believe that the market will increase. The increase in knowledge and in the development of infrastructure will create operational possibilities for customers.

The study also revealed areas for development that can be critical in making LNG more interesting alternative on the market. The main matter in this was the fact that in many cases the experts thought that they had information related to sales, but still there were many areas

in the use of LNG that they were uncertain of. As the information sharing for possible customers is a critical factor, it is important that experts have enough competence in these matters. Therefore a better information sharing internally and education could also have a positive impact on the external information sharing and in that way it would be possible to attract customers' genuine interest. It is important that customers feel that the experts are truly professionals, that way the promotion of LNG is easier. I also believe that as the year 2016 when the emission legislation tightens, comes closer and closer also the interest towards LNG ships will increase significantly.

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AN INVESTIGATION OF THE ENVIRONMENTAL BELIEFS AND ATTITUDES OF MANAGERS IN POLAND AND UKRAINE

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ABSTRACT

Empirical work on the acceptance of environmental impacts and responsibilities on the part of enterprises in developing countries is still relatively rare. There is also little research on the beliefs and attitudes of managers towards the issue of environmental protection. At the same time, a high ecological awareness is one of the most important motivators which induce organizations to undertake pro-ecological activities. This research helps fill the knowledge gap by providing information on the beliefs and attitudes of managers towards the environment. The purpose of the present study is to conduct an investigation of managers in two European countries: Poland and Ukraine. Results indicate that in practice managers did not go beyond the basic common sense of cutting their water & energy costs. This points to a lack of clear and adequate knowledge on relationships: environment – organization, and a tendency to be politically correct in relation to environmental issues.

Keywords: environmental belief, attitude, environmental management

INTRODUCTION

The underpinnings for environmental beliefs and attitudes lie in the means-ends theory of Rokeach (1973) which posits that motives can be explained by the underlying consequences and personal values. In the area of environmentally concerned behaviour, the operative personal values would include, for example, cleaner resources while the negative consequence would be environmental degradation.

The second stream is theory of planned behaviour which explains that individuals and groups strive to order their beliefs in a consistent framework (Ajzen 1985, 1888) cognizant of a specific mode of conduct or end-state of existence that is personally or socially preferable. In the light of that theory environmental beliefs and attitudes would pertain to the cognizance of the personally and socially preferable end-state of maintaining the integrity of the physical and natural environment through behaviours. Attitudes towards such behaviours are driven by beliefs about these behaviors and evaluation of the potential outcomes of the behaviors.
The importance of environmental beliefs and attitudes lies in a three-fold association. For many purposes, including the political arena, it is important to consider public awareness and opinion pertaining to environmental issues. It allows a country, among other things, to assume an appropriate ecological policy, to introduce instruments stimulating desired social behaviours. At the individual level, environmental beliefs comprise a key psychological determinant of behaviour. These include conserving behaviour, supporting intent, searching

for information. From the point of view of organization management, environmental beliefs and attitudes constitute one of the main factors affecting behaviours of organizations (Tilley, 1999; Worthington and Patton, 2005). Many organizations have engaged in environmental management initiatives in order to improve their environmental performance and have found other benefits to the process, such as financial savings and reduced risk of liability. Environmental beliefs and attitudes are carried forward into the realm of managerial decision-making.

Several analyses of attitudes towards various dimensions of the environment can be found in the literature (D'Souza, 2007; Boman and Mattsson, 2008, Gonzalez-Benito, 2010). These studies concern a general level of ecological awareness of a given country's public (Kasim, 2009; Tomicevic, 2010). The present paper focuses not on a general level of ecological awareness of the public but on managers' environmental beliefs and attitudes. Issues concerning the ecological awareness of a selected group (population) are sporadically presented in the literature. Limited research to date has been undertaken with respect to managerial attitudes towards environmental issues (Cummings, 2008). Therefore, the paper presents results of a study of managers' environmental beliefs and attitudes in two countries (Poland and Ukraine). The research seeks to explore whether managers possess knowledge pertaining to environmental issues; whether they possess the understanding of the relations between an organization and the environment; whether they think that being green is practical.

The reply to the questions posed enables one not only to determine managers' current attitudes towards environmental issues. Considering that the level of managers' ecological awareness and their attitudes are primary factors determining an organization's environmental strategy (Vithessouthi, 2009), the determination of environmental beliefs and attitudes of managers appears to be of key importance in the understanding of an organization's attitude in this sphere. Understanding how managers interpret environmental issues facing their firm is an important step in attempting to understand the development of pro-environmental organization behaviour as it is the attitudes and behaviours of managers that shape corporate behaviour.

THE CURRENT STATE OF KNOWLEDGE

Interest in environmental attitudes began in the early 1970s (Bord and O'Connor, 1997) led Dunlap and Van Liere (1978) to the publication of a new environmental paradigm (NEP), which sought to measure the degree of pro-environmental orientation through a series of 12 environmental items/statements. Hitherto conducted studies to a large extent concern factors that affect an environmental attitude. Some usual variables considered are age and gender as well as other socio-demographic and socio-economic factors (Whitehead, 1991; Engel and Pötschke, 1998; Witzke and Urfei, 2001; Dupont, 2004; Israel and Levinson, 2004; Hidano et al., 2005).

Limited research to date has been undertaken with respect to managerial attitudes towards environmental issues within the countries in question, although attitudes have been solicited in Japan (Pierce et al., 1987), Canada (Edgell and Nowell, 1989), Sweden (Widegreen, 1998; Gooch, 1995), Turkey (Furman, 1998) and the Caribbean (Rauwald and Moore, 2002), China

(Lee at al., 2005). On an international platform, Rojsek (2001) identified that at least in one developing country (Slovenia), significant differences regarding obstacles perceived by managers to environmental management were based on a firm size and age, whereas Branzei et al. (2002) attributed differences in environmental performance among Canada, China and Japan to a knowledge of environmental management. Studies conducted in China show that companies pay less attention to corporate environmental reporting and disclosure compared with some of their western counterparts, and only report when they are forced to do so (Peiyuan, 2005). This is confirmed by the latest studies according to which Australian respondents were more cautious of supporting a forthright view on environmental issues, whilst Chinese respondents favoured a more centralized approach to decision making regarding the environment (Cummings, 2008).

In Poland, studies of ecological awareness, referring to the general public, were conducted by the Centre for Public Opinion Research (CBOS 1996, 1997, 2000) and by other researchers (Wojnarowska, 2009). Taking into account the level of managers' ecological awareness Leszczynska (2009) showed that there is a gap between their attitudes towards the environment and actions undertaken in this area. There is no evidence which would enable a comparison of the level of awareness of Polish managers with the level of those from other countries. To our knowledge, studies regarding environmental beliefs and attitudes of managers in Ukraine are also lacking. Admittedly, there have been studies concerning a general attitude of the public to ecological issues in this country, however they referred to the whole society (Grodeland, 1996; Public, 2003). Studies focusing on the managers' group have not so far been published.

STUDY METHOD

The research process involved:

- literature review,
- semi-structured interviews with industry representatives to establish research focus and propositions. Results of discussions cross-checked with interviews prior to designing part I of the questionnaire,
- piloting the questionnaire, revision,
- sending the questionnaire by mail to sample organizations with a cover letter,
- input and analysis of survey data.

The studies were conducted in 2009. 200 managers in public and private corporations nationwide were selected in Ukraine. In Poland the population of managers was 250. The survey was directed to middle executives, with the exception of employees of environmental protection departments on the assumption that they are characterized by a higher level of ecological awareness and knowledge. Questionnaires were mailed to selected organizations. Organizations were chosen in a random way, based on information available in statistical bases.

The samples were selected predominantly from organizations within the manufacturing and natural resources industries, including chemicals, machinery, food, mining. All these industries have a direct involvement with the natural environment, and therefore were chosen specifically for this study. The study instrument was a survey which consisted of two parts.

The questions used in Ukraine were translated from Polish into Russian. The questionnaire was based on an assumption that environmental beliefs and attitudes are determined by knowledge, values, attitudes, a desire to act (Zsoka, 2008).

The first part of the questionnaire pertained to ecological awareness understood as a conglomerate of knowledge, values and attitudes. This part contained 15 closed dichotomous questions or disjunctive cafeteria-style checklists. The questions used were formulated based on Public Opinion Research Center in Poland (CBOS 1996, 1997, 2000) questionnaires. Therefore the instrument was verified in previous studies conducted by this institution in the years 1996-2009. The studies were of a quantitative character; the percentage of responses given to individual questions was assessed. Questions regarded the respondents' opinions concerning environmental threats, the environmental state in the vicinity of an organization, responsibility for the state of the environment, a knowledge of ecological organizations and eco-labels, etc. The second part of the survey referred to beliefs and opinions pertaining to ecological issues. The scope of the questions included in this part was quoted in Tab.2. In this part, which involved 18 questions, a 5-point rating scale suggested by L.S. Cumming (2008) was used. Responses were given in an interval response scale, on a 1–5 rating scale for a particular question, where 1-strongly unfavourable to the concept and 5-strongly favourable to the concept. This part was verified in pilot studies conducted in Australia.

RESULTS

The total response rate was 31 (15%) for Ukrainian respondents and 216 (86%) for Polish ones. Cumulative results from the individual questionnaires were obtained directly from the SPSS statistical software. The survey yielded varied statistical results. The Wilks' Lambda reveals significant differences between the two countries with regard to environmental attitudes (value=0,781; F=4,49). Significant differences were obtained for all environmental questions.

Assessing the level of ecological knowledge of Polish respondents it ought to be emphasized that less than a half of them (44%) possess the knowledge of which institution to inform in case of a threat to the environment. The respondents pointed to a fire brigade (35%), police (17%), emergency management headquarters (12%). Only 4% would contact public administration units responsible for the state of the environment. Taking into account marking products (labelling), every fourth respondent is able to recognize ecological labels. Whereas 45% of the questioned managers, 33% of all-Polish ones and 10% of local ones, can "pride themselves on" the knowledge of international ecological organizations.

Ukrainian managers are able to mention only international ecological organizations. The interviewees in this country report possible environmental threats to police (33%), a fire brigade (30%). Only 4 respondents (out of the whole population) were able to indicate examples of eco-labels. The above results point to a definitely lower level of ecological knowledge of Ukrainian managers. It may result from their lack of interest in these problems and also from a delay with which ecological ideas are promoted. One may suppose that in Ukraine eco-labelling is not popularized, and organizations' ecological activities are not propagated, for example, by the media. Despite the fact that results obtained by Polish managers are better, they cannot be fully positively assessed. A 25% knowledge index of

labels among managers in a country functioning in the European market is certainly insufficient.

Assessing a general state of the environment, a significant part of the respondents in both the countries studied is to a significant extent worried about the state of the environment (>40%). They consider the ozone layer and the greenhouse effect to be the greatest threats (Fig.1).

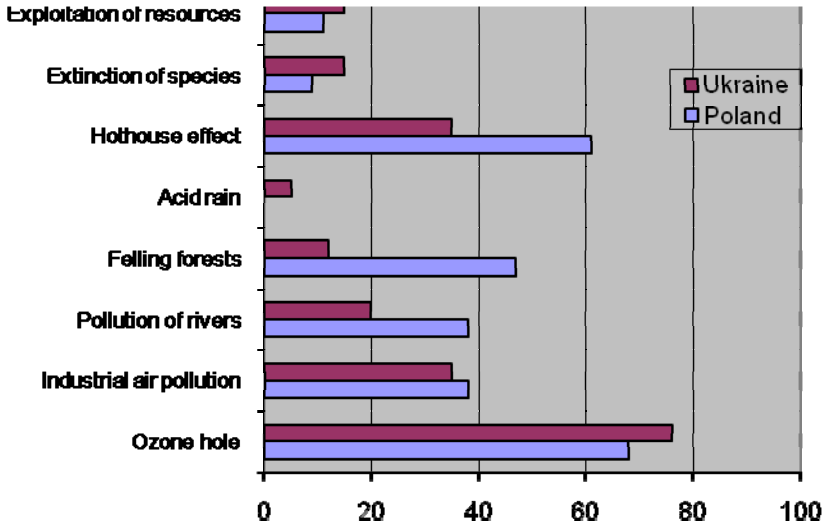

Figure 1. Environmental threats (in %[1])

Referring to local problems related to the environmental state in the vicinity of an organization, managers point to the existence of 2 or 3 threats (65%). In Ukraine 10% and in Poland 4% of the respondents do not perceive any threats. The greatest problem according to the respondents is air pollution and littering the area (Fig.2). Apart from that, essential differences among the countries are discernable. Problems which appear in Ukraine are caused by negligence on the part of authorities and by industry. In Poland the existent state is to a lesser degree caused by lack of interest of authorities in ecological issues. The interviewees in this country to a greater extent concentrated on antropogenic burdens on the environment i.e. air pollution, water pollution.

[1] The sum of responses does not need to be 100% due to a possibility of a choice of several answers.

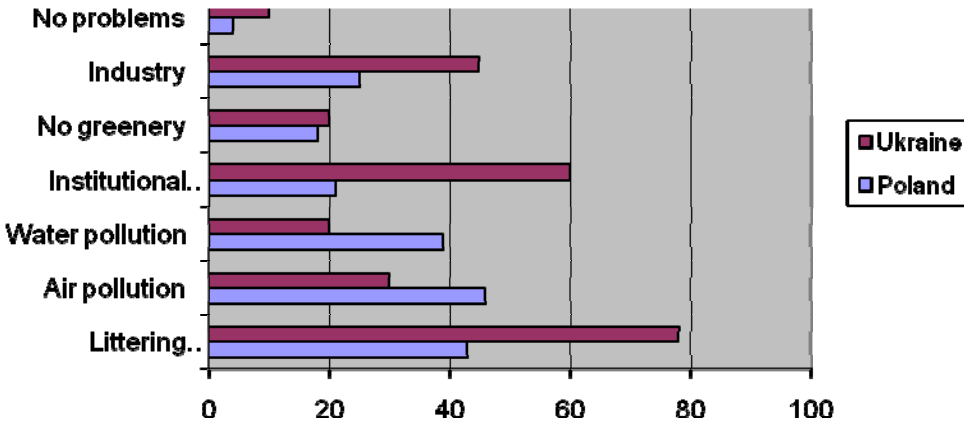

Figure 2. Ecological problems in the vicinity of an organization (in%)

In the opinion of 53% of the respondents, environment protection in Poland (compared to 2004) is functioning better (or definitely better 6%). The opposite answer was given by 15%, so by three times fewer, of the respondents. As to Ukraine, a general state of the environment over the last 5 years has not changed (52%). Managers notice neither a deterioration of the environmental state nor its improvement. These results may prove that authorities take certain actions aimed at restoring environmental components to a socially desirable state, and these actions neutralize the current negative impact. On the other hand, they may be indicative of a passive attitude of managers who are not concerned about those changes in the environment which do not directly affect their business activities.

The studies conducted show that in the opinion of the managers in both the countries an improvement of the state of the environment is dependent on their activities. However, there are differences as to factors regarded as having an influence on an improvement of the environmental state (Fig.3). The state of finances is perceived as a significant factor (though to a different extent), whereas responsibility of business clubs is considered to be of little importance. Due to the fact that Poland developed an ecological policy and that competences regarding environment formation were transferred to local self-governing bodies (along with a necessity of working out a regional development strategy) the activities of the government and of local authorities are also perceived there as having a significant impact on the environment.

From the standpoint of values recognized naturo-centric attitudes are more and more common. Managers indicate that nature preservation is one of the most highly appreciated values, in contrast to modernization of life and advance. Contrary to expectations, such an attitude is mainly typical of Ukrainian managers (50%), and to a lesser extent of Polish ones (38%).

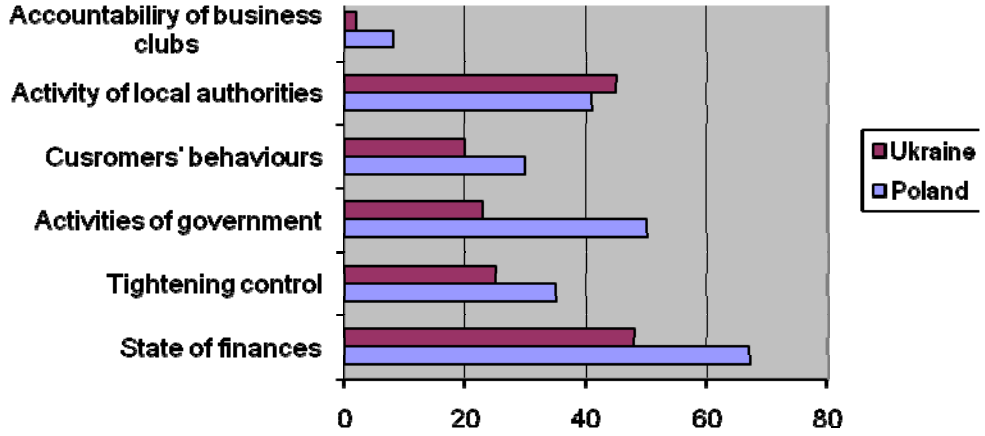

Figure 3. Factors affecting improvement of the state of the environment

As indicated in Table 1, there is a discrepancy between the current practices of the respondents and their overwhelmingly positive responses on the practicality of environmentally friendly measures described above. Except for saving water and electricity, the majority did not take measures against poor water quality, wastewater pollution or solid waste. This discrepancy reflects the tendency to have a "politically correct" stand on environmental issues, without any concrete effort to explore or address the issues further. The findings also indicate that organizations do not go beyond the basic common sense of cutting their water and energy costs. This is understandable considering the additional costs required to install facilities necessary to recycle waste water.

Table.1. Response on existing environmental practice

Is your organization taking any measures at present in relation to:	Poland		Ukraine	
	Yes	No	Yes	No
Water quantity	100%	-	95%	5%
Water quality	28%	72%	17%	83%
Electricity	100%	-	100%	-
Wastewater pollution	47%	53%	48%	52%
Generation of solid waste	23%	76%	35%	65%

The second part of the questionnaire, based on an ordinal scale (1-5), focused on convictions and beliefs. The results obtained were compiled in Table 2.
In the opinion of Polish respondents, employees whose tasks have a significant impact on the environment ought to participate in ecological training (3.8). The managers interviewed believe that:

- trade sanctions should be imposed on countries not complying with international ecological agreements (4.2),
- environment pollution in one country can have direct effects (financial or social) in other ones (4.7),
- national and local organizations should be subject to analogous requirements of compliance with environmental protection as international organizations in a given country (4.1).

Table 2. Results of study of ecological convictions (means, t-Test)

Question	Poland	Ukraine	Mean value	t-value	Sig.
1. Mandatory ecological education	3.8	3.8	3.8	-6.12	0.05
2. Environmental teams in manufacturing enterprises	3.8	2.6	3.2	-5.50	0.00
3. Ecological taxes	2.7	3.5	3.1	-5.42	0.04
4. Limitation of use of subsidies	3.3	3.3	3.3	-7.12	0.00
5. Sanctions for polluting countries	4.2	3.4	3.8	-6.80	0.00
6. Subjecting international problems to domestic policy	3.2	3.4	3.3	-5.66	0.23
7. Applications of ecological standards	3.3	3.7	3.5	-4.73	0.01
8. Financial profits from ISO	3.3	1.6	2.45	-3.90	0.08
9. Governmental control of environmental regulations	3.6	4.1	3.85	-5.18	0.00
10. International effects of pollution	4.7	4.0	4.35	-5.24	0.00
11. Taking into account opinion of the public	1.9	2.5	2.2	-6.09	0.05
12. Compromise with stakeholders	3.3	3.5	3.4	-6.78	0.05
13. Managers' accountability for environmental management	2.0	2.3	2.15	-7.05	0.00
14. Statistical data accumulated by manufacturing organization	2.8	4.3	3.55	-5.55	0.00
15. Considering interests of other groups	3.3	3.3	3.3	-4.89	0.06
16. Publishing a separate environmental report	3.7	4.2	3.95	-3.09	0.00
17. Verification of environmental performance by auditors	3.5	3.7	3.6	-7.15	0.00
18. Identical requirements for all organizations	4.1	4.0	4.05	-6.62	0.08

With reference to ecological standards and norms, in the opinion of Polish respondents, if there are no appropriate national standards, organizations should apply international ones (3.3). Central control over environmental norms and regulations should be maintained by governmental bodies (3.6). The respondents assumed a more conservative attitude towards considering the public's opinion in environmental decision-taking (1.9). A negative assessment was also made with reference to laying all accountability for implementation of environmental management in an organization only on managerial staff (2.0). At the same time, in the opinion of Polish people manufacturing enterprises and those whose area of activity is the environment protection sector should publish annual environmental reports which need to undergo independent verification (3.5). According to the respondents it is necessary for all manufacturing enterprises to accumulate and make available statistical information concerning the level of pollution (2.8).

Ukrainian respondents were the most prominent in expressing a desire to have trade sanctions imposed (3.4), and to have local companies exposed to the same degree of environmental compliance as foreign companies (4.0). On the questions of negative construct, they were however of the opinion that international environmental concerns should be subordinate to national concerns (3.4) and that the national government should maintain central control over the environmental regulations (4.1). This reflects a more nationalistic and centralized perspective on environmental accountability.

Ukrainian respondents do not perceive any benefits resulting from implementation of ISO14000. It is probably due to a very low popularity of environmental management schemes in Ukraine, which are implemented only by international organizations. Moreover, the interviewees do not perceive a need of forming environmental committees in organizations (2.6); they have a negative perception of their own accountability for implementing environmental management (2.3).

CONCLUSION

The findings of this study indicate that, in summary, managers are generally positive about the relevance of environmental issues in their operations and their role in them. However, their generally positive environmental beliefs and attitudes cannot be taken as indicative of their actual business practices. A discrepancy between a belief and attitude and actual practice can be explained by factors like capital availability, information availability, time availability as well as a socio-demographic background. From the standpoint of environment protection organization in an enterprise, Polish managers have a higher awareness of needs in this area. They are to a greater extent supportive of conducting ecological education, forming ecological teams, of an independent verification of environmental performance. In the opinion of the respondents from this country ecological problems ought to be solved on a national forum; it is also necessary to introduce sanctions for polluting countries. In Ukraine, there is a dominant position that international ecological problems need to be subjected to a national policy (in contrast to more developed countries where respondents were in favour of a global approach). Only in a situation when proper national solutions are not available, is a possibility of applying solutions created abroad taken into account (i.e. standards).

Environmental beliefs and attitudes of managers are weaker in Ukraine than in Poland. Managers in this country perceive their role in implementing tasks regarding environmental protection in a more passive way. They are to a lesser degree responsible for:

- considering the opinion of the public in taking environmental decisions,
- compromise with stakeholders,
- taking on responsibility for environmental protection in an organization.

This results, on the one hand, from a lesser openness of an organization to its surroundings (e.g. overlooking the impact of customers), on the other one, from a fear of taking on responsibility due to lack of proper knowledge. Key factors which determine an attitude towards the environment are: a level of knowledge, access to information. The studies conducted show that the level of knowledge of managers in less developed countries is lower. Therefore, it seems appropriate that they acquire knowledge concerning environmental protection and related fields. Such ecological education should be based mainly on self-study and involve examining specialist articles, monitoring results, study results. There is a need for the dissemination of environmental knowledge in business education, as well as through networking with media. Improved levels of environmental beliefs and attitudes would also inculcate a shared environmental value orientation in business students in the two countries.
As far as economic instruments of environment protection are concerned, the managers have an identical (i.e. negative) approach to the issue of reduction of subsidies. Subsidies are treated as additional sources of financing. Investments, including ecological ones, are not introduced without an additional external financial support. However, there are differences with respect to ecological taxes. Managers in Poland are to a greater extent of a negative opinion on taxes because they lower an organization's financial performance. Fees for use/pollution of the environment are also much higher in this country.

The results obtained point to Ukraine's significant backwardness which results from the attitudes and negligence on the part of local administration. The main problem is a lack of civil movement and governmental pressure, and the experience and resources to address their negative environmental impacts. In Poland, for example, environmental regulations are complex, contradictory and vague. Ukraine's strong desire to achieve economic development also contributed to a generally low consideration for environmental management. High priority for economic development at the expense of the environment was coupled with a lack of strong civil pressure. Only the recent years have brought the introduction of environmental protection regulations based on legal solutions used in more developed countries. However, the adjustment of the legislation on environmental protection to the requirements of, for example, the European Union requires a long period of time. It has to be accompanied by a transition of decision and control powers to local bodies. Therefore, apart from appropriate legislation, it is necessary to simplify the administrative process by shortening proceedings or by informal negotiations which will replace procedures and administrative decisions with a system of agreements of directly concerned parties.

Since regulation is one of the key driving forces of the adoption of environmental practices, it is recommended that the government should be more aggressive in implementing laws and regulations that are applicable to organizations. Information and advice on environmental programmes that are affordable and suitable should also be easily accessible so as to further

promote their take up of environmental practices. Such information and advice should convince managers that environmental practices contribute towards long-term financial benefits and demonstrate their social responsibility.

In the light of the results obtained a country's socio-economic development affects an attitude towards the environment. This concerns especially positive changes in the sphere of economic, social, political activities. More developed countries (Poland) are characterized by a higher level of ecological awareness, and vice versa. Therefore, the findings of the study confirm a need to raise ecological awareness in less developed areas.

The current research is not free from limitations. Firstly, compared to the Polish sample, the Ukrainian one comprised a marginal proportion. To that extent, results may not be strictly comparable between the two countries. Secondly, the literature points to the role of a collectivist orientation, a cultural value in the formation of environmental beliefs and attitudes. In the present study the author did not include culture as a study variable. The assumption made was that the countries, as neighbouring ones, are party characterised by convergent cultural values. The study was also limited (as far as its scope is concerned) to selected determinants, indicative of environmental beliefs. There is a need for a deeper study of causative factors responsible for the making of environmental beliefs and attitudes, such as a collectivist orientation, and the role of environmental education in institutions.

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DEVELOPING AN ECONOMIC COST MODEL FOR A SUPPLY CHAIN

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ABSTRACT

Supply chain management (SCM) has become the most powerful tool for any business because it aims to provide the win-win situation for all members by maximizing the profit of the whole chain. However, some benefits from joining the chain are difficult to quantify into monetary term. If these benefits and big savings of supply chain coordination cannot be detected, it would result in the productivity paradox and failure to justify the benefits of building trust and coordination in the supply chain. The proposed classification of supply chain cost expands the cost concept breaking overhead costs according to their cost center and introduces the opportunity cost to estimate the neglected cost of non-value added activities. With this proposed classification, a company would be able to quantify the hidden benefits and their savings as well as other logistics costs if they choose to join and coordinate in the chain in which these savings would be ignored and overlooked by the traditional costing methods.

Keywords: Supply Chain Costs, Opportunity Costs, Cost Model, Activity-based Costing

1. INTRODUCTION

A supply chain is a set of channel members, which are suppliers, manufacturer, distributors, wholesalers, retailers, and end customers, transact to each other to satisfy customer requirements within the promised time at the minimized cost. Activities in a supply chain include flows of information and materials, technology, resources, and funds as well as coordination and collaboration with all members.

Council of Supply Chain Professional (2005) defined the term "Supply Chain Management" as planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. In essence, supply chain management integrates supply and demand management within and across companies. Recently supply chain management concept has evolved beyond a mere cost-reducing business function into a core competency and source of competitive advantage for many companies because of its impact on customer service – the output of the entire logistics function. In a highly competitive marketplace where products, prices, and quality are easily imitated, superior customer service can be the key element that ranks one company above another (Lambert *et al.*, 1998; Ferguson, 2000).

One of the problems to become a coordinating chain is that the mutual benefit cannot be realized to all coordinated members due to the fact that the traditional costing method can reveal and express only visible costs. Marx (2009) explained that the problem is in the

underlying methodology of the traditional costing systems. They adhere to the assumption that products cause cost. Each time a unit of product is manufactured, it is assumed that cost is incurred. This assumption makes sense for certain direct costs, but it does not work for activities that are not performed directly on the product units. The problem with this approach is that for most overhead activities, the proportions of the activity actually consumed by a specific product, does not universally correspond with a single cost driver. This holds true for most modern companies where products are produced by a combination of manpower and technology. The traditional cost accounting model employs a volume-based driver, such as direct labour hours or machine hours for the assignment of all manufacturing overhead costs. The conventional cost accounting model ends up with a cost of goods sold based on absorption costing and includes only product costs as defined in financial accounting. Fundamentally, traditional costing systems try to assign cost directly to products, rather than to activities first and then from the activities to product units. The typical cost report gives information on what is spent, but not why it is spent. When overhead costs are cut in order to reduce total costs it is the symptoms that are treated and not the cause. In many cases, the cutting of overheads is more likely to lead to a reduction in the quality of the products than to the long term reduction of the cost.

Lin *et al.* (2001) stated that tradition cost accounting systems have become extremely inadequate new concepts and advanced systems since they continue to allocate these escalating overhead costs on a volume-driven basis such as labor hours or machine hours which no longer predict the true consumption of resources in manufacturing and design. Su and Lei (2008) reported that the traditional costing systems were limited to analyzing production costs and less effective when considering the complex processes of the supply chain. As a result, many savings in new technology and useful concepts may not be quantified and overlooked.

In our paper, we use the process costing system together with Activity-based Costing to evaluate costs in a supply chain. In the process costing method, the costs are accumulated according to processes or departments and assigned to a large number of nearly identical products. It can provide information to analyze product and customer profitability and to make pricing, product-mix, and process improvement decisions. Then, Porter (1985) said activities consume resources and product consumes activities in which this is the fundamental assumption of Activity-based Costing system (ABC). Thus, in ABC, a cost is incurred at the point where the activity takes place. ABC allocates overhead costs using cause-and-effect criteria with multiple cost drivers. For ABC system, overhead costs can be more accurately allocated to products based on resource consumption during the activities.

2. LITERATURE REVIEW

Lalonde and Pohlen (1996) proposed a Supply Chain Costing, which employed many techniques embedded in Direct Product Profitability (DPP), Activity-based Costing (ABC), Total Cost of Ownership (TCO), and Efficient Consumer Response (ECR). To evaluate the supply chain cost, major activities were firstly identified and placed in a flow diagram. Secondly, the activities are broken down into the specific activities and put them in a flowchart. Thirdly, the resources required for each activity were identified, and their costs were traced to the activities. Next, the activity costs were traced to supply chain output or

cost object. Finally, the cost drivers for specific activities were analyzed by determining the causal effect between the demand for specific logistics services and costs spanning for the entire supply chain. Their analysis could help companies to evaluate how different channel structures drive costs and contribute to overall profitability.

Wu (2005) sparked the idea of cost architecture as a concept for how to evaluate supply chain costs. In the proposed cost architecture, costs are organized into hierarchy levels of increasing complexity, and the total supply chain cost was formulated as the sum of quantifiable costs, more complex quantifiable costs, and not directly quantifiable costs. Focusing on SCOR model, supply chain management costs are defined as measure of all costs associated with managing supply chain including costs associated with acquiring and delivering materials, planning and order management, but none of the expenditures associated with R&D or sales and marketing.

3. CLASSIFICATION OF SUPPLY CHAIN MEMBERS AND THEIR ASSOCIATED COSTS

Members in a supply chain may perform four main roles as manufacturer, warehouse, distributor, and retailer. The manufacturers order raw materials from their suppliers and convert them into finished products. Then, the external hiring warehouses or storage points are hired to keep the products for a period of time. They hold the products in the intermediate chain and distribute them to distributors or retailers as well as receive the incomes from their holding service. Next, the distributors buy a number of products from different manufacturers and make the profit from their sales to retailers. Finally, the retailers purchase the products from the manufacturers or distributors and sell them to their end customers.

A company who traditionally classifies its costs into direct material, direct labor, and factory overhead costs will not be able to quantify its true and aggregate costs when many costs are invisible by their nature. If these savings are overlooked or cannot be quantified, the benefits of becoming a supply chain will be underestimated and the project may be justified unsatisfactory. In our proposed supply chain cost model, costs in a supply chain are classified into both visible costs and invisible costs. These invisible costs are referred to the hidden opportunity costs. It is defined as the value of the next best alternative forgone as the result of making a decision. Although the opportunity costs are not shown in any financial statement, it is an important part of a company's decision making processes. The opportunity costs may not be easily seen and understood, but they may cost a company by a large amount if the company does not have ability to quantify them. Moreover, inability to quantify these hidden opportunity costs causes all supply chain members to be unable to realize the importance of the cooperation, which could be led to big loss or huge saving, within the chain. Figure 1 shows the proposed supply chain costs of all supply chain members. It explains the costs that may be incurred in each stage of a supply chain.

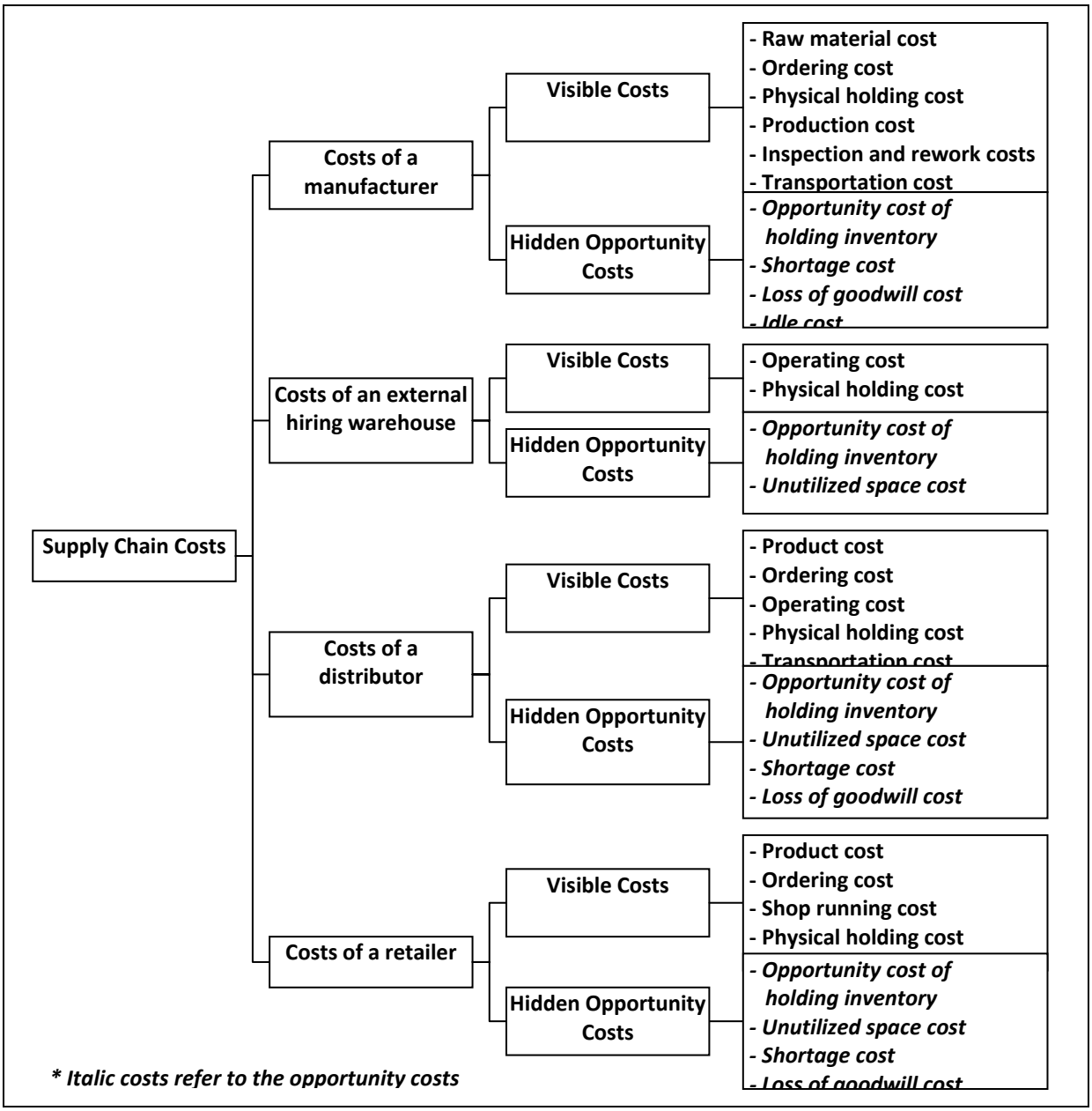


Figure 1: Proposed classification of supply chain costs

4. PROPOSED SUPPLY CHAIN COST MODEL

4.1. Manufacturer

A manufacturer is a stage in supply chain that produces products through a number of processes involving raw materials, components, or assemblies, usually on a large scale with different operations. Manufacturers may be commonly used interchangeably with producers.

Total cost of a manufacturer

= ***Raw material cost + Production cost + Warehouse and inventory cost + Transportation cost + Quality cost + Other expenses***

4.1.1. *Raw material cost* includes both direct and indirect costs of raw materials used to produce a product. Since one or more than one type of materials are transformed into a product, total material cost of a product is the sum of units of each direct material multiplied by its unit cost and the cost of indirect materials.

$$MTMC = \sum_{j=1}^{J}\sum_{i=1}^{I}\left(MDM_{ij} \times MDMC_{ij}\right) + \sum_{j=1}^{J} MIMC_j$$

where $MTMC$ = Total raw material cost of a manufacturer
MDM_{ij} = Quantity of direct material *i* of product *j*
$MDMC_{ij}$ = Unit cost of direct material *i* of product *j*
$MIMC_j$ = Indirect material cost of product *j*
for *i* = *1*, …, *I* (*i* is different types of direct materials.)
for *j* = *1*, …, *J* (*j* is different types of products.)

4.1.2. *Production cost* is manufacturing costs associated with converting raw materials into components and finished products. This cost includes the costs of direct and indirect labors, machining, machine setting-up, and inbound part handling. Total production cost can be formulated as:

Total production cost of a manufacturer
= Ordering cost + Machining cost + Set-up cost + Idle cost + Labor cost

1. *Ordering cost / Order preparation cost* is incurred each time an inventory replenishment order is placed. This includes costs associated with order processing, inventory allocation, ordering from internal or external suppliers, shipment scheduling, order status reporting, and shipment initiation.

$$MTOC = \sum_{s=1}^{S}\left(MO_s \times MOC_s\right)$$

where $MTOC$ = Total ordering cost of a manufacturer
MO_s = Number of placed orders from the supplier *s*
MOC_s = Ordering cost per order for the supplier *s*
for *s* = *1*, …, *S* (*s* is different types of suppliers.)

2. *Machining cost* includes utility costs, which could be driven by actual machine hours. Some examples of these costs are costs of electricity and fuel for running manufacturing equipment.

$$\sum_{j=1}^{J}\sum_{a=1}^{A}\left[\left(MMC_{aj}\right] \times MMH_{aj}\right)$$

where MMC_{aj} = Machining operation cost of machine type *a*, which is used to produce the product *j*
MMH_{aj} = Total operating time of machine type *a*, which is used to produce the product *j*
for *a* = *1*, …, *A* (*a* is different types of machines.)

3. *Set-up cost* is the costs incurred each time different batches are produced. It consists of engineering costs of setting up the production runs or machines.

$$\sum_{a=1}^{A} [(MSC]_a \times MST_a)$$

where MSC_a = Set-up cost for each time the machine *a* is set up
MST_a = Number of set-ups of the machine *a*

4. *Idle cost* is the cost associated with the under-utilization of manufacturing equipment. It shows inefficiency of the company planning in utilizing available resources.

$$MTIdC = \sum_{a-1}^{A} \left(\alpha_{M_a}^{I} \times Eff_a \times MIdT_a\right)$$

where $MTIdC$ = Total idle cost of a manufacturer
$\alpha_{M_a}^{I}$ = Opportunity loss cost of machine idle of the machine type *a* per unit time
Eff_a = Efficiency of the machine *a*
$MIdT_a$ = Total idle time of the machine *a*

5. *Labor cost* is a wage or salary, usually financial, received by workers, who produce products or works in a factory.

$$\sum_{j=1}^{J} [(MWDL]_j \times MH_j) + \sum_{b=1}^{B} (MWIL_b \times MNIL_b)$$

where $MWDL_j$ = Wage per unit time per person of direct labors, who produce the product *j*
MH_j = Number of working hours of direct labors, who produce the product *j*
$MWIL_b$ = Salary per unit time per person of indirect labors, who work in the department *b*
$MNIL_b$ = Number of indirect labors, who work in the department *b*
for *b* = *1*, …, *B* (*b* is different types of departments.)

4.1.3. *Warehouse and inventory cost* is the costs associated with warehousing and holding inventory in warehouses. Total warehouse and inventory cost of a manufacturer can be formulated as:

Total warehouse and inventory cost of a manufacturer
= ***Physical holding cost + Opportunity cost of holding inventory + Shortage cost***

1. *Physical holding cost* is the operating cost associated to the physical holding of inventory when the materials are held. This physical holding cost of holding different types of products can be charged according to their consumed spaces.

$$\sum_{j=1}^{J} [(MHOC]_j \times MSS_j \times MT_j)$$

where $MHOC_j$ = Physical holding cost per unit of storage space of the product *j* per unit time

MSS_j = Storage space of the product *j*
MT_j = Period of inventory holding time of the product *j*

2. *Opportunity cost of holding inventory* can be calculated as the expense that is lost or foregone due to keeping that inventory as a capital tied up. It can be expressed as a bank's interest rate or a company's own cost of capital, multiplied by the value of that keeping inventory.

$$\sum_{j=1}^{J}\left(\alpha_{M_j}^{H} \times MUC_j \times MT_j\right)$$

where $\alpha_{M_j}^{H}$ = Holding opportunity cost per unit time
MUC_j = Unit cost of inventory of the product *j*
MT_j = Period of inventory holding time of the product *j*

In order to calculate the opportunity cost due to the capital tied up, the bank's interest rate or company's cost of capital could be used depending on the following cases. The first case is when the product is stored while there is no immediate demand, so the company needs to pay the opportunity cost of holding the inventory equal to the amount of money to acquire that inventory (i.e., bank's interest). The other case is when the product is stored while it could have been sold, so the opportunity cost of holding is a loss according to the company's required cost of capital for the sold products.

3. *Shortage cost* is the opportunity cost of not having the units in stock for sales e.g., lost profits, penalty costs, and loss of customer goodwill. This cost can be calculated as the shortage cost per unit multiplied by the number of shortage units.

$$MTSC = \sum_{j=1}^{J}\left(\alpha_{M_j}^{S} \times MQS_j\right)$$

where $MTSC$ = Total shortage cost of a manufacturer
$\alpha_{M_j}^{S}$ = Shortage opportunity cost of the product *j*
MQS_j = Quantity of shortage of the product *j*

4.1.4. *Transportation cost* is the cost of transporting materials from one place to another place. This transportation cost includes both transportation cost inside and outside a factory. Transportation cost of a manufacturer can be formulated as:

Total transportation cost of a manufacturer
= ***Inbound handling cost + Outbound transportation cost***

1. *Inbound handling cost* is the cost of handling raw materials, work-in-processes, and finished products inside the manufacturing plant by different types of transporters such as forklift trucks, conveyors, etc.

$$\sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{l=1}^{L}\left([MHdC]_{ijkl} \times MHdT_l\right)$$

where $MHdC_{ijkl}$ = Cost of handling the raw material *i*, work-in-process *k*, and the finished product *j* per period of the transporter type *l* (*l* can be forklift trucks, conveyors, etc.)
$MHdT_l$ = Handling time of the transporter type *l*
for *k* = *1, …, K* (*k* is different types of work-in-processes.)
for *l* = *1, …, L* (*l* is different types of transporters.)

2.2. *Outbound transportation cost* is the cost for shipment between two geographical locations and the related expenses from the manufacturer to distributors or the manufacturer to retailers or distributors to retailers. This cost also includes all outbound transportation costs for the returned products from distributors or retailers back to the manufacturer in which it will be considered as a part of quality costs in this study. Note that for the manufacturer that hires a distributor to distribute its products, the manufacturer must also pay the outbound transportation cost from the point-of-distributor to the retailers.

$$MTTC = \sum_{v=1}^{V}\sum_{y=1}^{Y}\sum_{x=1}^{X}\left(MT_{xyv} \times MTC_{xyv}\right)$$

where $MTTC$ = Total outbound transportation cost of a manufacturer
MT_{xyv} = Number of trips from the starting point *x* to the ending point *y* by the mode of transportation *v*
MTC_{xyv} = Transportation cost from the starting point *x* to the ending point *y* by the mode of transportation *v* per unit of distance the mode of transportation *v* per trip
for *x* = *1, …, X* (*x* can be the manufacturer, the distributor, or the retailer.)
y = *1, …, Y* (*y* can be the manufacturer, distributor, or the retailer.)
v = *1, …, 4* (*v* is the mode of transportation, which may include truck, train, ship, and airplane.)

4.1.5. *Quality cost* is the total cost of quality-related efforts and deficiencies. The quality cost is separated into three parts, which are cost of inspection, cost of rework, and cost of loss of goodwill.

$$MTQC = \sum_{j=1}^{J}\left(MInspC_j \times MN_j\right) + \sum_{j=1}^{J}\left(MRC_j \times MNR_j\right) + \sum_{j=1}^{J}\left(\alpha_{M_j}^{Q} \times MRT_j\right)$$

where $MTQc$ = Total quality cost of a manufacturer
$MInspC_j$ = Cost of inspection of the product *j* per unit
MN_j = Number of the product *j* being inspected
MRC_j = Cost of rework of the product *j* per unit
MNR_j = Number of the product *j* that must be reworked
$\alpha_{M_j}^{Q}$ = Opportunity cost of loss of goodwill per unit of product *j*
MRT_j = Number of units that the product *j* is returned as defectives

4.1.6. *Other expenses* are other expenses that are not previously mentioned.

4.2. External Hiring Warehouse

An external hiring warehouse is a stage in a supply chain that holds the products for some periods of time before delivering them to its distributors or retailers by the request of the manufacturer. In this instance, the manufacturer requests the external hiring warehouse to keep its stocks until they will be delivered to the distributor later and the manufacturer will be responsible for all outbound logistics costs as mentioned earlier.

Total cost of an external hiring warehouse
= ***Labor cost + Warehouse and inventory cost + Inbound handling cost + Other expenses***

4.2.1. *Labor cost* is wage or compensation, usually financial, received by workers in exchange for their laborers, who work in warehouses.

$$\sum_{j=1}^{J}(WWDL_j \times WNDL_j) + \sum_{b=1}^{B}(WWIL_b \times WNIL_b)$$

where $WWDL_j$ = Wage per unit time per person of direct labors, who respond to the product *j*
$WNDL_j$ = Number of direct labors, who respond to the product *j*
$WWIL_b$ = Salary per unit time per person of indirect labors, who work in the department *b*
$WNIL_b$ = Number of indirect labors, who work in the department *b*

4.2.2. *Warehouse and inventory cost* is the cost associated with warehousing and holding inventory in warehouse. Total warehouse and inventory cost of a manufacturer can be formulated as:

Total holding cost of an external warehouse
= ***Physical holding cost + Opportunity cost of holding inventory + Unutilized space cost***

1. *Physical holding cost* is the operating cost associated to holding inventory. Similar to the manufacturer, this physical holding cost of holding different types of products may be different depending to their sizes.

$$\sum_{j=1}^{J}[(WHOC]_j \times WSS_j \times WT_j)$$

where $WHOC_j$ = Holding operating cost per unit of storage space of the product *j* per unit
WSS_j = Storage space of the product *j*
WT_j = Period of inventory holding time of the product *j*

2. *Opportunity cost of holding inventory* is the cost that is lost due to holding one type of inventory but loss a chance to hold another type of inventory that may give a company a higher return.

$$\left[WCS \times WDS \times \Sigma_{j=1}^{J}\left(\alpha_{W_j}^{H} \times WOS_j\right)\right]/_{WN}$$

where WCS = Initial investment cost per unit of storage space

WDS = Percentage of depreciation cost per unit time
$\alpha_{W_j}^{H}$ = Opportunity cost per unit time
WOS_j = Number units of occupied space of product *j*
WN = Number of replications per unit time

Opportunity cost of holding inventory is an extra cost of capital of the company that is foregone due to holding the inventory that may give a lower return. So, it could be calculated from a lost profit from keeping lower profit return units.

3. *Unutilized space cost* is the opportunity cost incurred due to under-utilization of the storage spaces. It shows a company's inability to use space effectively.

$$\left[WCS \times WDS \times USF \times \sum_{c=1}^{C}\left(\alpha_{W_c}^{U} \times WUS_c\right)\right] / WN$$

where WCS = Initial investment cost per unit of storage space
WDS = Percentage of depreciation cost per unit time
USF = Unutilized space factor
$\alpha_{W_c}^{U}$ = Opportunity cost per unit time
WUS_c = Number units of unutilized space of area *c*
WN = Number of replications per unit time
for c = *1, …, C* (*c* is different storage areas.)

4.2.3. *Inbound handling cost* is the costs of handling finished products by different transporter types such as forklift truck, conveyor, etc. in the warehouses.

$$\sum_{j=1}^{J}\sum_{l=1}^{L}\left[\left(WHdC\right]_{jl} \times WHdT_l\right)$$

where $WHdC_{jl}$ = Cost of handling the product *j* per unit time of the transporter type *l* (*l* can be forklift truck, conveyor, etc.)
$WHdT_l$ = Handling time of the transporter type *l*

4.2.4. *Other expenses* are other expenses that are not previously mentioned.

4.3. Distributor

A distributor is a stage in supply chain that a company buys a number of finished products from different manufacturers and sells them to retailers.

Total cost of a distributor
= ***Product cost + Operating cost + Warehouse and inventory cost + Transportation cost + Quality cost + Other expenses***

4.3.1. *Product cost* is the total cost of a number of finished products purchased from different manufacturers.

$$DPC = \sum_{j-1}^{J}\left[\left(DUC\right]_j \times DU_j\right)$$

where DUC_j = Unit cost of the product *j*

DU_j = Number of units of the product *j*

4.3.2. *Operating cost* is the recurring expenses which are related to the operation of a distribution business, or to the operation of a device, component, and piece of equipment or facility. Total operating cost of a distributor can be formulated as:

Total operating cost of a distributor = Ordering cost + Labor cost

1. *Ordering cost* is the cost incurred each time an inventory replenishment order is placed. This includes costs associated with order processing, inventory allocation, ordering from different manufacturers, shipment scheduling, order status reporting, and shipment initiation.

$$DTOC = \sum_{m=1}^{M} (DO_m \times DOC_m)$$

where $DTOC$ = Total ordering cost of a distributor
DO_m = Number of placed orders from the manufacturer *m*
DOC_m = Ordering cost per order for the manufacturer *m*
for *m* = *1, …, M* (*m* is different manufacturers.)

2. *Labor cost* is wage or salary, usually financial, received by workers in exchange for their laborers in order to distribute the products to a number of retailers. The labor cost for a distributor includes wage or salary paid to its workers.

$$\sum_{j=1}^{J} (DWDL_j \times DNDL_j) + \sum_{b=1}^{B} (DWIL_b \times DNIL_b)$$

where $DWDL_j$ = Wage per unit time per person of direct labors, who respond to the product *j*
$DNDL_j$ = Number of direct labors, who respond to the product *j*
$DWIL_b$ = Salary per unit time per person of indirect labors, who work in the department *b*
$DNIL_b$ = Number of indirect labors, who work in the department *b*

4.3.3. *Warehouse and inventory cost* is the costs that may be incurred due to storing inventory. This cost includes physical holding cost and opportunity cost of holding inventor. Total holding cost of a distributor can be formulated as follows:

Total warehouse and inventory cost of a distributor
= Physical holding cost + Opportunity cost of holding inventory
+ Shortage cost + Unutilized space cost

1. *Physical holding cost* is the operating cost associated to holding inventory. Similar to the previous two members, this holding cost may be differentiated based on their sizes.

$$\sum_{j=1}^{J} [(DHOC]_j \times DSS_j \times DT_j)$$

where $DHOC_j$ = Holding operating cost per unit of storage space of the product *j*
DSS_j = Storage space of the product *j*
DT_j = Period of inventory holding time of the product *j*

2. *Opportunity cost of holding inventory* can be calculated as the expense that is lost or foregone due to keeping that inventory. Similar to the holding cost of the manufacturer, it can be expressed as a bank's interest rate or a company's own cost of capital, multiplied by the value of that keeping inventory.

$$\sum_{j=1}^{J}\left(\alpha_{D_j}^{H} \times DUC_j \times DT_j\right)$$

where $\alpha_{D_j}^{H}$ = Opportunity cost per unit time, which may be interest rate or cost of capital per unit time
DUC_j = Unit cost of inventory of the product *j*
DT_j = Period of inventory holding time of the product *j*

3. *Shortage cost* is the cost of not having the units in stock for sales e.g., lost profits, penalty costs, and loss of customer goodwill.

$$DTSC = \sum_{j=1}^{J}\left(\alpha_{D_j}^{S} \times DQS_j\right)$$

where $DTSC$ = Total shortage cost of a distributor
$\alpha_{D_j}^{S}$ = Shortage opportunity cost of the product *j*
DQS_j = Quantity of shortage of the product *j*

4. *Unutilized space cost* is the cost incurred due to under-utilization of storage spaces. It shows a company's inability to use space suitably.

$$DTUSC = USF \times \sum_{c=1}^{C}\left(\alpha_{D_c}^{U} \times DTUS_c \times DUST_c\right)$$

where $DTUSC$ = Total unutilized space cost of a distributor
USF = Unutilized space factor
$\alpha_{D_c}^{U}$ = Unutilized space cost of the storage or shelf area *c* per unit of unutilized space per unit time
$DTUS_c$ = Total unutilized space of the storage or shelf area *c*
$DUST_c$ = Total unutilized space time for the storage shelf area *c*
for *c* = *1, …, C* (*c* is different storage or shelf areas.)

4.2.2. *Transportation cost* is the cost of transporting materials from one place to another place. This transportation cost includes both transportation cost inside and outside a factory. Transportation cost of a manufacturer can be formulated as:

Total transportation cost of a distributor
= ***Inbound handling cost + Outbound transportation cost***

1. *Inbound handling cost* is the cost of handling products by different transporter types such as forklift trucks, conveyors, etc.

$$\sum_{j=1}^{J}\sum_{l=1}^{L}\left[\left(DHdC\right]_{jl} \times DHdT_l\right)$$

where $DHdC_{jl}$ = Cost of handling finished product *j* per unit time of the transporter type *l* (*l* can be forklift trucks, conveyors, etc.)
$DHdT_l$ = Handling time of the transporter type *l*

2. *Outbound transportation cost* is the cost for shipment between two geographical locations and the related expenses from point-of-distributor to retailers.

$$DTTC = \sum_{v-1}^{V} \sum_{r-1}^{R} (DT_{rv} \times DTC_{rv})$$

where $DTTC$ = Total outbound transportation cost of a distributor
DT_{rv} = Number of trips from the distributor to the retail *r* by the mode of transportation *v*
DTC_{rv} = Transportation cost from the distributor to the retailer *r* by the mode of transportation *v* per unit of distance
for *v* = *1*, …, *4* (*v* is the different modes of transportation, which may include trucks, trains, ships, and airplanes.)

4.3.5. *Quality cost* is the total cost of quality-related efforts and deficiencies. For distributor, since there is no production activity, only inspection cost and opportunity cost of loss of goodwill when the defective units are sold appear as the quality cost.

$$DTQC = \sum_{j-1}^{J} (DInspC_j \times DN_j) + \sum_{j-1}^{J} (\alpha_{D_j}^{Q} \times DRT_j)$$

where $DTQC$ = Total quality cost of a distributor
$DInspC_j$ = Inspection cost of the product *j*
DN_j = Number of units that the product *j* is inspected
$\alpha_{D_j}^{Q}$ = Opportunity cost of loss of goodwill
DRT_j = Number of units that the product *j* is returned

4.3.6. *Other expenses* are other expenses that are not previously mentioned.

4.4. Retailer

A retailer is a stage in supply chain that sells goods or merchandises from a fixed location such as a department store, boutique, or kiosk, in small or individual lots for direct consumption by the purchaser.

Total cost of a retailer
= ***Product cost + Operating cost + Warehouse and inventory cost + Quality cost + Other expenses***

4.4.1. *Product cost* is the total cost of purchased products from upstream members in the chain.

$$RPC = \sum_{j=1}^{J} (RUC_j \times RU_j)$$

where RUC_j = Unit cost of the product *j*

RU_j = Number of units of the product *j*

4.4.2. *Operating cost* is the recurring expenses which are related to the operation of a retail business, or to the operation of a device, component, and piece of equipment or facility. Total operating cost of a retailer can be formulated as:

Total operating cost of a retailer
= ***Ordering cost + Labor cost + Shop running cost***

1. *Ordering cost* is incurred each time an inventory replenishment order is placed. This cost may include the cost of ordering directly from manufacturers or distributors.

$$RTOC = \sum_{m=1}^{M} (RO_m \times ROC_m) + \sum_{d=1}^{D} (RO_d \times ROC_d)$$

where $RTOC$ = Total ordering cost of a retailer
RO_m = Number of placed orders from the manufacturer *m*
ROC_m = Ordering cost per order for the manufacturer *m*
RO_d = Number of placed orders from the distributor *d*
ROC_d = Ordering cost per order for the distributor *d*
for *d* = *1, …, D* (*d* is the different distributors.)
m = *1, …, M* (*m* is the different manufacturers.)

2. *Labor cost* is salary paid to workers during an accounting period on daily, weekly, or monthly basis, plus payroll, related taxes, and benefits (if any).

$$\sum_{b=1}^{B} (RW_b \times RNW_b)$$

where RW_b = Salary per worker, who works in the department *b*, per unit time
RNW_b = Number of workers, who work in the department *b*

3. *Shop running cost* is the day-to-day operating expenses which are related to the operation of a retail business such as utility cost for its operations management.

$$\sum_{j=1}^{J} (RU_j \times RSOC_j) \times ROpT$$

where RU_j = Average number of units of product *j* in the shop
$RSOC_j$ = Shop operating cost per unit of product *j* per unit time
$ROpT$ = Period of shop operating time

4.4.3. *Warehouse and inventory cost* is the cost of having an inventory in stock for a specified period of time. Total holding cost of a retailer can be formulated as:

Total holding cost of a retailer
= ***Physical holding cost + Opportunity cost of holding inventory***
+ Shortage cost + Unutilized cost

1. *Physical holding cost* is the operating cost associated to holding inventory. Similar to other members in the supply chain, this holding cost can be differentiated based on their sizes.

$$\sum_{j=1}^{J} [(RHOC]_j \times RSS_j \times RT_j)$$

where $RHOC_j$ = Holding operating cost per unit of storage space of the product *j*
RSS_j = Storage space of the product *j*
RT_j = Period of inventory holding time of the product *j*

2. *Opportunity cost of holding inventory* can be calculated as the expense that is lost or foregone due to keeping that inventory. Similar to the holding cost of the manufacturer and the distributor, it can be expressed as a bank's interest rate or a company's own cost of capital, multiplied by the value of that keeping inventory.

$$\sum_{j=1}^{J} \left(\alpha_{R_j}^{H} \times RUC_j \times RT_j\right)$$

where $\alpha_{R_j}^{H}$ = Opportunity cost per unit time, which may be interest rate or cost of capital per unit time
RUC_j = Unit cost of inventory of the product *j*
RT_j = Period of inventory holding time of the product *j*

3. *Shortage cost* is the opportunity cost of not having the units in stock for sales e.g., lost profits, penalty costs, and loss of customer goodwill.

$$RTSC = \sum_{j=1}^{J} \left(\alpha_{R_j}^{S} \times RQS_j\right)$$

where $RTSC$ = Total shortage cost of a retailer
$\alpha_{R_j}^{S}$ = Shortage opportunity cost of the product *j*
RQS_j = Quantity of shortage of the product *j*

4. *Unutilized space cost* is the opportunity cost incurred due to under-utilization of storage and shelf spaces. It shows a company's inability to use space effectively.

$$RTUSC = USF \times \sum_{c=1}^{C} \left(\alpha_{R_c}^{U} \times RTUS_c \times RUST_c\right)$$

where $RTUSC$ = Total unutilized space cost of a retailer
USF = Unutilized space factor
$\alpha_{R_c}^{U}$ = Unutilized space opportunity cost of the shelf area *c* per unit of unutilized space per unit time
$RTUS_c$ = Total unutilized space of the shelf area *c*
$RUST_c$ = Total unutilized space time for the shelf area *c*
for *c* = *1*, …, *C* (*c* is different shelf areas.)

4.4.4. *Quality cost* is the quality-related cost. For retailers, since there is no production activity, only inspection cost and opportunity cost of loss of goodwill, when the defective units are sold, appear as the quality cost.

$$RTQC = \sum_{j=1}^{J} \left(RInspC_j \times RN_j \right) + \sum_{j=1}^{J} \left(\alpha_{R_j}^{Q} \times RRT_j \right)$$

where $RTQC$ = Total quality cost of a retailer
$RInspC_j$ = Inspection cost of the product *j*
RN_j = Number of units that the product *j* is inspected
$\alpha_{R_j}^{Q}$ = Opportunity cost of loss of goodwill
RRT_j = Number of units that the product *j* is returned

4.4.5. *Other expenses* are other expenses that are not previously mentioned**.**

5. ILLUSTRATIVE EXAMPLE

An illustrative example is used to demonstrate our proposed cost classification. In the model, a customer arrives at a retail shop with the mean of the inter-arrival time of 10 minutes under the exponential distribution. Both distributor and retailer use the periodic review with order up to the target stock level (*T, OptS*) policy by making an order to the upstream members every week while the manufacturer orders its raw materials from the supplier according to the pre-determined interval. It takes 10 minutes with standard deviation of 5 minutes normally distributed to produce a product at the manufacturer. It is assumed that there is no delivery lead time and there is a 5% defect rate caused from the manufacturer's production even though there is an inspection for every batch of the production. After the manufacturer has produced the products, it transfers them to the external hiring warehouse, and the warehouse holds the products until receiving an order from the distributor. Then, the distributor will deliver the products to the retailer according to weekly orders. Suppliers and customers are considered to be external members in the chain as shown in Figure 2.

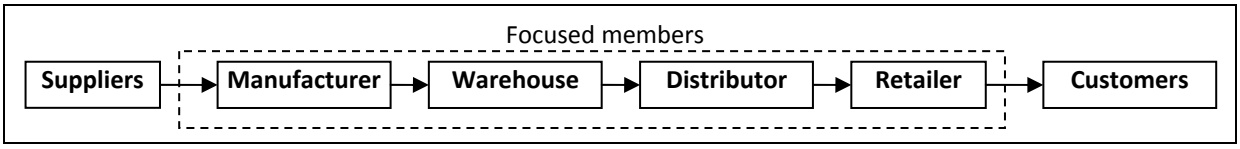


Figure 2: Illustrated supply chain

Arena 12.0 is used as a tool to simulate the behavior of the above system and OptQuest is used to optimize the target stock levels of the retailer and the distributor as well as the pre-determined interval time of raw materials' arrival at the manufacturer. This is to maximize the profit of the whole chain and to avoid any bias in the result due to poor parameters setting of the system. Twelve replications (one month per replication with the warm-up period is also one month) have been performed as a 95% confidence interval of part flow time has a width less than 5% of our point estimated for this value. The cost structure is shown in Table 1

Table 1: Cost structure

Cost items	Manufacturer	Warehouse	Distributor	Retailer
Raw material cost per unit (Baht)	120	-	500	1,000
Production and operation cost				
Ordering cost per order (Baht)	800	-	2,000	2,000
Machining cost per minute (Baht)	3	-	-	-
Set-up cost per set-up (Baht)	50	-	-	-
Idle cost per minute (Baht)	*0.1*	-	-	-
Direct labor per unit (Baht)	40	2.4	24	40
Indirect labor per unit (Baht)	10	2	10	-
Shop running cost per unit per minute (Baht)	-	-	-	0.05
Warehouse and inventory cost				
Physical holding cost per unit per minute (Baht)	0.003	0.003	0.005	0.015
Opportunity cost of holding inventory per unit	*0.01%*	*0.001%*	*0.002%*	*0.002%*
Shortage cost per unit (Baht)	*500*	-	*1,000*	*2,000*
Unutilized space cost per ft^2 per minute (Baht)	-	*0.01*	*0.01*	*1*
Transportation cost				
Inbound handling cost per unit (Baht)	1	4	4	-
Outbound transportation cost per unit (Baht)	50	-	50	-
Quality cost				
Inspection cost per unit (Baht)	10	-	3	3
Rework cost per unit (Baht)	3	-	-	-
Loss of goodwill per unit (Baht)	*750*	-	*1,500*	*2,500*
Transportation cost for rework per unit (Baht)	50	-	-	-

Table 2 shows the optimized system parameters including the bounds and their optimal values, and the results from the simulation can be summarized in Table 3.

Table 2: Optimized system parameters

	Lower bound	Upper bound	Optimized value
Distributor TSL (unit)	1,200	1,600	1,475
Retailer TSL (unit)	1,300	1,800	1,508
Inter-arrival time (min)	130	180	146.206645

Table 3: Profit and costs classified by each member

Cost item	Manufacturer		Warehouse		Distributor		Retailer		Whole chain	
	(Baht)	(%)	(Baht)	(%)	(Baht)	(%)	(Baht)	(%)	(Baht)	(%)
Raw material cost	709,200	24.4500%	-	-	2,974,250	59.7248%	5,903,080	70.3176%	9,586,530	56.7765%
Production and operation cost										
Ordering cost	236,400	8.1500%	-	-	8,500	0.1707%	8,500	0.1013%	253,400	1.5008%
Machining cost	177,987	6.1362%	-	-	-	-	-	-	177,987	1.0541%
Set-up cost	3,123	0.1077%	-	-	-	-	-	-	3,123	0.0185%
Idle cost	*1,896*	*0.0654%*	-	-	-	-	-	-	*1,896*	*0.0112%*
Direct labor	249,813	8.6124%	14,870	4.7369%	142,764	2.8668%	236,123	2.8127%	643,570	3.8116%
Indirect labor	62,453	2.1531%	12,391	3.9474%	59,485	1.1945%	-	-	134,330	0.7956%
Shop running cost	-	-	-	-	-	-	149,751	1.7838%	149,751	0.8869%
Warehouse and inventory cost										
Physical holding cost	739,085	25.4803%	187,363	59.6866%	299,775	6.0197%	413,042	4.9202%	1,639,265	9.7086%
Opportunity cost of holding inventory	*393,783*	*13.5759%*	*620*	*0.1974%*	*599,549*	*12.0393%*	*550,723*	*6.5602%*	*1,544,675*	*9.1484%*
Shortage cost	*33,833*	*1.1664%*	-	-	*453,670*	*9.1100%*	*959,500*	*11.4296%*	*1,447,003*	*8.5699%*
Unutilized space	-	-	*73,885*	*23.5369%*	*34,639*	*0.6956%*	*54,584*	*0.6502%*	*163,109*	*0.9660%*
Transportation cost										
Inbound handling cost	6,245	0.2153%	24,783	7.8948%	23,794	0.4778%	-	-	54,822	0.3247%
Outbound transportation cost	309,784	10.6799%	-	-	295,154	5.9269%	-	-	604,938	3.5828%
Quality cost										
Inspection cost	59,100	2.0375%	-	-	17,846	0.3583%	17,709	0.2110%	94,655	0.5606%
Rework cost	10,126	0.3491%	-	-	-	-	-	-	10,126	0.0600%
Loss of goodwill	*186,315*	*6.4233%*	-	-	*70,500*	*1.4157%*	*101,875*	*1.2135%*	*358,690*	*2.1244%*
Transportation cost for rework	16,809	0.5795%	-	-	-	-	-	-	16,809	0.0995%
Summary of profit and costs										
Total visible cost	2,284,787	79%	239,406	76%	3,821,567	77%	6,728,206	80%	13,073,967	79%
Total invisible cost	615,827	21%	74,505	24%	1,158,359	23%	1,666,682	20%	3,515,373	21%
Total revenue	2,974,250	-	345,302	-	5,903,080	-	11,835,340	-	21,057,972	-
Total profit	**73,635**	**-**	**31,391**	**-**	**923,154**	**-**	**3,440,452**	**-**	**4,468,632**	**-**

Please note that all italic costs in Table 1 and 3 are considered to be the invisible opportunity costs. As presented in Figure 3, the results under optimal setting of the system show that the invisible opportunity cost can contribute up to 21% of the total cost of the whole chain. This 21% will not be recorded in the accounting systems but it represents the amount of money that the company could save if the right strategy can be performed. In addition, if these costs are ignored or cannot be quantified, the benefits of becoming a supply chain will be underestimated and the company would not be able to realize its true costs. This could cause many wrong judgments and decisions when an important policy is needed to be made based on these notified costs.

Figure 3: Proportion of costs in a supply chain

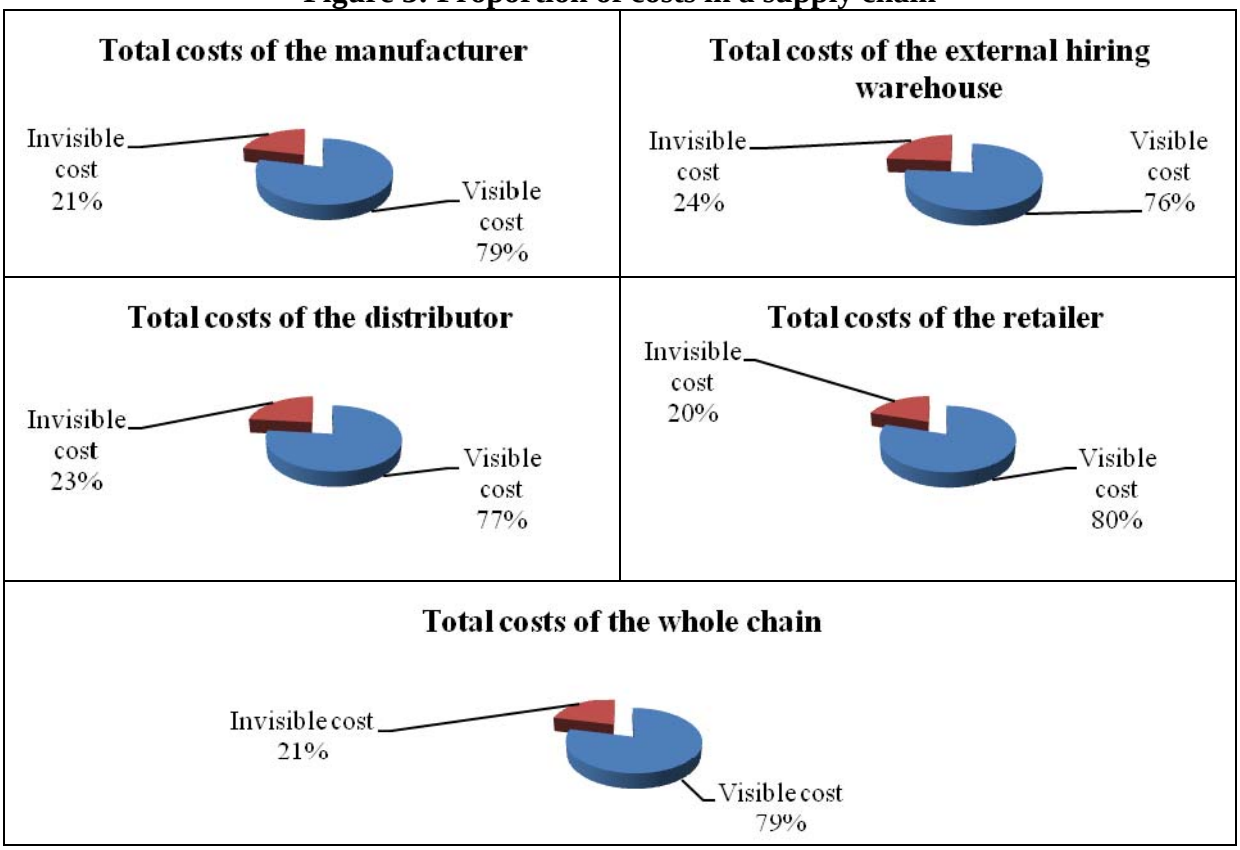
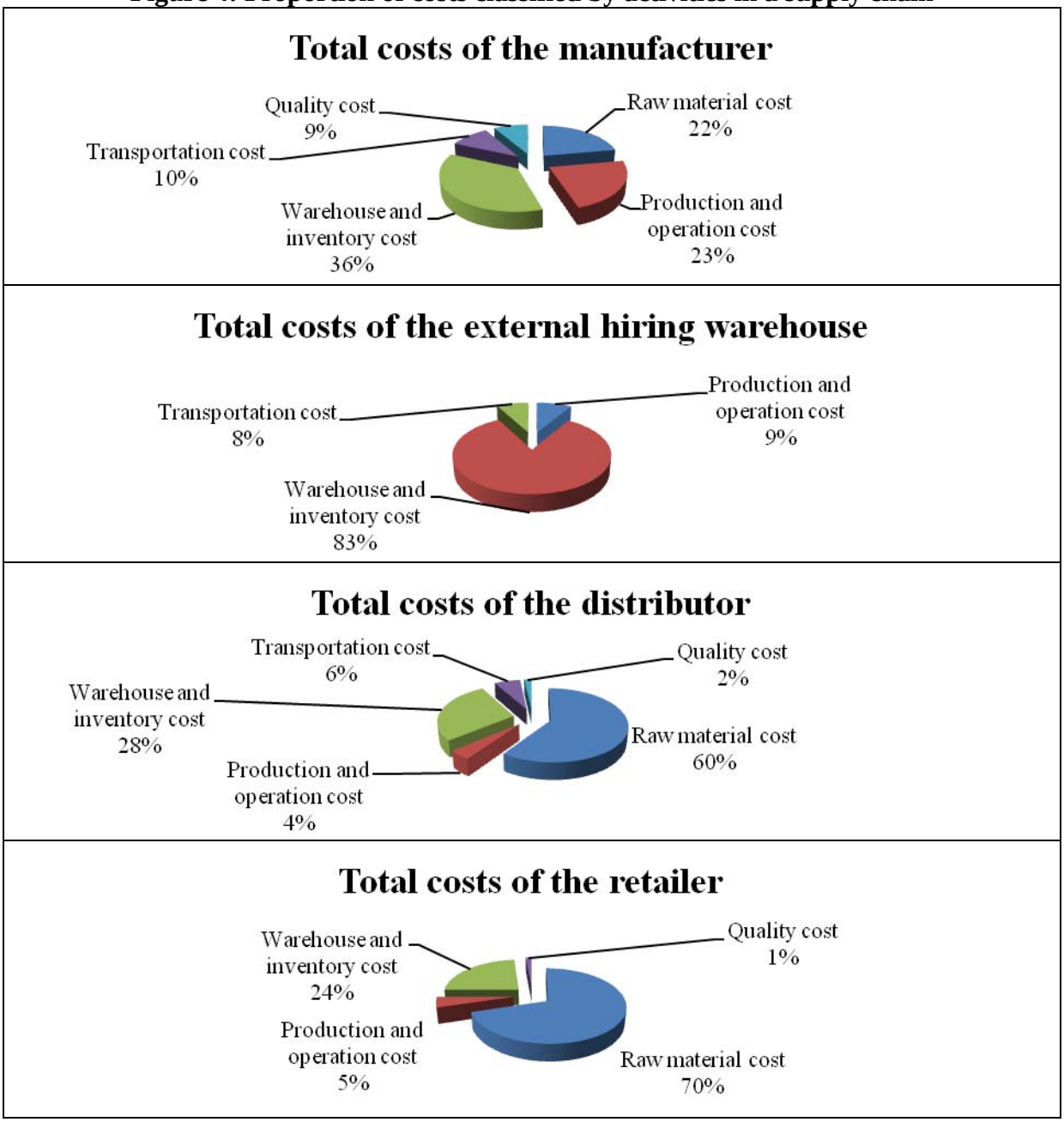
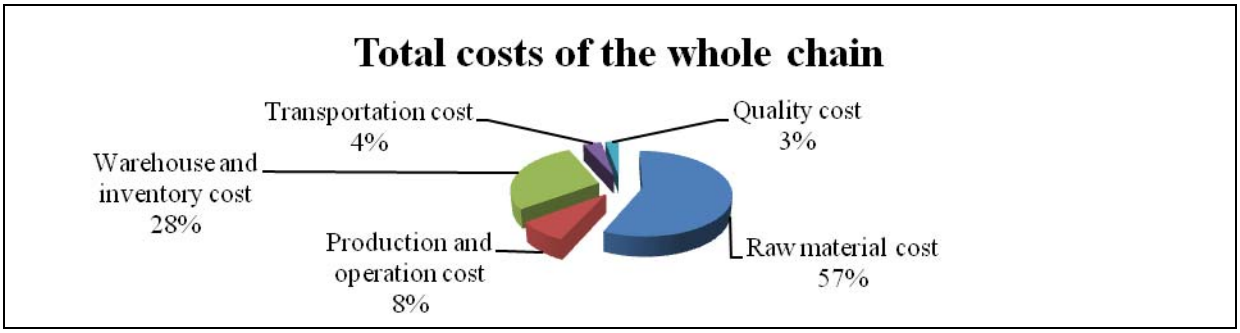


Figure 4 also summarizes the break-down of total costs to each group of costs (i.e. raw material, production and operation, warehouse and inventory, transportation and quality costs). Under our pre-determined cost structure, the raw material cost and the warehouse and inventory cost share the highest amount (expect for the external warehouse, which does not pay for the material cost since it only gives holding service). Raw material cost gets more expensive along the downstream members since each member needs to mark-up for their profits. It is also found that the majority of the warehouse and inventory cost as well as the quality cost are invisible by their nature. Without the proposed cost classification, these costs would be hidden and the company may not realize how big the amount is. However, this is the amount that they can save if the coordination among them can be better established.

Even though, the result shows that the distributor and retailer share a high amount of the profit in relation to other members, their profit, in fact, could be lower since the study did not include the marketing and advertising costs in our proposed cost classification. These costs are essential for their retailing business and are quite expensive in its nature. However, this result is only based on one set of cost structure and may not be generalized to other cases. As the study just intended to show the distribution of these costs among the supply chain' members classified by visible and invisible criteria, the obtained results present the optimal cost of this chain based on one set of cost structure. Perhaps the sensitivity analysis of some significant costs may be required in order to gain more insights into the variability of their amount and their impact on the company's decision making.

Figure 4: Proportion of costs classified by activities in a supply chain





5. CONCLUSIONS

This paper proposes a classification of supply chain members and their associated costs, which account for the value of supply chain costs savings. An economic cost model is also developed to include two major cost elements. One presents the visible costs, which accounts for the costs which can be quantified into monetary term. Another is invisible cost, which considers for the hidden opportunity costs. This step involves a big risk because they are hidden intangible, non-structured, and entail considerable time for recognizable results. The proposed classification of supply chain cost expands the cost concept breaking overhead costs according to their cost center and introduces the opportunity cost to estimate the neglected cost of non-value added activities. This will present a more coverage cost structure that should be used to estimate the supply chain costs more thoroughly and more accurately. Since if these hidden costs could not be justified, the benefits of joining a chain may not be realized and each member would not be willing to take risk and join the chain. The study will also extend to justify the cost and benefit analysis to join the chain under different kinds of incentive schemes.

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A GENERAL APPROACH TO UNCERTAIN MULTIPLE ATTRIBUTE DECISION MAKING

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ABSTRACT

This paper proposes a general approach to the uncertain multiple attribute decision making problems where the attribute values in decision matrix is expressed in the form of interval linguistic variables. The interval linguistic variable is the most general expression of the attribute values, while the proposed approach deals with the most general uncertain situation for multiple attribute decision making problems. In the approach, by calculating the relative distance between the interval linguistic attribute values and their corresponding negative ideal alternative, the decision matrix with interval linguistic term elements is transferred into a single-point (definite numeric) one. According to the obtained single-point decision matrix, the maximum possible intervals for the overall values of alternatives can be calculated, based on which the ranking values of them can be figured out, together with superiority possibility between them. An example is used to illustrate the proposed approach in the end.

Keywords: Uncertain multiple attribute decision making; Interval linguistic variable; Ranking; Superiority possibility

INTRODUCTION

Multiple attribute decision making (MADM) refers to making preference decisions (e.g. evaluation, prioritization, selection) over the available alternatives that are characterised by multiple, usually conflicting, attributes (Hwang and Yoon, 1981). Due to its complexity, the MADM problem can be modelled either by subjective pairwise comparison matrices (Saaty, 1980) or a decision matrix (Hwang and Yoon, 1981). The analytic hierarchy process (i.e., AHP) is proposed by Saaty (1980) to solve MADM problems. In AHP, pairwise comparison between alternatives is used to find out priority weights (of alternatives) to rank them. In fuzzy decision making situations, linguistic or interval judgements are often used to express uncertain subjective pairwise comparisons between alternatives (Haines, 1998). Two major approaches have been used to process interval judgements. The first approach is based on simulation or assumption of distribution on the interval judgements (Haines, 1998). The second approach is based on mathematical programming (Arbel, 1989).

This paper deals with the MADM problems when the decision matrix includes the attribute values of interval linguistic variable. In the uncertain situation, the information available for the decision makers is fuzzy (Yoon, 1989). Interval number is usually one of the methods for handling uncertain decision information (Yoon, 1989; Bryson and Mobolurin, 1996). In

addition, interval linguistic variable is more flexible when modelling the uncertain MADM problems.

In the course of dealing with MADM problems with uncertain linguistic variables, 2-tuple methods are employed (Herrera and Martínez, 2000a, 2000b, 2001; Delgado et al., 2002), however, it requires that the linguistic variables be the same across the different attributes. But, for many cases, different attributes present different properties. It is desirable to employ different linguistic variables (derived from different sets of linguistic terms) (Herrera et al., 2005). Therefore the current research on MADM problems with uncertain linguistic variables should be improved and be extended to the more complex situation where different sets of linguistic terms would be used to evaluate the alternative against different attributes. In order to solve this kind of problems, this paper proposed a general approach, which is composed of the following steps: Step 1. Calculate the relative distance between the interval linguistic attribute values and their corresponding negative ideal alternative, the decision matrix with interval linguistic term elements is transferred into a single-point (definite numeric) one. Step 2. According to the obtained single-point decision matrix, calculate the maximum possible intervals for the overall values of alternatives; Step 3. Calculate the superiority possibility between the alternatives; Step 4. Figured out the ranking values of the alternatives; Step 5. Rank the alternatives with superiority possibility between them.

The research in this paper is organised as follows: Section 2 describe the complex MADM problems with interval linguistic variable as the attribute values. The general approach is proposed in section 3. In section 4, an example is used to illustrate the proposed approach. Conclusions are given in section 5.

PROBLEM DESCRIPTIONS

Definition 1. Let *R* be the real number domain. A bounded interval $[x^L, x^U]$ is called interval number and expressed as $\tilde{x}$, where $x^L, x^U \in R$, and $x^L < x^U$.

On evaluating the alternatives against the attributes, it is necessary to determine the linguistic term set for different attributes. Different attributes can employ different sets of linguistic terms. A linguistic term set, *e.g.*, *TERMSET*=$\{t_0, t_1, \ldots, t_g\}$, is of the following properties: its cardinality is odd and the linguistic term set *TERMSET* satisfies the following properties (Herrera and Martinez, 2000a; Herrera and Herrera-Viedma, 2000):

(1) It is ordered. If $i \geq j$, then $t_i \geq t_j$, here symbol "$\geq$" denotes "better or equal".

(2) There is the reciprocal operator "*Neg*". If $j=g-I$, then Neg(t_i)=t_j, where g+1 is the number of the elements in the linguistic term set *TERMSET*, and the maximum term is t_g.

(3) Min and Max operators. If $t_i \geq t_j$, then Max$\{t_i, t_j\}$=t_i and Min$\{t_i, t_j\}$=t_j. For example, linguistic term set *TERMSET* is composed of seven terms, i.e., *TERMSET* ={t_0=extremely bad, t_1=very bad, t_2=bad, t_3=fair, t_4=good, t_5=very good, t_6=extremely good}.

It is noticed that a linguistic term can be expressed in triangular or trapezoidal form. If a linguistic term t_i is expressed in the triangular form, then it could be represented as ($\alpha_i, \beta_i, \gamma_i$), while its membership function is defined as:

$$\mu_i(x)=\begin{cases}0 & x<\alpha_i \\ \dfrac{x-\alpha_i}{\gamma_i-\alpha_i} & \alpha_i \le x \le \gamma_i \\ \dfrac{x-\beta_i}{\gamma_i-\beta_i} & \gamma_i \le x \le \beta_i \\ 0 & x \ge \beta_i \end{cases} \quad (1)$$

If a linguistic term t_j is expressed in the trapezoidal form, then it could be represented as ($\alpha_j, \gamma_j, \delta_j, \beta_j$), while its membership function is defined as:

$$\mu_j(x)=\begin{cases}0 & x<\alpha_j \\ \dfrac{x-\alpha_j}{\gamma_j-\alpha_j} & \alpha_j \le x \le \gamma_j \\ 1 & \gamma_j \le x \le \delta_j \\ \dfrac{x-\beta_j}{\delta_j-\beta_j} & \delta_j \le x \le \beta_j \\ 0 & x > \beta_j \end{cases} \quad (2)$$

Definition 2. $term=[t_l, t_u]$ is called a uncertain interval linguistic variable, if t_l and t_u are both linguistic terms, and t_l and t_u are called the lower and upper limits respectively.

The following notations are used to represent the uncertain MADM problems when the attribute values are given in the form of interval numbers with linguistic variables.

• $S=\{S_1, S_2, \cdots, S_m\}$: a discrete set of m ($m \ge 2$) possible alternatives.

• $C=\{C_1, C_2, \cdots, C_n\}$: a set of n ($n \ge 2$) attributes. The attributes are assumed additively independent.

• $\overline{A}=[\overline{a}_{ij}]_{m\times n}$: the decision matrix in the form of interval linguistic variables, where, $\overline{a}_{ij}=[a_{ij}^L, a_{ij}^U]$ denotes the attribute values of alternative S_i with respect to attribute C_j, which is expressed in the form of intervals with linguistic variables, $i=1,\cdots,m$, $j=1,\cdots,n$. $\overline{a}_{ij}$ is the interval linguistic variable as stated in Definition 2, with a_{ij}^L and a_{ij}^U are linguistic terms.

•The weights of attributes are given in the form of interval, $w_j \in [w_j^L, w_j^U]$, where w_j^L and w_j^U are limit ends of the weight of attribute C_j , $j=1,\cdots,n$.

THE PROPOSED APPROACH

Normalize the decision matrix

Definition 3. Given two interval numbers $\widetilde{q}_i$ and $\widetilde{q}_j$ as stated in Definition 1, the distance between them is defined as:

$$d(\widetilde{q}_i, \widetilde{q}_j) = \frac{\sqrt{2}}{2}\sqrt{(q_i^L - q_j^L)^2 + (q_i^U - q_j^U)^2} \tag{3}$$

Obviously, $d(\widetilde{q}_i, \widetilde{q}_j) \geq 0$ holds.

Definition 4. Given two triangular linguistic terms $t_i = (\alpha_i, \beta_i, \gamma_i)$ and $t_j = (\alpha_j, \beta_j, \gamma_j)$, as defined in (1), the distance between them is defined as:

$$dis(t_i, t_j) = \sqrt{\frac{1}{3}[(\alpha_i - \alpha_j)^2 + (\gamma_i - \gamma_j)^2 + (\beta_i - \beta_j)^2]} \tag{4}$$

Definition 5. Given two trapezoidal linguistic terms $t_i = (\alpha_i, \gamma_i, \delta_i, \beta_i)$ and $t_j = (\alpha_j, \gamma_j, \delta_j, \beta_j)$, as defined in (2), the distance between them is defined as:

$$dis(t_i, t_j) = \sqrt{\frac{1}{4}[(\alpha_i - \alpha_j)^2 + (\gamma_i - \gamma_j)^2 + (\delta_i - \delta_j)^2 + (\beta_i - \beta_j)^2]} \tag{5}$$

Definition 6. The distance between two interval linguistic terms $Term^1 = [t_l^1, t_u^1]$ and $Term^2 = [t_l^2, t_u^2]$, as stated in Definition 2, is defined as:

$$d(Term^1, Term^2) = \frac{\sqrt{2}}{2}\sqrt{dis(t_l^1, t_l^2)^2 + dis(t_u^1, t_u^2)^2} \tag{6}$$

where $dis(t_l^1, t_l^2)$ and $dis(t_u^1, t_u^2)$ are defined in (4) (or (5)) respectively.

Definition 7. With respect to attribute C_j, the positive ideal attribute value is defined as:

$$ideal_j^+ = [ideal_j^{+L}, ideal_j^{+U}] \tag{7}$$

where,

$$ideal_j^{+L} = \max_{1 \leq i \leq m}\{a_{ij}^L\},\ j = 1,2,..., n. \tag{8a}$$

$$ideal_j^{+U} = \max_{1 \leq i \leq m}\{a_{ij}^U\},\ j = 1,2,..., n. \tag{8b}$$

Definition 8. With respect to attribute C_j, the negative ideal alternative (point) is defined as:

$$ideal_j^- = [ideal_j^{-L}, ideal_j^{-U}] \tag{9}$$

where,

$$ideal_j^{-L} = \min_{1\le i\le m}\{a_{ij}^L\},\ j = 1,2,...,n. \tag{10a}$$

$$ideal_j^{-U} = \min_{1\le i\le m}\{a_{ij}^U\},\ j = 1,2,...,n. \tag{10b}$$

Definition 9. With respect to attribute C_j, the relative distance between attribute value $\bar{a}_{ij} = [a_{ij}^L, a_{ij}^U]$ and the negative ideal attribute value $ideal_j^-$ is defined as:

$$b_{ij} = \frac{d(\bar{a}_{ij}, ideal_j^-)}{d(\bar{a}_{ij}, ideal_j^+) + d(\bar{a}_{ij}, ideal_j^-)}, \qquad i=1,\ldots,m,\ j=1,\ldots,n, \tag{11}$$

where $d(\bar{a}_{ij}, ideal_j^+)$ and $d(\bar{a}_{ij}, ideal_j^-)$ defined in (6).

By means of calculating the relative distance between the attribute value $\bar{a}_{ij}$ and the negative ideal alternative (point) $ideal_j^-$, the interval linguistic terms $\bar{a}_{ij}$ is transferred into a single-point (definite numeric) value. Thus, the decision matrix $\bar{A} = (\bar{a}_{ij})_{m\times n}$ with interval linguistic terms as its attribute values is transferred into a single-point one $B=(b_{ij})_{m\times n}$.

Calculate the maximum possible intervals for the overall values of alternatives

Based on the obtained single-point decision matrix $B=(b_{ij})_{m\times n}$ in (11), the maximum possible intervals for the overall value of alternative S_i, i.e., $O_i = [O_i^l, O_i^u]$, can be obtained:

$$O_i^l = \sum_{j=1}^{n} b_{ij} w_j^l, \quad i=1,\ldots, m. \tag{12a}$$

$$O_i^u = \sum_{j=1}^{n} b_{ij} w_j^u, \quad i=1,\ldots, m. \tag{12b}$$

where $w_j = [w_j^l, w_j^u]$ is the weights of attribute C_j, which is expressed in the form of interval, $j=1,\ldots, n$.

Calculate the superiority possibility between the alternatives

Suppose $O_i = [O_i^l, O_i^u]$ and $O_j = [O_j^l, O_j^u]$ are the maximum possible intervals for the overall value of alternative S_i and S_j, respectively, then the superiority possibility between the alternatives S_i and S_j is calculated as:

$$p(S_i \succ S_j) = \frac{\max(0, len(S_i) + len(S_j) - \max(O_j^u - O_i^l, 0))}{len(S_i) + len(S_j)} \quad (13)$$

where $len(S_i)$ and $len(S_j)$ are the length of the intervals $O_i = [O_i^l, O_i^u]$ and $O_j = [O_j^l, O_j^u]$ for the overall value of alternative S_i and S_j, respectively. Therefore, the superiority possibility matrix $P = (p_{ij})_{m \times m}$ between the alternatives can be set up, where its elements are defined in (13).

Calculate the ranking values of the alternatives

Based on the superiority possibility matrix $P = (p_{ij})_{m \times m}$ between the alternatives, the ranking value of alternative S_i can be calculated as:

$$\omega_i = \frac{1}{m(m-1)} (\sum_{j=1}^{m} p_{ij} + \frac{m}{2} - 1) \quad (14)$$

where p_{ij} is the element in the superiority possibility matrix $P = (p_{ij})_{m \times m}$ which is defined in (13), i, j=1,□, m.

Rank the alternatives with superiority possibility

The alternatives can be ranked according to the values of ω_i, i=1,□, m, together with the superiority possibility between them.

APPLICATION ILLUSTRATION

The example in (Herrera and Herrera-Viedma, 2000) is used for illustration. A venture investment company consider evaluating five projects (i.e., the alternatives S_i, i=1,2,…, 5) against four attributes. The alternatives are as follows: S_1 is a car company, S_2 is a food company, S_3 is a computer company, S_4 is an arms company, while S_5 is a TV company. Four attributes are employed to select the best alternative(s), the details are as follows: C_1 is the risk analysis, C_2 is the growth analysis, C_3 is the social-political impact analysis, C_4 is the environmental impact analysis. The linguistic term set which is used for evaluating the alternatives against the attributes is $TERM = \{t_1 = extremely\ poor, t_2 = very\ poor, t_3 = poor, t_4 = medium, t_5 = good, t_6 = very\ good, t_7 = extremely\ good\}$. The corresponding membership functions for the terms are as follows: t_1=(0, 0, 0.17), t_2=(0, 0.17, 0.33), t_3=(0.17, 0.33, 0.5), t_4=(0.33, 0.5, 0.67), t_5=(0.5, 0.67, 0.83), t_6=(0.67, 0.83, 1), t_7=(0.83, 1, 1).
Without loss of generality, the attributes are assumed all for the benefit, and the details in the decision matrix is:

$$\overline{A}=\begin{pmatrix}[t_2,t_3] & [t_3,t_4] & [t_1,t_2] & [t_1,t_2]\\ [t_1,t_2] & [t_4,t_5] & [t_3,t_4] & [t_2,t_3]\\ [t_2,t_4] & [t_1,t_3] & [t_4,t_5] & [t_3,t_7]\\ [t_2,t_3] & [t_1,t_2] & [t_2,t_3] & [t_2,t_3]\\ [t_3,t_4] & [t_4,t_6] & [t_1,t_4] & [t_3,t_4]\end{pmatrix}.$$

According to (3)-(11), the original decision matrix is transformed into a definite one as follows:

$$B=\begin{pmatrix}0.4771 & 0.5412 & 0 & 0\\ 0 & 0.7984 & 0.6510 & 0.2518\\ 0.6780 & 0.1986 & 1 & 1\\ 0.4771 & 0 & 0.3126 & 0.2518\\ 1 & 1 & 0.4096 & 0.4939\end{pmatrix}.$$

Furthermore, weights of attributes are given as follows: w_1=[0.1, 0.3], w_2=[0.2, 0.4], w_3=[0.3, 0.5], w_4=[0.2, *0.*3]. According to (12a) and (12b), the maximum possible intervals for the overall value of alternatives can be obtained as: O_1 =[0.1560, 0.3596], O_2 =[0.4053, 0.7204], O_3 =[0.6075, 1.0828], O_4 =[0.1919, 0.3750], O_5 =[0.5217, 1.0530], respectively. According to (13), the superiority possibility matrix $P=(p_{ij})_{m\times m}$ between the alternatives is obtained as:

$$P=\begin{pmatrix}0.5 & 0 & 0 & 0.4337 & 1\\ 1 & 0.5 & 0.1428 & 1 & 0.2348\\ 1 & 0.8572 & 0.5 & 1 & 0.5574\\ 0.5663 & 0 & 0 & 0.5 & 0\\ 1 & 0.7652 & 0.4436 & 1 & 0.5\end{pmatrix}.$$

Therefore, based on (14), the ranking value of alternative can be calculated as: ω_1 =0.1217, ω_2 =0.2189, ω_3 =0.2707, ω_4 =0.1283, ω_5 =0.2604. Thus, the alternative ranking together with the superiority possibilities between them is obtained as: $S_3 \underset{0.5574}{\succ} S_5 \underset{0.7552}{\succ} S_2 \underset{1}{\succ} S_4 \underset{0.5663}{\succ} S_1$.

CONCLUSIONS

With respect to the uncertain multiple attribute decision making problem with interval linguistic variables as the attribute values in the decision matrix, this paper develops a general approach, which is composed of the following four steps: (1). Normalize the decision matrix with interval linguistic variables by calculating the relative distance between the interval linguistic attribute values and their corresponding negative ideal alternative; (2). Based on the

single-point decision matrix obtained in step (1), calculate the maximum possible intervals for the overall values of alternatives; (3). Calculate the superiority possibility between the alternatives; (4). According to the results in (3), calculate the ranking values of the alternatives; (5). Obtain the alternative rankings with superiority possibility between them.
The proposed approach allows different linguistic term sets to be used to evaluate the alternatives against different attributes and is simpler than that in (Herrera, et al., 2005). The proposed approach is innovative and can be readily implemented into a computer-based information system. Thus, the new approach is of extensive applications. Furthermore, the future research will focus on the more complex situation where multiple decision makers take part in the decision process by using different linguistic term sets.

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ENVIRONMENTAL MANAGEMENT FOR CULTURAL EVENTS: CASE STUDY FROM APULIA REGION, ITALY

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ABSTRACT

This research study represents one of the first attempts to measure the environmental impact of the cultural events (theatrical and festival) in order to evaluate the risks for formulating better policy. It is important to underline that this sector, which is not considered responsible in having a direct influence on the environment, has on the contrary a substantial ecological impact as other sectors, like services and commodity's manufacturing. In this paper the impact both of theatrical and festivals events in Apulia region, through the tool of the I-O (input/output) Ecological Footprint Analysis (EFA), has been carried out.

Keywords: theatrical sector, physical indicators, sustainability, environmental management system.

BACKGROUND

The creative and cultural industry impacts on the national economy as well as industries like tourism, film production and so on. Normally this industry is broken down in 7 sub-sectors: theatre, lyrics, musical, ballet, puppets, circus and others (mainly festivals).
According to EU figures, the creative and cultural sector contributes to 2.6% of European GDP and employs roughly 5.8 million employees. In Italy the cultural sector is worth 2.6% of Italian GDP, with around 40 billion euros. Furthermore it employs 550,000 workers. More difficult to measure but equally important, are the implications for other economic sectors and for the local development.

Nevertheless the financial crisis during the 2008-2009, in Italy, the cultural sector, (in this case all the 7 sub-sectors) has generated a turnover of 481.7 million of Euros of which only the sub-sector of the theatre accounts for 241.8 million of Euros (see table 1).

Table 1. Trend of theatrical industry in Italy during the 2008-2009.

Theatrical Industry (sub-categories)	Number of spectacles	Audience	Turnover (million of Euros)
Theatre	81 000	420 000	241.8
Lyrics	3 000	6 000	98.5
Musical	2 580	9 600	41.7
Ballet	6 350	146 000	32
Puppets	2 800	35 000	1.2
Circus	17 700	83 000	10.5
Others (mainly festivals)	39 000	2 100 000	56
Total	152 430	2 799 600	481.7

Source: [8].

These figures represent significant performance indicators if compared with the Sport and the Cinema, which, for the same period, have generated 190.6 and 354.4 million of Euros respectively. Always in Italy, in 2009, over 52,000 performances in theatres and roughly 17,000 festivals have been realized.

On regional level in Apulia, which is located at the South part of Italy, the cultural industry has reached roughly 9.5 million of Euros of which 6.5 million from theatrical activities, as showed in table 2.

In Apulia there are 80 theatres and 40 companies of players and actors with over 3,000 performances realized in one year. For the development of the theatrical sector in the Region, it was established as implementing body a network, one of the largest in Italy, formed by more than 56 partners including municipalities, provinces and the Apulia Region, named TPP (Theatre Public of Apulia). The TPP, in other words, is a Consortium for the promotion both of theatrical events and for the valorisation of the Regional cultural Institutions. TPP is responsible for the realization of cultural events and for the creation of Apulia festivals (folkloristic and internationals) with the aim to promote and to preserve the cultural heritage of the Region.

Table 2. Trend of theatrical industry in Apulia Region during the 2008-2009.

Theatrical Industry (sub-categories)	Number of spectacles	Audience	Turnover (million of Euros)
Theatre	3301	6170	6.5
Lyrics	78	N. A	0.5
Musical	72	N. A	0.6
Ballet	196	3 300	0.8
Puppets	202	150	0.8
Circus	1835	N. A	0.4
Others (mainly festivals)	181	5 159	0.5
Total	5 865	14 779	9.5

Source: [8].

In the last theatrical season 2007/08 the Public Theatre of Apulia has realized 182 shows, for a total of 819 replicas with roughly 209 thousands tickets sold.

The creative abilities express for the production of entertainments, festivals, conferences or concerts to international large-scale as well as theatrical and cultural events, contribute positively to keep and to preserve the worldwide-recognized brand “cradle of Culture”. Associated to this important aspect there is, as well, the ecological impacts on the environment such as resources consumption, wastes production, and not formalized attention in civil planning efforts.

Culture events, nowadays, are playing a crucial role in attracting visitors since that the culture gives to the consumer a reason to visit a particular location. In this scope, besides a long organizational tradition exists, new factors of management are being considered in order to pursue higher efficiency targets. Because of their nature, cultural events impact negatively on the environment. A gathering of thousands of people at a festival or a concert, and a simple performance of a play in theatre as well, naturally amplifies wastes generation as glass and plastic bottles, used paper plates, packaging, unwanted food and drink, waste water, cartons, plastic bags etc. These events can also negatively impact on the environment in other ways, increasing for example the traffic and the related carbon dioxide emissions. For instance, in a recent report published in 2008, the total emission from London theatres was calculated. It emerges that the carbon emissions account for roughly 50,000 tonnes a year- the equivalent of emissions from 9,000 households. This figure doesn’t include the travel audience estimated at approximately 35,000 tonnes of CO_2 per year. Furthermore, it has been estimated that if all theatres plan to switch on the lights half an hour before the performance, it should be possible to save more than € 110 million of Euros per year in energy costs and to reduce pollutants emissions [3].

From these data a question stand out: What entertainment industries should be doing to promote and achieve both sustainable theatre and environmental friendly cultural events performance?

Considering the great variety of events, there are innovative criteria and indicators that need to be implemented in the organization of cultural events in order to comply with sustainable development concept. This means that cultural event management requires new competencies and radical innovation aims at delivering tools for the professional sector of the arts production.

OBJECTIVE

The aim of this paper is both to propose suitable environmental indicators for managing cultural events in Apulia region and to calculate their environmental impacts, through the tool of the I-O (input/output) Ecological Footprint Analysis (EFA). The EFA in this paper is used in order to identify criticalities and to provide guidelines for ensuring environmental standards in theatre building and manufacturing. Important challenge for this paper is to compare the green policy, which concerns Apulia cultural events with the existing worldwide sustainable cultural management.

METHODOLOGY

As above cited, in order to plan a sustainable policy in the management of the cultural events innovative criteria and indicators were necessary to identify.

For this reason the choice of the Ecological Footprint Analysis (EFA) was done.

Nowadays several approaches are available to businesses in order to measure the environmental impact of their products or services. Methods reviewed are Life Cycle Analysis (LCA), Energy and Material Flow Analyses (EMFA) or Mass Balance Analysis (MBA) and Material Intensity per Unit Service (MIPS).

Ecological Footprint Analysis (EFA) is a system of accounting and expressing environmental impact, which draws on all these approaches.

The traditional definition of Ecological Footprint is "the area of productive land and water ecosystems required to produce the resources that the population consumes and assimilate the wastes that the population produces, wherever on Earth the land and water is located". Mathis Wackernagel and William Rees at the University of British Columbia coined this definition, in the 1990, and nowadays the Ecological Footprint tool is widely used by scientists, businesses, governments, agencies, and institutions working for monitoring sustainable development. During the years, different researchers and centres of research have implemented this methodology creating a database for integrating bio-productivity analysis with the embodied energy analysis in order to measure ecological value of commodities and services. In the 2003 *Global Footprint Network* was created with the aim to improve methodologies in the EFA. For measuring the Ecological Footprint a spreadsheet for the calculation was created (National Footprint Accounts) which provides all the primary conversion factors describing the area (ha) demand of economical activities. The Ecological Footprint conversion factor depends on each component involved in the human activities which are available for licence from *Global Footprint Network*. We underline that detailed factors are needed, because different inputs are necessary to manufacture products and these

may be calculated especially using the conversion factors for primary resources as provided by the National Footprint Accounts. One of the most important recent innovations in the field of EFA has been the use of physical input –output (I-O) analysis. With this new application it is possible to link macro-sectors decoupling it with micro-activities. The physical input–output (I-O) analysis become useful when there is a need to identify reporting tasks and routines. In this way it becomes possible to establish structured work procedure in green management of services, as well. The main constraint, for realising an I-O EFA in the specific sector of theatre industry, is the availability of detailed information about the material basis of the system. It is important, to develop a materials flow network by connecting all the phases of the system. For accomplished to this, the festival and theatrical sectors are schematized as an industry composed by different phases, measuring for each phase resource flows in units of weight [1, 2, 5, 9, 11].

The main constraint in assessing the EF required to carry out this type of analysis has been the availability and quality of data, which requires improving, cataloguing and quantifying the resources flows.

It is important to underline that this methodology has been used with significant results in the different services, mainly in the tourist sector, allowing to design construction effective measures for environmental policies and encouraging practices in reducing the use of materials that have a detrimental effect on environment.

In this research paper we focus on (I-O) EFA analysis. The choice of this methodology, rather than others, is due mainly to one important reason; with (I-O) EFA the advantage is to have a single number, an index coefficient (expressed as t/ha), with whom it is possible to make comparison with other Footprint studies. This study represents one of the first attempts to apply the I-O EFA at the sector of the cultural events.

DATA COLLECTION

In the first phase of the research studies, environmental data have been obtained through two different questionnaires surveys mailed to: a) the theatres in Apulia region, b) the Consortium TPP and c) the theatrical companies. Furthermore technical sheets of the spectacles have been scrutinized. In the technical sheets different information is contained about the general outline of spectacles, the equipment, the light design, the stage space. The questionnaires survey has been used to determine which information needs to be handled in order to prioritize and control the cultural events.

The requested topics are linked with the possible planning of waste minimization, recycling, sustainable transport modes etc. during the organization and the performance of the cultural events. The questionnaire survey has been implemented with interviews and personal discussion with artistic managers of Apulia theatres and festivals in the region.
In the second phase data acquired have been analyzed for calculating the Ecological Footprint related to the culture events (festivals and theatres).

CASE STUDY

The main aim of this paper is to propose suitable environmental indicators for managing cultural events in Apulia region, in order to encourage the audience to recognize the green cultural events in Apulia region. As mentioned, the ecological footprint is an accounting model of resource consumption and waste production, and is based on reliable data sources available at the relevant scale. For this reason an inventory of inputs and outputs has been constructed in order to make a qualitative and quantitative evaluation of those inputs and outputs, and to identify the most significant aspects of the system relative to the objectives of the study.

The issues have been differentiated according to both theatre and festivals.

Calculation of EF for Theatres

For theatres the main issues have been the following:

- ✓ Pre-production considerations;
- ✓ Materials selection and disposal/ recycling;
- ✓ Working with suppliers and partners;
- ✓ Lighting during the spectacle;
- ✓ Power Factor;
- ✓ Staff travelling;
- ✓ Modalities of travelling of participants;

Overall, data availability has exceeded initial expectations. However, it has been varied from component to component.

Data covered the period 2007-2008 and have been obtained thanks to analysing questionnaires sent to managers, scrutinizing the different technical sheets of theatrical companies and to the support of TTP. After, it has been constructed a matrix necessary for allocating all the data and for calculating the EF. The Theatres event have been divided on four phases: a) preparation, b) event, c) transport, d) food/drink (see table 3).

Table 3: Matrix for measuring the EF of theatres

Preparation	Typology	Number	Power (watt)	Timing
	papers	//		
	posters			
	printer		//	//
	photocopier		//	//
	technical sheets	//		
	billboard/flyers	//		
	pc/fax	//	//	//
	sounds and video equipment	//	//	//
Event				
	light spot	//	//	//
	mixer light	//	//	//
	mixer speakers	//	//	//
	sounds and video equipment	//		
	pc	//	//	//
Food/Drink				
	potatoes	//		
	tin cans	//		
	plastic bottles	//		
Transport				
	bus	//		
	car	//		
	bicycle	NA		
	foot	NA		

Ecological footprint has been measured by disaggregating the different materials and products, driven by data availability and the necessity to discount double counting between material and product consumption data.

The main constraint in this calculation has been the *lack of homogeneity* of the theatrical performances.

Each performance is different from the other, as well as, each theatre has its own characteristics not comparable between them. These aspects made difficult to have an average figure, which could characterize the EF. Furthermore, managers don't have high familiarity with the most of the data (such as energy and material consumptions, recycling and so on) because they consider unnecessary the benchmarking process from this point of view. For this reason we can only report the range between the "maximum" figure and the "minimum" figure of EF.

The EF ranges between 0.30 gha (global hectares) and 1.5 gha. The main reasons for the EF variability are the energy consumption and the objective differences between spectacles.

Calculation of EF for festivals

For Festivals the main issues to check have been the following:

- ✓ Pre-production considerations;
- ✓ Materials selection and disposal/ recycling;
- ✓ Lighting during the event;
- ✓ Modalities of travelling of participants;
- ✓

Data covered the period 2007-2008 and have been obtained mainly with the support of TPP and some managers of events. Furthermore, the different technical sheets of festivals organized in Apulia have been analysed, mainly during the summer season, in order to have average figure for each component necessary for measuring the EF. It was decided, as well, to split the festival in two categories: a) big festivals (15 days); b) small festivals (5 days). The Festival event has been disaggregated in 4 phases a) preparation, b) event, c) transport, d) food/drink and then it has been prepared a matrix as showed in table 4.

Table 4: Matrix for measuring the EF of Festivals.

Preparation	Typology	Number	Power (watt)	Timing
	papers	//		
	posters			
	printer		//	//
	photocopier		//	//
	technical sheets	//		
	billboard/flyers	//		
	pc/fax	//	//	//
	sound and video equipment	//	//	//
Event				
	light spot	//	//	//
	mixer light	//	//	//
	mixer speakers	//	//	//
	sound and video equipment	//		
	Pc	//	//	//
Food/Drink				
	potatoes	//		
	tin cans	//		
	plastic bottles	//		
Transport				
	bus	//		
	car	//		
	bicycle	NA		
	foot	NA		

The calculation of the EF for festivals has been possible thanks to the similar characteristics of the planning and typology of festivals.
For the big festivals the EF is equal to 4.3 gha per day.
For the small festivals the EF is equal to 1.4 gha per day.

Benchmarking these figures with data coming from other research studies, we can found that the EF for a 2-week holiday to Majorca and Cyprus is 0.37 gha and 0.93 gha per person, respectively [4, 6, 7, 10].

It is interesting to note that with this approach emissions are not quantified in physical terms, but it possible to identify the interventions which are necessary (such as optimizing energy consumption, virtuous behaviour, etc..) highlighting its potential benefits.

CONCLUSION

This research study represents one of the first attempts to measure the environmental impact of the cultural events (theatrical and festival) in order to evaluate risks and formulate better policy. It is important to underline that this sector, which is not considered responsible to in impacts directly on the environment, has on the contrary a substantial ecological footprint as other sectors, like services and commodity's manufacturing. The environmental issue is remarkable and we note the massive attempts of the International Community to improve decision-making process. In the last years, the new standard ISO 16001 (International Standard Organization) was passed in order to promote a better environmental management. The ISO 16001 Standard has the aim to stress the organization on the necessity to develop an energy management system. This should cause a decreasing of costs and of environmental issues as well as the implementation of a regular information system for benchmarking activities (to develop environmental policy, to establish objectives, etc). As emerges from this analysis, it is necessary to boost the management of companies in this direction because, mainly in service sector, the benchmarking process is considered not helpful

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ONTOLOGY-BASED REASONING FOR CONTEXT-AWARENESS ENVIRONMENT

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ABSTRACT

Due to the development and popularization of mobile devices and wireless telecommunication, everyone can save and retrieve the needed information and services anytime, anywhere with any device. However, the challenge is that the requirements from users are varied and uncertain. Context-Awareness is one of the solutions. It could capture the contextual information of users through many sensors, like GPS, RFID, Camera, Monitor, etc., and could understand the context thereafter, then provides appropriate services for users. This study is aimed at finding a well-defined context model that can demonstrate the correlation between human beings and the environment. This study employs ontology to describe the context and the context-aware engine takes into account the changes in context. As well, this study adopts case-based reasoning for the reasoning method. There are two advantages by adopting case-based reasoning, one is that it supports the reasoning of mobile contexts and the other one is that it can adjust itself and improve its precision after a number of uses. Comparing with the location-based context-aware system, the reasoning method employed by this study is better than that of the location-based context-aware system.

Keywords: Ontology, Context-Awareness, Case-based Reasoning

INTRODUCTION

As the development of wireless communication, mobile devices, and other relevant technologies, these services have become very popular nowadays. The concept of context-awareness therefore emerges. An intelligent context-aware system will detect users' context information, such as the location, the temperature, the time and any other physical information, by using sensors like GPS, cameras, video cameras, RFIDs or electronic thermometer, etc., and furnish users with required products or services based on the context. A most simple context-aware system can utilize the GPS module from mobile devices to locate the current position of a user and supply information related to the location. Other similar applications such as the mobile guide system that users can interact with the environment via such device which also supports navigation and search services, and

intelligent rooms and offices are all designed to reduce the burden of users. These services are provided to promote a tight connection between users and the environment.

There are two directions of the current development of context-awareness. On the one hand is the research and development of sensors for finer and more accurate detection in its subjects. On the other hand is to integrate existing sensors with context information to provide services. For instance, the Aura program of Carnegie Mellon University, (CMU), and the Oxygen program of MIT are both accomplishing the users' demand by detecting their context through mobile devices and sensors. Remarkable and progressive developments have been found in numerous researches regarding context-awareness. The current development of context-awareness focuses on "integrating existing sensors to do value-added services". How are the services value-added? This means context-awareness must be able to provide personalized services, and this is a crucial task. To do so, context-awareness could infer the personal service demand from the context information detected by sensors. The contexts that the system is required to know are depicted in Figure 1.

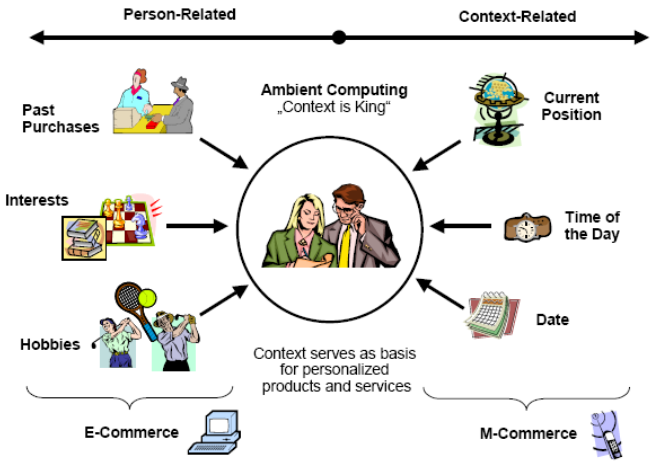

Figure 1. Personalized contexts in context-awareness environment (Koch, 2002)

Koch (2002) divided the information required for personalised context-aware environment into two: (1) those relevant to the users and (2) those relevant to the context. The information includes user's name, location, statistics and purchase history, or some dynamic information such as position, time, date, etc. All of them could assist personalization and called context factors in this research that could be combined to create different contexts.

A personalised context-aware service system must be able to display context models well and precisely. In service providing aspect, it needs an appropriate reasoning mechanism to support it. Therefore, this research wishes to achieve the following three targets:

(1) The context model would be built upon ontology and through which the interaction between human beings and the environment would be demonstrated adequately. Furthermore, the adoption of ontology could achieve the benefits of knowledge sharing and reusing. Other context-aware applications could benefit from this ontology.

(2) The use of Ontology Web Language Description Logic (OWL DL) to describe context ontology affords abundant of descriptive grammar, and in comparison to other ontology

descriptive languages, OWL DL supports interpretation of attribute constraints. In one word, the use of OWL DL could fully demonstrate the correlation between contexts.

(3) Considering the human contexts are circumstance and location related, the reasoning mechanism of context-awareness needs to be accurate, flexible and adaptable. Through its learning ability, it should be able to adapt the results according to the change of users. The research takes into account rule-based and case-based reasoning mechanism. In the context-aware system, the context is half/non-construction issue; besides, the case-based reasoning possesses learning ability, therefore the results of the reasoning mechanism would be adapted to best as it is used many times by users. Consequently, adopting case-based reasoning as the context-aware reasoning mechanism would be more appropriate.

LITERATURE REVIEW

Context-Awareness

The idea of context-awareness was first proposed by Schilit and Theimer (1994), who mentioned that due to the rising of distributed mobile computing, users were able to interact with other mobile devices or computers using their own mobile devices. Computing is no longer restricted to a specific location or a particular environment, it can extend to offices, conference rooms, houses, airports, bus stops, and on airplanes, etc. Besides, the mobility of mobile devices makes location information indispensable, because based on such information users can search for nearby devices as well as services. This is where the new challenge, context-awareness, comes in. The definition of context-awareness according to Dey (2001) is: “A system is context-aware if it uses context to provide relevant information and/or services to the users, where relevancy depends on the users’ tasks”. A context-aware system should be able to support the following 3 points: (1) providing information and/or services to a user, (2) automatic execution of a service for a user, and (3) tagging context to the original information which can be used for advanced search.

What does the “context” in context-awareness actually mean? The definition of context varied among many scholars. The one adopted by this research is that of Dey (2001), who combined the definition offered by past researches and came up with the following: “Any information that can be used to characterize the situation of an entity. An entity is a person, a place, or an object that is considered relevant to the interaction between a user and an application, including the user and applications themselves”.

Understanding the situation aids the design of a context-aware application. Terry (2001) mentioned that an effective context had to be sharable and managed by a context-aware system. In other words, the system must be able to understand the contexts before they are even being used. Schilit et al. (1994) thought context information could be divided into 3 categories:

(1) Computing context: this describes surrounding computable devices such as Internet connection, broadband Internet, communication costs and nearby resources including printers, monitors or workstations, etc.

(2) User context: this describes user’s preferences, location, surrounding company, current social circumstances, or present posture and behaviour of the user.

(3) Physical environment context: for example, lights could present information regarding the environment, such as lamplight, the amount of noise, traffic, and temperature, etc.

To fully represent the contexts, Chen and Kotz (2000) had included time context as the fourth one that contained information such as date, week, month, seasons, etc. The definitions of contexts as offered by individual scholars only intended to discover a contextual model that is more comprehensive. Such a model would describe all sorts of contexts, thus benefiting the reasoning of machines as well as its service provision

Ontology

Ontology was derived from philosophy, and according to Bunge (1977), "ontology is a philosophical discipline aimed at studying the nature of the real world". This viewpoint was later introduced to computer science to promote interoperability, information search and retrieval, natural language, artificial intelligence, and communication among agents, which went on to show its wide applicability. According to W3C, "ontology describes the knowledge of each domain". To put it simply, ontology could be used as the framework for domain knowledge and to analyze the relationship between individual ideas. Furthermore, Studer et al. (1998) adopted the definition from Gruber (1993) and Borst (1997) and stated, "an ontology is a formal, explicit specification of a shared conceptualization", which illustrates the four-layered meanings of ontology:

(1) Concept: ontology derives its concept from the real world.
(2) Explicitness: the application of the concept, which must be defined clearly with its constraints state. For instance, in the medical field, illnesses and symptoms are two varying concepts, their relationship is causal and the constraint of an illness is that it does not cause itself.
(3) Specification: ontology could be deciphered by computers.
(4) Sharing: the knowledge of ontology is collectively approved by a group, but not by an individual.

Chen et al. (2003) believed that ontology is an essential pre-requisite in the development of context-awareness, and they introduced the three reasons below:

(1) Ontology of a concept could achieve knowledge sharing in an open and dynamically distributed system.
(2) A well-defined ontology could provide semantics to facilitate the communication among agents so as to intelligently reason context.
(3) An explicit ontology allows interconnection and interoperation between devices and agents without the two having to operate together, thus accomplishing the ability of meaningful communication.

OWL is an abbreviation of Web Ontology Language and a descriptive language for ontology. It is developed by the Web Ontology Working Group from W3C, and is the most comprehensive descriptive language of ontology. It is designed for certain applications that handle the content of information rather than simply presenting the information. In brief, rather than human-readable, it is hoped that machine-readable can be achieved by using OWL. OWL consists of 3 sub-languages:

(1) OWL Lite: in comparison with OWL DL, OWL Lite is less complicated and supports users who only need a single category hierarchy and basic constraints.

(2) OWL DL: its name is derived from Description Logic (DL). This language supports users who require a large number of descriptions. It also ensures the completeness and decidability during computing, which means the conclusion must guarantee computability and the computing must be completed within the limited time, respectively. OWL DL comprises all the constraints of OWL.
(3) OWL Full: supports users who require a large number of descriptions, besides, RDF does not require computing guarantee, and OWL allows users to add pre-defined (RDF and OWL) words, therefore not one single reasoning software is able to fully support the reasoning features of OWL Full.

Case-based reasoning (CBR)

From a cognitive psychology perspective, human brains are like computers with a large memory. The moment human beings come across anything or an emergency, they search inside their brains for similar problems previously encountered. Those problems encountered before turn into experiences that would be used to solve the issue at hand, and once it has been solved, it would be stored in the brain as a part of the existing experiences.
Case-based reasoning (CBR) is identical in its problem-solving ability. It utilizes past cases, circumstances and solutions to solve the problems. Its feature lies in that it takes account of every past experience and case to deal with any unexpected situation. Due to each new experience the system becomes a step closer to the learning behaviour of human beings, which ensures later problem-solving accuracy.

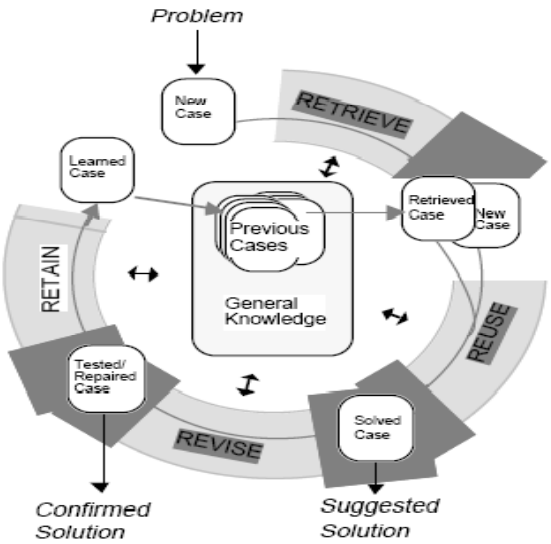

Figure 2. CBR cycle diagram (Aamodt and Plaza, 1994)

As shown in Figure 2, the steps involved in CBR consist of:
(1) Case retrieval: as soon as a case arises, the system will go into the case knowledge base and based on the similarity in computed result retrieve a similar case. The system will then provide the user with a solution based on the case description and result.
(2) Case reuse: when a new case which is not in the knowledge base arises, the expert system assesses whether it should be added to the case knowledge base.
(3) Case revision: although certain cases are not stored in the case knowledge base, due to its distinctness they will be revised.

(4) Case renewal: once the cases are tested or repaired by the expert system, they will be stored in the case knowledge base.

RESEARCH METHODOLOGY

This research is focused on context-aware service reasoning based on ontology. When users use mobile devices (mobile phone, PDA, notebook, etc.), the devices would furnish the system with context information, or the system could detect such information through sensors (such as GPS, RFID and monitor). Basing on the context, the system would work out the current or future information or service demanded from users.

Network Structure

The foundation of the system in this research is based on pervasive computing, so the mobile devices of users' (PDA, mobile phone, notebook…) could communicate with context-aware system via wireless network or Bluetooth. Another fundamental structure is built upon receiver module sensors such as GPS, RFID, thermometer, camera, monitor, etc as shown in Figure 3.

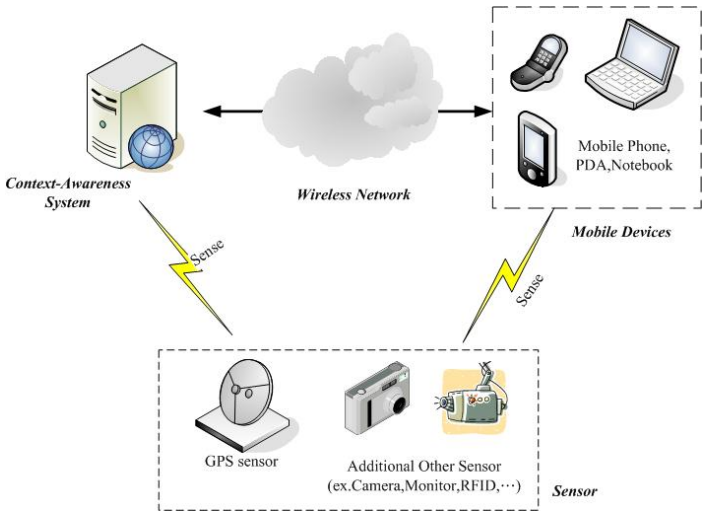

Figure 3. Network structure of context-aware system

The sensors could detect the context information of both users' and of the environment. For instance, the positioning function of GPS provides system users with information on current location, and based on such information the thermometer would connect to local weather report, or if the users are indoor, the temperature information would be obtained by connecting to an electronic thermometer in that room. Another example like RFID reader would detail resources closest to the users.

System Structure

Figure 4 illustrates the system structure of this research. The dotted squares represent modules and the arrows indicate information flow. This research is divided primarily into two parts: one is the context reasoning modules, and another is the case knowledge base of ontology and cases. Should the needs arise in the future for real connection to sensors, the

information providing modules sponsored by companies can be used to connect to the retrieving module of context information. The procedure of the system is as follows: (1) the Context Acquirement Engine receives context information detected by sensors as well as those provided by users, and subsequently forwards them to the Context Reasoning Engine; (2) the Context Reasoning Engine compares the context with existing cases stored in the case knowledge base, and search for similar or totally matching cases through similarity computing. Then find out the possible services required by users based on their corresponding service results. The Context Reasoning Engine would then forward the inferred service information to the Service Center, (3) the Service Center would furnish users with services based on this result, or act as a service medium for users; (4) finally, based on the feedback from users regarding service reasoning, the Case Adjustment/Addition Engine would revise the importance of the case or add it to the case knowledge base.

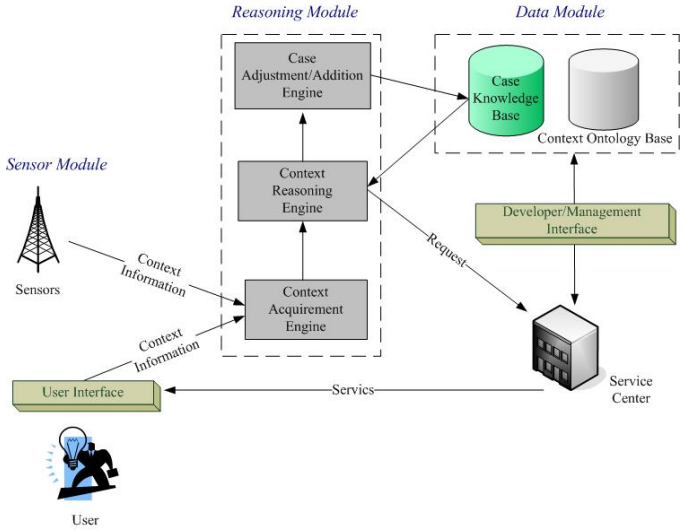

Figure 4. System structure

The illustration of the system components is as follows:

(1) User Interface: A medium between users and the system. Users use it to communicate and interact with the system. It consists of two primary functions: (a) to assist users to send context information and (b) to present users with services from the Service Center.

(2) Context Acquirement Engine: It saves and retrieves the communication protocol of each sensor and could automatically retrieve context information, be it user-provided or sensor-detected. The information would then be forwarded to the Context Reasoning Engine.

(3) Context Reasoning Engine: It stores all context factors from Context Acquirement Engine and compares their similarity with cases in the Case Knowledge Base.

(4) Case Adjustment/Addition Engine: This module adjusts the importance of cases according its number of uses. The formula employed is as above mentioned. This module is also responsible for the addition of new cases to Case Knowledge Base.

(5) Context Ontology Base: Context is very complicated. It can even be seen as the knowledge of interaction between human being and the environment, and cannot be described fully by the usual information structure. That is why this research adopts ontology to demonstrate the context.

(6) Case Knowledge Base: The case knowledge base saves and judges the required service case under each circumstance. The design concept of cases is based on the search of

correlation between contexts in contextual ontology. Each context would find out a corresponding service.

(7) Developer/Management Interface: This interface allows Service Center to add, delete, and modify both the Context Ontology Base and Case Knowledge Case. It also allows Service Center to transform and save the knowledge of ontology in the Case Knowledge Base.

SYSTEM ESTABLISHMENT AND VERIFICATION

In this section, we are focused on the establishment and verification of system which comprises primarily (1) the establishment of contextual ontology (determining the range and domain, defining the category and its hierarchy, case attributes as well as constraints on attributes, etc.); (2) Service Reasoning Engine based on ontology in practice; and (3) the experiment design and use of evaluation indicators to verify the service reasoning accuracy of the system. Only location-based service-providing mechanism is used as the comparison with the reasoning mechanism adopted by this research.

The establishment of ontology

As illustrated in Figure 5, the contextual ontology adopted by this research could be divided into 4 levels, nameed Top-level Ontology, Task Ontology, Domain Ontology, and Application Ontology. This division aids the ontology of maintenance, sharing, and re-using. Table 1 explains the different levels of ontology.

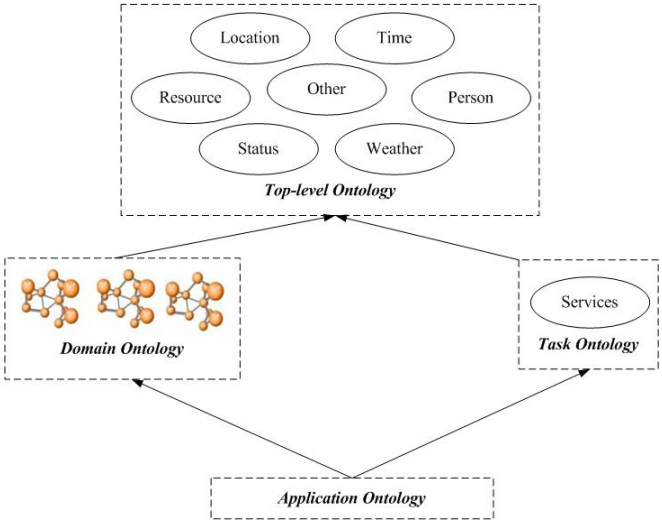

Figure 5. Ontology design of this study

Figure 6 illustrates the relationship of factors in the top-level. Each category depicts the context using item attributes and is established upon the ontology engineering proposed by Natalya (2001). This ontology engineering is orderly and mature, and furnishes the developer of ontology with a strict set of models to follow, so as to avoid unsuccessful and unsuitable establishment of ontology. Seven steps are involved in the ontology engineering: (1) to determine the domain and range of the ontology; (2) to consider whether or not to use existing ontology; (3) to list the words in this domain; (3) to define the categories and decide

the level among them; (5) to define domain attributes; (6) to define constraints and (7) to establish cases. Lastly, the consistency of a completed ontology is verified by Racer.

Table 1 Explanation of the ontology levels

Ontology Levels	Explanation
Top-Level Ontology	Context factors belong to this level: 1. Location: obtained through GPS module. 2. Time: divided into minutes, hours, days, months and years or seasons. It could also be defined by holidays. The setting of which should depend on the domain. 3. Resources: including all the surrounding resources, such as the Internet, facilities, application and information etc. 4. Status: describes user status including sitting, lying or moving, etc. It could also record the duration of the action. 5. Weather: describes the changes in weather and temperature. 6. Human beings: according to this research, the human context factor is determined by user identity. (For example: lecturer or students in institute of information management, and the latter could be divided into freshmen and current students). 7. Other: exceptions and future addition could be placed under this category.
Domain Ontology	The addition or choice of which is domain-based. For instance: medical study, tourism, entertainment, etc. (This research chooses school.)
Task Ontology	The establishment of ontology aimed to provide services to users, thus put the Services here.
Application Ontology	Describes incidents and the definition of which is based on Domain and Task Ontology.

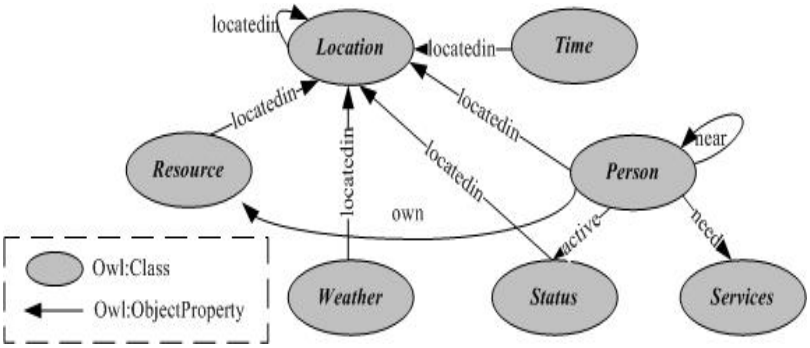

Figure 6. Context factors relationship in Top-level Ontology

Figure 7 illustrates the final ontology as established by this research using the Protégé plug-in, Jambalaya. Table 2 represents the algorithm of context-reasoning engine of this study.

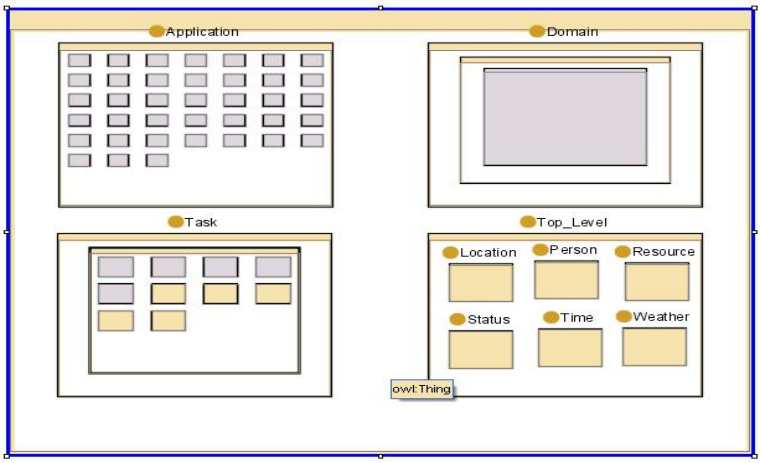

Figure 7. Ontology categories and cases correlation of this study

Table 2 Algorithm of reasoning engine in this study

Input	User's context information / new case
Output	Case's services

For all new case, C.
To read ontology m.read(OWL document's URI).
To catch all cases in ontology by mapping context factory's property, CRi (i=1..n, case number).
Compute similarity of C & CRi .

1.sim(C,CR)= $\frac{\sum_{i=1}^{n} P_i \times same(C_i, C_i^R)}{T(C, C^R)}$

2.Similarity(C, CRi) = $W_i \times sim(C, C^R)$,

If users feedback cases' weight, then $W_{default}^{t} = \frac{W_{default} \times t + W_{user}}{t+1}$

If users want to add this case that ontology doesn't have this case, then add this case in ontology.
Output the case's result that has the top score.
m.write(OWL document URI)

Experimental design

First of all, the target users need to install the domain-specific ontology (which in this research is school). Actually, the system could automatically detect user context, but the experiment is conducted under the assumption that the environment is equipped with sensors, which in the future would be connected to the database connectivity to complete the automation process. At this stage of the experiment, users must provide their context information. Figure 8 is the system operation procedure. The mobile device used here is a notebook and the main steps are: (1) installing the ontology for this particular domain; (2) choosing and confirming current context information; (3) based on the degree of similarity in the case, the system would report back with the top 4 services, and

the user could check interested services and give feedbacks; (4) then responding the importance of the case; (5) last, adding the case to Case Knowledge Base or not.

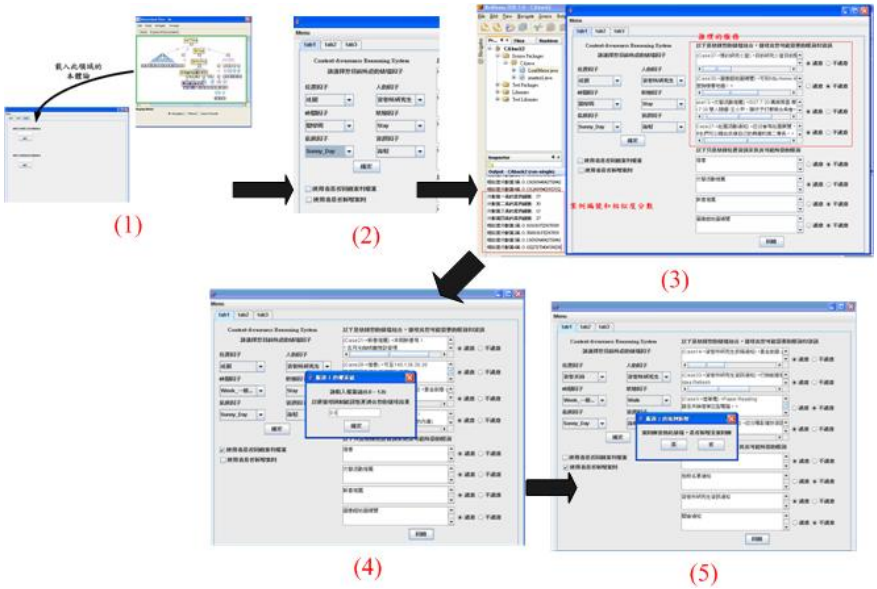

Figure 8. System operation procedure

This study consists of 3 experiments: the first one is students who have known the environment for more than a year. It focuses on the comparison of service-providing mechanisms, namely the reasoning engine adopted by this research, and that of the location-based. Users of this experiment do not report back the importance of cases nor do they add any. The ontology installed would be the default, and the importance of attributes and cases are set at default value. Experiment two tests users who are not familiar with the environment (freshmen in this research). An important goal of the context-aware system is to reduce the unfamiliarity and the search cost in this environment for users. That is why the test subjects are freshmen. Experiment two also compares its accuracy with location-based service-providing mechanism and users do not need to report back the importance or add cases. The ontology installed is also the default, and the importance of attributes and cases are not adjusted. Both Experiment three and one share the same subjects, but the former allows users to adjust case importance depending on the cases. The adjustment is intended to make the reasoning result of this system a better match to users' needs. Users in this experiment continuously use the system to test if the accuracy of the reasoning system could be improved in accordance with its number of uses. Unlike Experiment one and two, the ontology installed by Experiment three would write the importance and addition of cases into the ontology each time users report back or at the end of reasoning. Each user has a personal ontology. This study employs precision as the evaluation criteria. The formula is as below:

Precision = Count of services which users are interested in / Count of services reasoned by the system

Results of experiment

Results of experiment 1

Figure 9 illustrates the result of experiment 1. Axis Y indicates precision, and Axis X is the reasoning mechanism of this research and location-based service-providing mechanism. As demonstrated in the figure, the precision of the mechanism employed by this research is 0.658, and that employed by location-based service-provider is 0.441. Based on precision alone, the mechanism used in this research clearly is better. This is due to that general users (undergraduate and graduate students) are already familiar with the environment, and services provided based on user location would not be sufficient. Taking into consideration not only the location of users, the reasoning mechanism employed by this research provides services by comparing the similarity of context combination with other users, which comprises user identity, time, surrounding resources, weather, user status, information, etc. The use of ontology enables the conceptualization of correlation and logics of these contexts information.

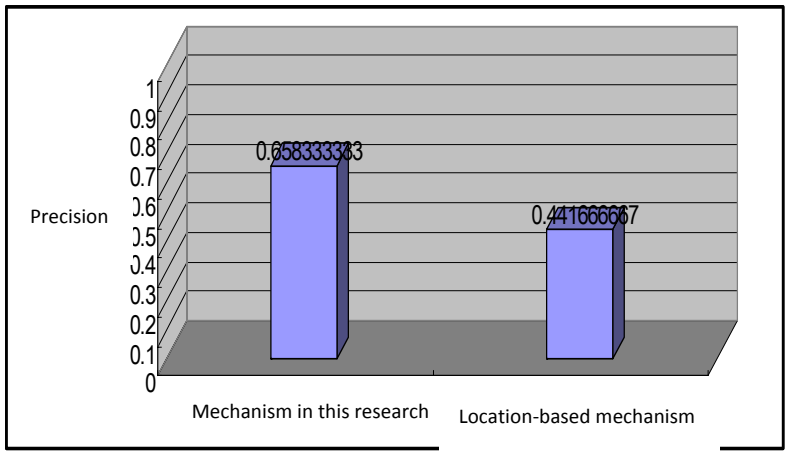

Figure 9. Result of experiment 1

Based on the location factor alone, the description of the context is not specific. For instance, if it is break time during a rainy day and the user is in the library, then the service needed by user would not be borrowing or returning books or the returning date of books. It is more likely to be weather forecast or university event searching, so the user could find out when the rain would stop or to simply pass the time. Such service could not be achieved by location-based mechanism.

Additionally, the location-based mechanism could not provide services at locations such as the laboratory. As a result it is only able to provide basic environmental information. However, the mechanism used by this research provides services in addition to information. The reason being although the service-providing unit is not immediately present, similar service requests had occurred in this environment, therefore the system could reason that user might need the service. Furthermore, services provided by this mechanism are diverse. Overall, based on experiment 1, the reasoning mechanism of this research is more precise than that of the location-based service-provider.

Results of experiment 2

As exhibited by Figure 10, the precision of reasoning mechanism used in this research is 0.821, and that of the location-based is 0.857. The two are very close and are higher compared to those of experiment 1. This is due to the fact that subjects are all freshmen who are unfamiliar with the environment and therefore it has lower evaluation threshold for service precision. As long as the system is able to provide services and information related to user location, the user could easily be satisfied.

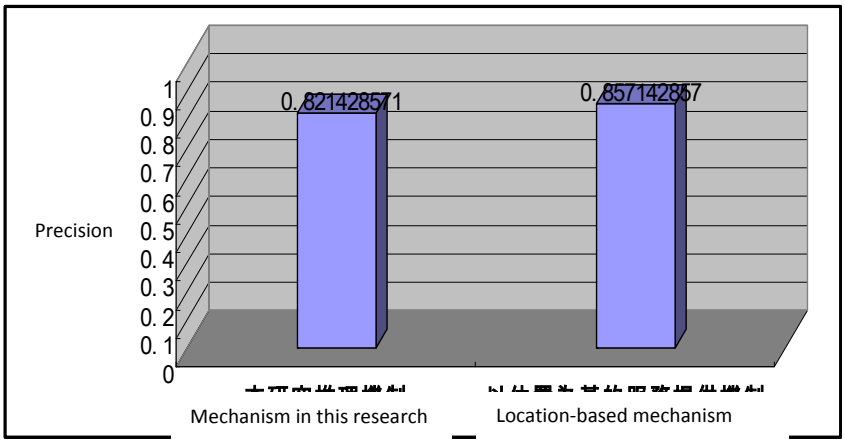

Figure 10. Result of experiment 2

Based on the value of precision, location-based service-providing mechanism is slightly above that employed by this research, which could be due to two possibilities: (1) users are not familiar with the environment and identify better with location context. Services provided by location-based mechanism have lower mobility, and as a result have greater precision. (2) The case designed by this research could not satisfy the needs of freshmen, and to rectify this, detailed interviews with them might be needed. The Service Center would expand the cases according to interview results. The reasoning mechanism used in this research provides services according to case similarity; the mobility of which might be too high for freshmen. In other words, certain services are not located in this environment. Had the users been those from experiment 1 it might have worked, but for the freshmen from experiment 2 such reasoning does not seem to work.

However, the reasoning mechanism of this research could adjust the importance of attributes. The importance of location would be placed on the highest when user identity is freshmen in order to match their context model. As they gradually get used to the environment, their service requests would become more mobile, and the re-adjustment of attribute importance would result in similar outcome as in experiment 1. The advantage of which would become obvious. Judging from the outcome of experiment 2, it is necessary for context-awareness to find out user identity beforehand. Simply by adopting a complicated algorithm to perform service reasoning would not necessarily satisfy certain users. Take the freshmen from experiment 2 for example, only a simple location-based context-aware service-providing mechanism can supply information relevant to the location, their needs would be satisfied and it might even be more effective. In other related literature, the context-aware devices are often used in tourism to provide information based on location. To tourists, the primary goal

of a context-aware system is not about providing highly accurate services, but rather services that could remove the barrier between users and the environment when they arrive at a new place. From the humane perspective, overly complicated information and reasoning mechanism would overload the tourists with information and cause stress, which would miss the purpose of sightseeing.

Results of experiment 3

Each User in this experiment has their own default ontology which comprises identical content and cases. The default attributes and case importance are also the same, and users could adjust the importance of the case provided by their ontology. Each time the system provides users with services, they could give feedback on the importance of the case, which the system would then re-write into the ontology. The value range of the case importance feedback is between 0.1~1, where 1.0 indicates the service is strongly needed by the user, and 0.1 presents the least and so on. Experiment 3 intends to test the ability for self-learning and adjustment of the system. The system becomes a personalized service reasoning system to users through the number of case uses. The procedure of the experiment is pretty much the same as the previous two, whereby users supply context information to the system and services would be provided according to similar cases. The difference lies in that each of the six users chooses three contexts to make up to 18. In addressing each of these contexts, the system continues to adjust the importance of cases, and each context would at least be used over 20 times.

As shown in Figure 11, the reasoning mechanism of this research follows the number of system uses to observe changes in precision. The location-based service reasoning mechanism which is not equipped with learning ability remains at 0.43 throughout. The mechanism employed by this study follows the number of uses and increases its accuracy to 0.694 after three uses. The precision advances to 0.764 after six uses and 0.764 after eighteen uses. After about twelve times of uses, the accuracy begins to dampen and the precision value is about 0.764. The final value for precision in comparison to that of the default system increases by 13.9%, and compared with location-based service-providing mechanism, there is a 33.4% difference in accuracy. It could be deduced that the accuracy of this mechanism could increase following the number of uses.

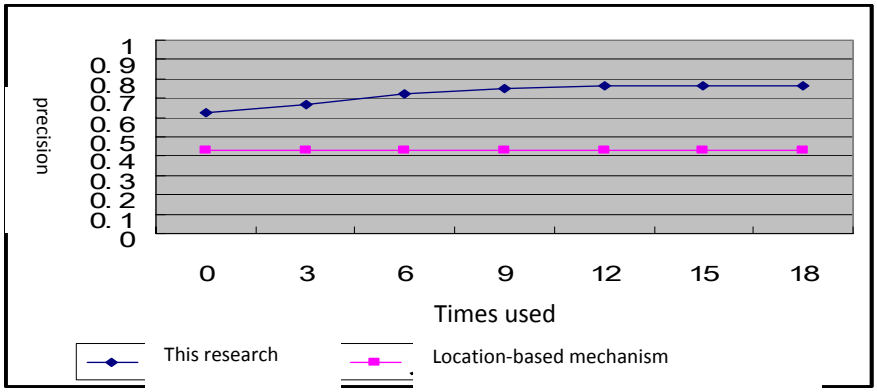

Figure 11. Result of experiment 3

It could be seen from Figure 12 that precision increase of the reasoning mechanism of this research is most prominent after 6 uses. After 3 uses the degree of precision increases by 6.667% and by 8.333% in comparison after 6 uses. The precision advances by 3.846% after 9 uses in comparison to 6. The elevation of precision begins to dampen after 12 times used, and after 15 and 18 times there is a limit in the increase of precision. There are 2 possibilities to this phenomenon. First, the case importance has been adjusted to its optimal, and any additional importance would result in the same services. Unless the user changes the need and interests, then the system would re-adjust accordingly. Second, the Case Knowledge Base is incomplete, and more cases need to be added by the Service Center to satisfy users' needs in services. Overall, after about 12 uses, the reasoning mechanism of this research could adjust itself to enable personalized service reasoning.

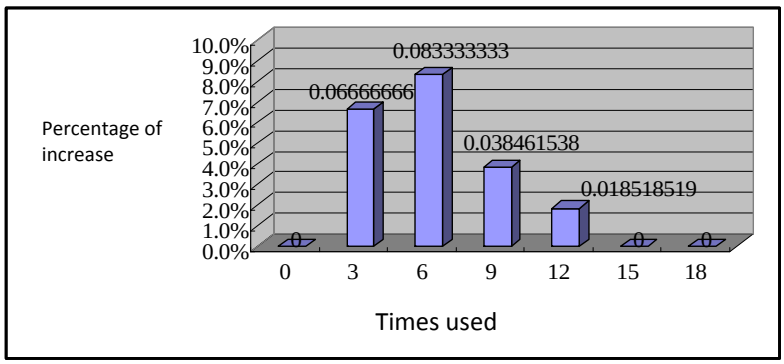

Figure 12. Percentage of increase in precision

CONCLUSION

How the context-aware system retrieves the context is no longer the most significant thing. What is more important is the process afterwards, which means how to provide the users with services. As Dey (2001) stated, context-awareness provides relevant products of services to users, but such relativity should be based on user's task. The task is what produces user's service needs. A common context-aware system simply provides the location information based on user's location, which cannot fully satisfy the task. This does not mean such a system is useless, because it is still suitable for some domains like tourism, and produces a good result even in comparison with the reasoning mechanism of this research. But from a personalized service perspective, it does not support in-depth reasoning.

Take the experiment results of this research as examples, the service reasoning mechanism adopted by this research is ontology-based. Ontology has the features of describing domain knowledge and fully expressing complex contexts and user tasks. What is more, the reasoning mechanism could regularize context information gathered by sensors using ontology. It could also filter and revise erroneous context information from the sensors, and transform basic information to advanced one. In short, it confers meaning to semantics and logics.

People exhibit non-structure and mobility in their need for services, therefore a context-aware system must, on the one hand, obtain more contexts concerning the users. That is to discover

more accurate services based on the combination of people, time, and location. The task on the other hand is how to find a more intelligent and flexible reasoning mechanism.

How does context-awareness obtain contexts for its reasoning? The simplest method for reasoning is rule-based reasoning, but the drawback is that it produces fixed results. Once user needs for service changes such reasoning will not meet the demand unless the service needs of users are certain and constant, which is very unlikely in reality. Even with the same situation, when certain context factors change (for example, the change in user interests), the service requirement will also change. As a result, the use of rule-based reasoning on context-awareness is plausible, but it is domain-dependent and the service for such domain is fixed and simple.

The context-aware reasoning mechanism must be able to follow the change in contexts and adjust its system model. The use of case-based reasoning as the reasoning engine for context-awareness can overcome the mobility of contexts. Results from experiment 1 show that case reasoning is more accurate than location-based service-providing mechanism. Experiment 3 further illustrates that one of its advantages of it is that following the number of case uses the mechanism would become personalized.

This research has constructed a context-aware reasoning mechanism by combining ontology and case reasoning. The experiment results from section 4 also indicate that the outcomes of such a context-aware reasoning mechanism are better than those of the location-based one. Based on the research results, two contributions are deduced and detailed below:
The context ontology design of this research emphasizes top-level ontology, where every category and attribute constraint is clearly defined. That means, the context ontology of this research is designed under the top-level structure, and any future context-aware application could draw from this research without the need of re-definition. By using this context ontology context information received from sensors could be filtered and integrated, as well as simple reasoning via the definition constraint. For example, it could be used to reason the context information is wrong or not, whether the relationship between context cases is inconsistent or receiving garbage information, etc. Furthermore, the use of ontology to design cases would be better than a common case reasoning design in terms of semantics and logics.
In regards to the context-aware reasoning mechanism, this research has referred to many other literatures and discovered that certain reasoning still adopts rule-based reasoning. However, rule-based reasoning is not in-depth and its result is absolute, which means it is impossible to produce other results. It's not enough in the context-aware environment, though in some situations it could be adopted. For instance, the intelligent offices will light up when a user steps in, but this is under the pretext that the applying domain must be apparent clear from the start, which will then of course be more effective than case reasoning.

By adopting case reasoning as the context-aware reasoning engine in this research, it could solve service reasoning under uncertain circumstances, because when a lot of context factors are involved, the uncertainty would become even greater. That is why simple rule-based reasoning cannot be employed. Additionally, case reasoning could revise reasoned services following changes in user service needs. The use of case reasoning could also solve the cold start problem in recommender systems, because the essence of case reasoning is the use of similarity in its calculation. Since there is no relevant context case of new users, the system

could still provide new users with services, because it could refer to similar cases of other users and their service needs.

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LOYALTY-BASED CUSTOMER RELATIONSHIP MANAGEMENT

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ABSTRACT

This study mainly presented an ontological foundation conceptual model for firms to implement CRM called loyalty-based customer relationship management (LBCRM). Over the last two decades the recognition of CRM is increasingly important and is invested in heavily within the firms in vary industries. However, the implementation performance of CRM are often far away from the expectations of the firm. Regardless of traditional or practice researches have shown the fact that attain to the goal and earn value from success CRM is a big task let along find the silver bullet from it to create a core business strategy of firm. Some works argued the reasons such as most researchers still exploring factors internal to the organization, most researches lacking both integrated and holistic view so that CRM yet done right. Therefore, this paper employed the customer perspective and integrated components link external and internal to the firms. In addition, comparing with the currently approaches this paper also presented a holistic lens and propositions are provided for future studies.

Keywords: Loyalty-Based CRM, CRM, stakeholder value management, ontology

INTRODUCTION

The customer relationship is considered as the highest priority in management in many companies (Becker, Greve, and Albert, 2009). However, firms pursue a broad spectrum of CRM initiatives, from after sales support, to product optimization, to cost reduction (Badgett and Connor, 2003) in one hand. On the other hand, due to the implementation performance of CRM are far away the expectations of firm (Budget, Ballou, and LaValle, 2004; Badgett and Connor, 2003; Wetsch, 2005), over 70% CRM appears to stay (Badgett et al, 2003).

Previous CRM researches concern more on micro process-based therefore lacking of a universal manner even it really provide deeper insight into achieving success with CRM strategy and implementation(e.g. Payne and Frow, 2005). A few researches more or less take CRM initiatives as one kind of particular organizational change and take it for granted so that focus on top-down management and overstate top-level support (Badgett et al., 2004). However this will bring a dramatically change within organization which cause an expected innovation initiatives toward termination unexpectedness due to lack of the support directly from the internal stakeholders.

Further, Studies have shown that a large number of CRM implementation either suddenly stopped or wait and see (Badgett et al. 2003), the reason is that our knowledge is so limited. It is reasonable to assume that if organizations keep investing heavily dollars on CRM implementations but the shareholder cannot participate in policy decision-line process and lack of obtaining timely and appropriate implementation of performance feedback and adjustment information, it is hard to support the development of CRM (Wetsch, 2005).This

may be the reason why although many companies know the importance of CRM still stop doing the initiatives (Badgett and Connor, 2003).

Thus, in this paper we suggest the conceptual framework of LBCRM employed the customer perspective and integrated components link external and internal to the firms. In addition, comparing with the currently approaches this paper also presented a holistic lens and propositions are provided for future studies. Furthermore, for LBCRM is an ontological foundation framework it fit application for firms including the actors and activities of given projects for keeping and earning the customer equality, satisfaction, and loyalty such as the industry of automobile, telecommunication, and bank especially.

INTROSPECTION AND REVIEW

Customer Relationship Management (CRM) is the outcome of ongoing evolution and integration of marketing thinking and newly available data, technologies and organizational approaches (Boulding, Staelin, Ehret, and Johnston, 2005), which were well received by the attention (Badgett, Ballou, and LaValle, 2004; Badgett and Connor, 2003) continuing to be a core business strategy and invested in heavily by corporations (Kim and Kim, 2009).

However, the implementation performance of CRM was not as expected, failure rate 70% (Wetsch, 2005), less than 15% companies worldwide done right, 85% of CRM implementation in companies of the U.S., Europe, and Asia, regardless of the size, not fully implemented successful(Badgett et al., 2004:1). Wetsch surveyed previous research found that the failure of CRM implementations were firms concerned too much on technological factors, such as database integration or factors internal to the organization such as system adoption or organizational culture (2005:29).

Recently works also pointed that the key Factors of CRM success were the steps associated with people (Badgett et al., 2004; Badgett and Connor, 2003). A few works notice that we must pay more attention on the impact of stakeholder to successful CRM (Badgett et al., 2004; Badgett et al.,, 2003; Becker et al., 2009; Payne, Ballantyne, and Christopher, 2005; Stephen, and Thomas, 2008).

Becker et al. among four industry studies in ten countries of Europe, the evidences of this study strongly supported my thinking to consider an exploration of CRM initiatives toward macro lenses, found that different process viewpoint in CRM initiative had no significant impact on business performance (2009: 207), which means that the process in CRM implementations may have its own meaning for the organization but it may not directly link to the business performance.

Furthermore, on the other hand, Reinartz, Krafft and Hoyer noted that previous studies have focused on CRM strategic components, such as the link between customer satisfaction and business performance, the link between customer loyalty and profitability, customer profitability heterogeneity, and customer loyalty programs, which needed to be broaden and focus on across firms strategic research which were less noticed (2004:293). Thus, CRM research need to be more integrated, holistic (Kim and Kim, 2009; Becker et al., 2009; Zineldin, 2006: 432), and exploring more systematically research topics.

Therefore, past works have shown the facts although recognizing the importance of CRM, relatively few firms and persons neither thinks CRM done right nor satisfy with the reports of performance improvement, the fact imply to have a clear objective to ensure future CRM initiative with practicality and usefulness is so key and must be, the fact also told us a holistic perspective is necessary to explore the people-related issues of CRM. On the basis above, it is necessary to adjustment our lenses while considering successful implementation of CRM. Keep all the investment of resources for CRM initiatives will have better outcome and enhance the stakeholder value management (SHVM).

EXPLORATION AND PROPOSITION

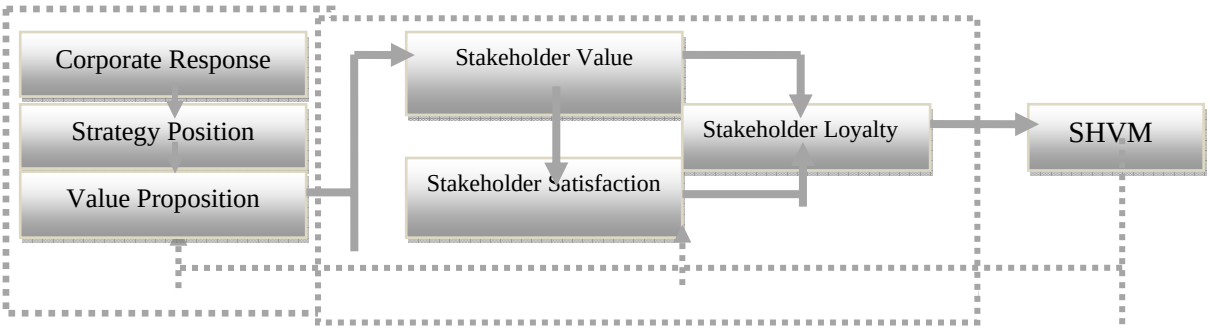
Loyalty based CRM is an ontological foundation for firms to implement their own CRM initiatives which offer a more powerful framework to meet those expectations I draw, derived from the given environment scanning and analyzing via the literatures review above. LBCRM intended to serve two purposes: Its prescriptive purpose is to guide the conceptualization and design of practical CRM initiatives which earn the loyalty from the stakeholder of the firms; its management innovation purpose is to emphasis on project-based management methodologically. Thus the use of the framework will not only lead to long-term systematic improvement for firms to earn the commitment and loyalty from its stakeholder but also lead firms' exploration and exploitation on the basis of the mechanisms of given projects such as the programs of co-creation of value, customer equality, satisfaction, and loyalty. The conceptual framework of LBCRM is shown as below.

Developing a Loyalty-Based CRM Model

Loyalty based CRM, Figure 1, it illustrates this integrated, methodical approach in a simple but post-hoc conceptual model, including mainly three blocks namely the co-creation of value between the firm and its stakeholder, the causal model of the antecedents and consequences relationships between stakeholder value, stakeholder satisfaction, and stakeholder loyalty, the SHVM which response to stakeholder with caring, feedback, and adjustment in a swift manner.

From Co-Creation of Value to Customer Value

The co-creation of value processes are illustrated in Figure 1. The corporate respond is to echo the stakeholders, the strategic position is how the firm selected a certain group of stakeholder from multi-stakeholder groups, and conduct a product, need, or channel-based positioning toward these certain stakeholder (Porter, 1996), and the value proposition is (Payne, Ballantyne, and Christopher, 2005: 868) to invite critical stakeholder involvement and provide the necessary products or services to the stakeholder individually. To ensure the stakeholder value will be created by co-creation of value flow above, I focus on three types of alignment across organizations: strategy, tactic, and culture.



Strategy Alignment

Strategy alignment is the premise of competitive advantage for firms (Porter, 1996). Reinartz, Krafft, and Hoyer argued that as firms become able to align their organizations and structure more effectively with their market goals, it is expected that they would be more successful in that market because they can adapt more readily to the needs of customers (2004: 296). Becker et al. (2009:207) also pointed out that I should pay attentions to the notions of multi-stakeholders of firm rather than caring the details of different processes of CRM initiatives. In fact, more and more studies have shown that strategy alignment is the critical factor for a successful strategy development process, and that emphasizing especially in the goals of the stakeholder (Badgett et al., 2004; Badgett and Connor, 2003). Thus:

Proposition$_1$: The wider the level of organizational strategy alignment with the goals of their stakeholder, the higher the positive link between successful CRM and relationship initiatives.

Tactic Alignment

Another required alignment for CRM success is tactic alignment (Huang and Liu, 2009). Since such internal tactical activities are based on the operation of parallel relationship, it is also known as so called horizon fit (Wright and Boswell, 2002). It is important for the various corporate functional units to achieve the same organizational strategy aligned projects in the same direction, because these divisions of labor in different sectors have different goals and must be effective integrated by human systems, prior research provide that various tactics alignment between activities will enhance organizational synergy (Way and Johnson, 2005). Hence forward:

Proposition$_2$: The deeper the level of internal tactic alignment with the goals of successful CRM, the higher the positive link between successful CRM and relationship initiatives.

Culture Alignment

The goal of culture alignment is mainly the organizational climate alignment. Prior researchers pointed out that the culture alignment of organization will help increase the level of collaboration across various corporate functional units (Way and Johnson, 2005). With the same organizational target, members in the organization should know that any kinds of competition internal are meaningless. If firms are able to understand their own subsections' difference, such as: organizational climate, subculture, and inertia. It will be possible to avoid the impact of the gap between various divisions

Therefore, since different subsections with their own inertias that may have different ways to achieve CRM goal. Top management team of firm can take this opportunity to integrate whole organizational climate and then create a favorable organizational climate to enhance successful CRM implementation (Badgett et al., 2004; Badgett and Connor, 2003). Present study suggests that culture alignment, will make the members we pursuit common goals with trust and share organizational performance with each other in the same atmosphere. Therefore:

Proposition$_3$: The wider the level of culture alignment with the goals of successful CRM, the higher the positive link between successful CRM and relationship initiatives.

From Customer Value to Customer Loyalty

Since a proper performance measurement framework is based on a causal model (Lebas, 1995; Kim and Kim, 2009). Prior studies have shown customer value has a positive effect link customer satisfaction (Heskett et al., 1994; Kamakura et al., 2005; Wetsch, 2005) and customer loyalty (Kim and Kim, 2009).Customers satisfaction has a positive effect on customer loyalty (Heskett et al., 1994; Kim and Kim, 2009). We considered the relationships between customer value, customer satisfaction, and customer loyalty for the performance measurement of the LBCRM in this study. We extend the traditional definition of the customer replaced it as stakeholder, see Figure1. And we argued five propositions for ensuring the success toward stakeholder value to stakeholder loyalty.

Stakeholder value and Stakeholder satisfaction

To enhance customer satisfaction, firms have to provide competitive products or services for their Stakeholders first. Many studies has shown that customer satisfaction must make their customers feel the services value they received are higher than other firms (Dabholkar, and Abston, 2008) In addition, both of the tangible and intangible value added are necessary to be considered for stakeholder value and then such of these services will directly bring stakeholder satisfaction (Bharadwaj and Roggeveen, 2008; Wetsch, 2005; Zineldin, 2006). As prior researches show that there is a positive relationship between customer value and customer satisfaction (Heskett et al., 1994; Kamakura et al., 2005; Wetsch, 2005). Hence forward:

Proposition$_4$: The greater the level of the stakeholder perceived value from firms, the higher the positive link between stakeholder satisfaction and successful CRM.

Many CRM initiativess of firms have been devoted to design the integration of marketing channels (Payne and Frow, 2005). Customers can feel the true satisfaction from the result of channel integration and single unit service center. Further, many firms have been able to grasp the opportunity for interpersonal contacts with their customers. Firms particularly concerned if customers experience the satisfaction with their appropriate services. For this reason, many firms draw up standard operation procedures for operation so as to enhance customer service delivery and to suggest specific solutions satisfaction with quality of the processes (Bharadwaj and Roggeveen, 2008; Zineldin, 2006). Thus:

Proposition$_5$: The greater the level of the stakeholder perceived quality of the processes from firms, the higher the positive link between stakeholder satisfaction and successful CRM.

As stated above, the product / service and process impact in raising customer satisfaction, the customers for the firm infrastructure (Jamal, and Adelowore, 2008; Zineldin, 2006) will also affect the customers to complete the process of consumption. The impression of firms is also related to customer satisfaction.

Customers receive and decode the firm's expressions easily from the firm's official web site, product catalog, an answer form call service center of firm, and even on the firm's advertisements which outside the external walls of building. Besides, even one mail seems to affect a customer via the wording and design quality that also lead customers deciding whether he or she will consume or not. These factors influence customers to repurchase

scenario as well as the notion which might discourage consumption of the original intent. On the other hand, according to similarity-attraction theory, human capital, organizational image, and day and night information of firm will constitute and express the meaning and service and it would also help to attract and enhance customer satisfaction if tempted. Therefore, present study suggests that:

Proposition$_6$: The greater the level of the stakeholder perceived quality of the resource expression from firms, the higher the positive link between stakeholder satisfaction and successful CRM.

Stakeholder Satisfaction and Stakeholder Loyalty

Currently organizational management strategy is to develop and enhance a long-term relationship and the ability that satisfy existing customers. They focus on customer satisfaction (CAST) and customer loyalty (Heskett et al., 1994; Zineldin, 2006).As mentioned above, the provision of competitive products or services to customers, firm convey high quality information and transaction process for timely and appropriate interpersonal interaction may also help improve customer satisfaction.

Unless the market and customers repurchase is recursive otherwise we can hardly say any relationship between buyer and seller has been established (Burt, 2000). To obtain customer loyalty, firms should consider how to make the customer satisfied with the present service and transfer customer satisfaction to customer loyalty (Oliver, 1999). This is the reasons why firms want to create and establish the relationships with their customers.

Wetsch (2005) pointed out that it is difficult to tell real from spurious loyalty when the marketing literature using behavioral data to analyze customer loyalty Firms perceived satisfied customers and strengthen the linkages and interaction with customers, known as a comprehensive feedback. Comprehensive feedback includes both active and passive cases. The latter, commonly referred to post sales service, is mainly in the provision of customer support services and the former is based on customer consumption records, initiated by the firms with social cognitive (Zineldin, 2006) feedback programs (e.g.: special recognition)for re-purchase proposal.

Firms apply to CRM seems special interested in the data mining technology, the initiative provide customers can contribute to re-purchase or complete the feedback and adjust the cross-selling of information (Heskett et al., 1994; Kamakura et al., 2005). While improving customers' care and the rate of customer value management are the main objectives.

However, without a good post sales service it is hardly to build customer loyalty (Kamakura et al., 2005).

Proper development of a comprehensive feedback and adjustment of CRM tactical activities is to help customers perceived the firms for their support. Thus, on the basis of the customers feelings will enhance the psychological attachment and create customer loyalty to the firms. Here forward:

Proposition$_7$: The greater the level of the stakeholder perceived corporate support from firms, the higher the positive link between stakeholder loyalty and successful CRM.

Proposition$_8$: The closer the level of the stakeholder perceived corporate value from firms, the higher the positive link between stakeholder loyalty and successful CRM.

Stakeholder Value Management

Payne, Ballantyne and Christopher cited Peck (2001) that research issues in stakeholder relationships has shifted emphasizing from a corporate responsibility for multiple stakeholders towards corporate responsiveness to these groups (2005:868). We employ the customer perspective (Kaplan and Norton, 1992) of CRM, Examining, positing, and developing the value of the stakeholder will make the organization resources allocation effective and value exchangeable to the stakeholder. In light of these considerations, we stressed not only on feedback and adjustment but also stakeholder involvement while echoing the opinions of stakeholder in time. Therefore we argued two propositions for the Stakeholder Value Management success.

Feedback and adjustment

Stakeholder value management is based on customer loyalty-based CRM. This study has proposed to conduct a comprehensive and stakeholder feedback and adjustment which can develop customer loyalty and help the individual customer lifetime value management. In fact, the customer value management also focuses on the basis of feedback and adjustment.

As mentioned before, since CRM processes in every action have a high level of context sensitivity the customer value management is clearly need for more long-term commitment to work. To grasp the sensitivity of these situations, we must continue caring out a search over time and thinking, the critical success factor is to maintain the value of the entire stakeholder network interaction management system and real-time feedback and adjustment. For example, in an attempt to provide customers with the desires of the firm product line of all possible pairs of products and services (Kamakura et al., 2005). Do all of these products or services fit customers' needs? Is the value of these products and prices competitiveness? Can firm afford to offer these services? Will it not be because of an impatient and self-defeating? How to ensure that each product or offer rewards of re-purchase service (Zineldin, 2006)?

Are acceptable for the customer? Any issues above will be very likely to result in loss of customers if getting serious flaws in the situation of the processes of CRM.

On the other hand, the culture alignment makes employee work under the same objectives and atmosphere. It is necessary to regularly inform the staff's attitude and behavior changes. For instance, the project staff, responsible for the tactical activities, whether the extent of their organizational identity change or not? How about the project of full feedback and adjustment? Do they recognize degree? Especially, how to deliver firm's value when we want to understand the front-line employees? To achieve customer loyalty and trust, we must firstly obtain the trust of employees: employee patronage, take the initiative to consumer products companies or services, willing to be the ratio of the level of internal customers for life (Dabholkar, and Abston, 2008; Wright and Boswell, 2002), the speed and the response that a staff deal with the customer complaint; if firms have any kind of competitive bonus scheme to employees that make good customer service. All these will affect the firm's success of stakeholder value management.

Proposition $_9$: The greater the level of the stakeholder perceived corporate support from firm, the higher the positive link between employee patronage and stakeholder value management development.

DISSCUSSION AND CONCLUSION

Present paper has presented a macro perspective and capture real circumstance of currently trend derived from previous researches, a holistic and measureable causality conceptual model combined stakeholder involvement from co-creation of value toward stakeholder loyalty are presented. Instead of merely focus on terminal customer I expand and extend the traditional definition of the customer and replaced it as stakeholders of focal firm. To such an extent that firms will keep up with the mainstream concepts and trends from the knowledge and practices of corporate strategy, which may makes a better alignment and a fully understanding between firms and their stakeholder.

Comparing the other approaches, LBCRM is more useful and meaningful while guiding an initiatives for CRM implementation since it based on firm's given projected-based manner so that the employees in focal firms will perceive more moderate change pressure during the period of the implementation and thus may willing to fit such an innovation evolution instead of shift gear for practices revolution within the organization, the level of the shareholder perceived corporate goal from firm will closer and higher the positive relationships between shareholder and stakeholder value management development which meet firms' expectations.

This paper has suggested the LBCRM model for CRM implementation based on ontological concepts. The model with its propositions presented in this paper currently has further developed for an empirical measurement (Tseng, 2010). However, the measurement validations remain an open issue and the relationships of components in LBCRM may be different in industries. The future finding will contribute to our knowledge while doing a loyalty-based customer relationship management and will serve its turn on stakeholder value management.

Finally, I suggest the LBCRM is a suitable guidance framework for firms which including the actors and activities of given projects for keeping and earning the customer equality, satisfaction, and loyalty such as the industry of automobile, telecommunication, and bank especially.

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THE EFFECTS OF MOBILE ADS, ADS VALUES AND PRIVACY PROTECTION ON CONSUMER ADOPTION INTENTION

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ABSTRACT

The study discusses the determinant effects of advertising content (informativeness/entertainment/irritation/credibility) on mobile advertising value, and consumer adoption intention regarding three mobile advertising type including permission advertising, incentive advertising and location-based advertising. The research applies the advertising content theory (AC theory), advertising value theory (AV theory), privacy theory and adoption intention (AI theory) to develop the conceptual framework and then discusses consumer attitudes and adoption behaviors concerning the mobile advertising applications.

Keywords: Advertising content, advertising value, privacy protection, adoption attitude

INTRODUCTION

The Internet-enabled mobile handset has rapidly achieved worldwide penetration owing to the very personal nature of the devices and their employment of sophisticated communication technology [32]. According to Gallen, the Asia-Pacific region leads the world in mobile marketing and advertising; accelerating growth will see nearly $7.7 billion (and more than $16 billion globally) spent in 2011 [15]. In 2009, Taiwan's Generation Mobile Communication users made up more than one million households, 11 times the number of users in 2006 [30]. Therefore, mobile marketing development has become increasingly important.

Academic studies indicate that while the cost of mobile advertising is higher than that for sending e-mail, early adopters easily book response rates five times higher than those for direct mail ([14]; [24]), hence, it is prudent for firms to carefully schedule mobile medium programs. Current mobile advertising is primarily concentrated on the effects of mobile content on mobile advertising value ([8]; [4]; [18]). What is lacking is an examination of mobile advertising value, privacy concerns and consumer adoption intention. Furthermore, most studies focus on the permission advertising ([16]; [3]; [40]), and are noticeably deficient in comparative analysis for both incentive and location-based advertising. To better understand consumer acceptance and attention regarding mobile ads and mobile marketing, it

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is essential to investigate an integrative mobile advertising research subject. Zoller, Housen and Matthews (2001), in there study on mobile advertising types, proposed three types of mobile advertising: permission advertising, incentive advertising and location-based advertising [47]. Concerning mobile advertising content, Ducoffe (1996) proposed informativeness, entertainment, irritation and credibility, as factors to examine the effects of mobile advertising content on advertising value [8]. By adopting an integrated perspective that emphasizes the roles of mobile advertising content (AC theory) and value (AV theory), privacy theory and consumer adoption intention (AI theory), this paper addresses these key gaps. It develops empirical mobile advertising development strategy explanations for related mobile marketing products, while advancing service application research in the form of a linear regression method. Accordingly, this study examines a variety of effects that include: 1. the effects of three types of mobile advertising content on advertising value; 2. the effects of three types of mobile advertising value on consumer adoption intention; 3. the effects of consumer privacy concerns on the intentions of consumer adoption in regard to a variety of mobile advertisings.

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 mobile advertising content, advertising value, consumers privacy concern and adoption 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.

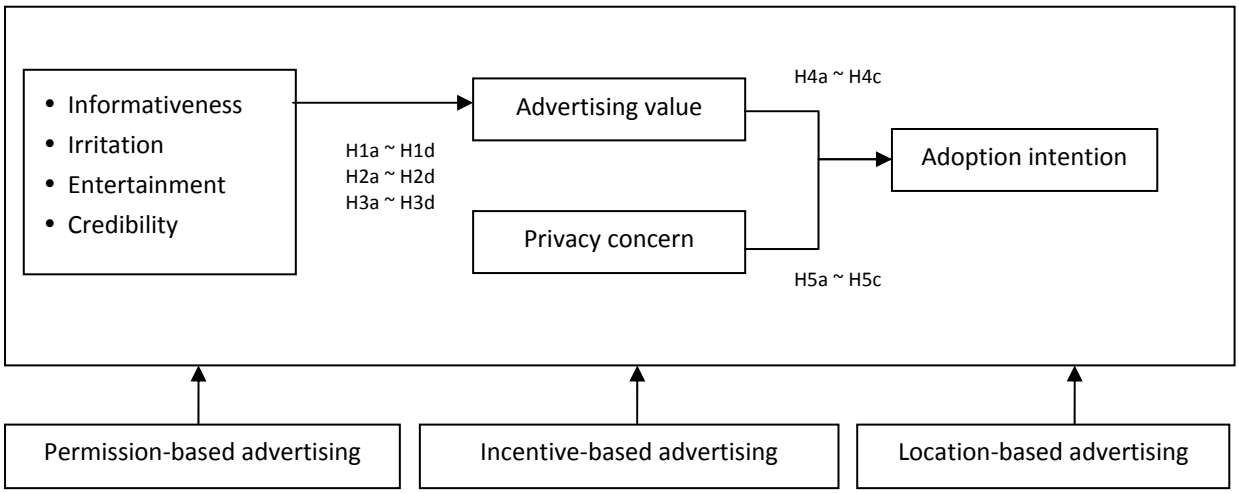

Figure 1 conceptual framework

LITERATURE REVIEW

Previously, a mobile advertising application in AV, AC and AD theory has not yet been explored. Therefore, this study aims to add to the limited literature on mobile advertising, mainly in Taiwanese context. This section outlines literature reviews of former scholars and defines a theory base for this study.

Mobile Advertising

Kotler and Armstrong (2000) defined advertising as any paid form of non-personal presentation and promotion of ideas, goods or services by an identified sponsor [25]. The Mobile Marketing Association (2008) defines mobile marketing as the use of a mobile medium as a communication and entertainment channel between a brand and an end-user [28]. Mobile devices will gradually become more functional: increasing numbers of people will purchase services and products as a result of mobile marketing promotion. According to scholars, mobile advertising contains the following important features: (1) It is Personalized: advertisers can provide for the needs of consumers; (2) It is immediate: advertisers can deliver an advertising limit time; and (3) Location-based services: providers see advertising as the cornerstone of their business plans [12].

Imhoff, Loftis and Geiger (2001) argued that personalization is "the ability of a company to recognize and treat its customers as individuals through personal messaging, targeted ads, or other personal transactions [21]." It is immediate: mobile advertising transcends time and space limitations, so advertisers can deliver their message to the customer at any time. Location-based services that connect to a distinct location are highly relevant for local advertising [6]. Consequently, the abovementioned features make mobile advertising the 'dream environment' for every marketer (Evelyne, 2007).

Thus, based on the characteristics of mobile advertising, Zoller et al. (2001) identified three types of mobile advertising: (1) Permission-based advertising in which consumers are willing to provide their personal information to firms and consent to receiving advertisements. According to consumer information, firms can then target their products or services to the individual consumer; (2) Incentive-based advertising which provide feedback venues for consumers while they agree to receive information on promotional or advertising activities; (3) Location-based advertising which sends regional advertising information to consumers located in specific regions [47].

In academia, scholars have studied various mobile advertising strategies to suggest and predict their application or promotion ([3]; [18]). Findings indicate that these three constructs (permission advertising, incentive-based advertising and located-based advertising) are valid for evaluating consumers' intentions to adopt mobile advertising information. For example, permission advertising was derived from the concept of permission-based marketing. Barwise and Strong (2002) found that consumers responded well to text adverts that grab their attention [3]. Incentive-based advertising refers to advertisers provide incentive for consumers to respond advertising content of receipt of reward. Finally, Varshney (2003) refers location-based advertising as messages can be sent to all users who are currently in a certain area or to certain users in all locations [45]. Transparent opt-in processes and an advanced level of customization are key success factors for location-based advertising [2]. Therefore, based on the above discussion about moblie advertising, we select permission advertising, incentive-based advertising and located-based advertising as our research targets.

Mobile Content and Mobile Advertising Value

In academia, Brackett and Carr (2001) referred to advertising content as comprising entertainment, informativeness, irritation and credibility [4]. Several scholars have indicated that mobile content includes: (1) informativeness: consensus exists with regard to the ability of advertising to inform consumers of product alternatives so that purchases yielding the greatest possible satisfaction can be made [8]; (2) entertainment: people's feeling of enjoyment which they associate with advertisements play the greatest role in accounting for their overall attitudes towards them [38]; (3) irritation: sponsored links are like any ad that causes irritation. They may depress an ad's value [26] and (4) credibility: has a direct relationship with both advertising value and attitudes toward advertising [4].

According to Ducoffe (1996), value potentially comes from expectations about the offering itself, from the experience that accompanies the exchange and from the residual feelings of having engaged in the behaviors necessary to achieve the exchange; i.e., value can reflect the worth of the element itself as well as the transaction [8]. The implication that each party to the exchange both gives and receives value differentiates the exchange from other forms of satisfaction based on need [20]. Advertising processing decisions are based on initial, spontaneous and categorical evaluations that combine to form an expected advertising value (EAV) assessment [9]. Consequently, attempts to achieve appropriate advertising values are not usually undertaken to copy extensive advertising, but rather only for brand names or appearance [34].

Scholars have indicated that informativeness, entertainment, irritation and credibility are four important factors to influence the effects of mobile advertising. For example, Varshney (2003) considered information a valuable incentive in mobile advertising because recipients react very positively to advertising transfer incentives. Entertainment is also a crucial factor for mobile advertising. In the findings of Fernandez (2000), informativeness is defined as being relevant to a purchase situation response to directional advertising in the Yellow Pages [13]. Wang et al., (2002) suggested that using advertising with more specific information that matches consumers and purchase situations are more likely to be made, resulting in a proactive response [46]. Haghirian, et al. (2005) extended the concept for measuring mobile advertising: the results indicated that entertainment, informativeness, irritation and credibility affect mobile advertising value, while exposure has no impact [18]. In entertainment, it is essential that the message is concise and funny, and captures consumers' attention immediately [22]. Brackett and Carr (2001) found that informativeness, entertainment and credibility affect advertising value positively, and that irritation has no impact [4]. Greyser (1973) suggested that public receptivity to advertising depends on goodwill that is eroded by the public dislike of advertising. Irritation can serve to distract, inhibiting counterarguments [17], therefore enhancing persuasion [1].

Hence, manufactures and service providers can create new mobile advertising and perform mobile marketing to encourage the development of new services and offer incentives for consumers [36]. Thus, this research chooses informativeness, entertainment, irritation and credibility to examine the effects of mobile advertising content on advertising value. Drawing from the above discussion concerning mobile advertising content and advertising value factors for three mobile advertising types, the following relationships were hypothesized:

H1a: The informativeness of permission-based advertising has a positive effect on its advertising value.
H1b: The entertainment of permission-based advertising has a positive effect on its advertising value.
H1c: The irritation of permission-based advertising has a positive effect on its advertising value.
H1d: The credibility of permission-based advertising has a positive effect on its advertising value.
H2a: The informativeness of Incentive-based advertising has a positive effect on its advertising value.
H2b: The entertainment of Incentive-based advertising has a positive effect on its advertising value.
H2c: The irritation of Incentive-based advertising has a positive effect on its advertising value.
H2d: The credibility of Incentive-based advertising has a positive effect on its advertising value.
H3a: The informativeness of Location-based advertising has a positive effect on its advertising value.
H3b: The entertainment of Location-based advertising has a positive effect on its advertising value.
H3c: The irritation of Location-based advertising has a positive effect on its advertising value.
H3d: The credibility of Location-based advertising has a positive effect on its advertising value.

Privacy concerns

Privacy is a complex concept; an acceptable use of private information in one situation may be deemed an unacceptable invasion of privacy in another [10]. Liu et al. (2004) Liu defined privacy as the right of an individual to be left alone and be able to control the release of his or her personal information [27]. Fareena and Adrew (2008) suggested that people have been concerned about the privacy of their personal information online since the advent of the Internet [11], and Hoffman, Novak and Peralta (1999) indicated that the Internet threatens consumer information privacy in new and extreme ways [19]. Therefore, in order to reduce privacy concerns, companies could offer consumers greater control over the acquisition and use of their personal information, in effect, forging a new trust in the marketer [44]. Scholars indicated that customers' privacy concerns arise from the feeling that their information is vulnerable and that they are not able to control their personal information [7]. For instance, the protection of location-privacy has become a key factor in the success of location-based services. As users consider their own physical location and movements to be extremely privacy-sensitive, the demand for solutions that protect such information in a variety of environments is great [5]. Hence, this study investigates the perceived privacy issues of consumers related to advertising value and adoption intention, in regards to a variety of mobile advertising strategies.

Adoption intention

In the academic world, Kim, Hock and Sumeet (2007) perceived that value reflects this concern for privacy by comparing benefits with sacrifices, thereby constituting an indicator of adoption intention [23]. Thaler (1985) stated that the prospect theory value function is defined in regard to single, one-dimensional outcomes [42]. A study by Urbany, Bearden, Kaicker and Smith-de Borrero (1997) concluded that a noticeably low or high price (relative to what was expected) affects purchase intentions in a manner beyond the ordinary allocated role of price [43]. A customer's privacy concerns can outweigh the benefits of using u-commerce services which, in turn, can influence their intentions to adopt u-commerce applications [39].

The Theory of planned behavior, an extension of the well-known Theory of Reasoned Action, is proposed as a model to predict consumer adoption intention [42]. In expectancy value models such as TAM, has been widely used in studies examining why consumers used or adopted new communication technologies ([23]; [37]).

Social norms theory can be used to develop interventions that focus on mobile advertising perceptions for the purpose of correcting misperceptions among students, thereby positively affecting adoption intentions [37]. Okazaki and Taylor's (2008) findings are of central importance to managers as he concluded that the factor most correlated with the willingness to adopt SMS advertising is the perceived ability to build a brand [33]. Therefore, the following hypotheses can be formulated.

H4a: The value of Permission-based advertising has a positive effect on consumer adoption intention.
H4b: The value of Incentive-based advertising has a positive effect on consumer adoption intention. H4c: The value of Location-based advertising has a positive effect on consumer adoption intention. H5a: Perceived privacy concerns regarding the privacy of permission - based advertising has a positive effect on consumer adoption intention.
H5b: Perceived privacy concerns regarding the privacy of incentive-based advertising has a positive effect on consumer adoption intention.
H5c: Perceived privacy concerns regarding the privacy of location-based advertising has a positive effect on consumer adoption intention.

RESEARCH METHOD

This study surveys consumer attitudes toward mobile advertising chosen from Taiwan market. In addition, the questionnaire items are designed and then modified to make them appropriate for assessing attitudes toward three types mobile advertising. Young consumers were chosen as survey targets. The data are collected over a period of one month (June, 2009). Research findings and suggestions are provided to examine the relationships among mobile advertising content (informativenness, irritation, entertainment, credibility) [8], advertising value [8], privacy concerns [27] and consumer adoption attitudes [35] for the three abovementioned types of mobile advertising [47]. Likert scales (1-5), which range from strongly disagree to strongly agree, were used for all questions in this study. Data analysis methods used in this research include factor analysis, reliability analysis, and a linear

regression method.

DATA ANALYSIS

Descriptive Statistic

The 360 respondents produced a total of 340 usable questionnaires resulting in a response rate of 94%. The respondents comprised 53.7% males and 46.3% females; 64% of the respondents ranged in age from 20 to 25, while 23% were between 26 and 30; 84% of respondents had a college degree.

Factor Analysis and Reliability Analysis

To verify the relationships among the factors, the study performs factor analysis and reliability analysis using SPSS statistical package. 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 model factors. All factor loadings of variables exceed 0.5, while the α values of the item to total correlation exceed 0.7. The constructs with eigenvalues are greater than one. The mobile content of permission-based advertising, incentive-based advertising and location-based advertising resulted in similar factors, namely informativeness, entertainment, irritation and credibility.

Table 1 Factor and reliability analysis of model factors

	Permission-based advertising			Incentive-based advertising			Location-based advertising		
	eigenvalue / Cronbach's	Factor loading	α	eigenvalue / Cronbach's	Factor loading	α	eigenvalue / Cronbach's	Factor loading	α
Informativeness (KMO: 0.706/0.695/0.721)									
Is a good source of product information		0.842	0.717		0.676	0.720		0.748	0.793
Supplies relevant product information	1.847/ 0.822	0.815	0.734	1.589/ 0.768	0.771	0.662	1.879/ 0.832	0.823	0.749
Provides timely information		0.688	0.813		0.733	0.682		0.801	0.761
Entertainment (KMO: 0.670/0.715/0.701)									
Is entertaining		0.716	0.783		0.778	0.739		0.720	0.813
Is enjoyable	1.873/ 0.819	0.948	0.649	1.782/ 0.814	0.799	0.726	1.949/ 0.842	0.916	0.713
Is pleasing		0.649	0.808		0.734	0.767		0.747	0.810
Irritation (KMO: 0.680/0.667/0.712)									
Insults people's intelligence		0.798	0.602		0.798	0.562		0.784	0.717
Is annoying	1.510/ 0.746	0.652	0.693	1.424/ 0.721	0.616	0.676	1.734/ 0.804	0.746	0.740
Is irritating		0.671	0.684		0.639	0.658		0.750	0.738
Credibility(KMO: 0.672/0.690/0.712)									
Is credible		0.717	0.718		0.789	0.711		0.736	0.756
Is trustworthy	1.699/ 0.785	0.888	0.620	1.768/ 0.804	0.853	0.675	1.760/ 0.809	0.806	0.713
Is believable		0.629	0.778		0.646	0.805		0.754	0.745
Advertising value (KMO: 0.684/0.660/0.721)									
Is useful		0.814	0.665		0.702	0.700		0.797	0.766
Is valuable	1.707/ 0.785	0.812	0.667	1.659/ 0.769	0.898	0.589	1.885/ 0.833	0.830	0.747
Is important		0.620	0.796		0.601	0.773		0.749	0.796
Adoption intention (KMO: 0.734/0.718/0.764)									
		0.650	0.771		0.607	0.766		0.619	0.838
Ads appear in my life		0.861	0.681		0.823	0.670		0.841	0.755
This ad with different ad messages	2.028/ 0.794	0.643	0.764	1.939/ 0.779	0.673	0.732	1.278/ 0.834	0.763	0.788
Purchase decision use of the advertising in the future		0.672	0.751		0.663	0.734		0.779	0.777
Privacy (KMO: 0.797/0.779/0.778)									
Advertisers is making efforts to keep my personal information out of hands of unauthorized individuals		0.690	0.762		0.675	0.748		0.695	0.777
Advertisers will not release personal information about me without my express permission.		0.790	0.891		0.786	0.894		0.756	0.856
Advertisers made a reasonable effort to ensure that the information collected about me was accurate	2.702/ 0.836	0.623	0.691	2.647/ 0.827	0.540	0.610	2.594/ 0.816	0.621	0.687
Advertisers gave me a clear choice before disclosing personal information collected about me to third parties		0.599	0.669		0.646	0.712		0.523	0.595

Regression Analysis

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. Tables 2, 3 and 4 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 2, the results of regression Model 1 (F=48.321; ΔR^2=0.378) and Model 2 (F=63.060; ΔR^2=0.374) suggest that informativeness (β=0.161/0.160), entertainment (β=0.115/0.124) and credibility (β=0.522/0.522) have positive effects on advertising value in permission-based mobile advertising. Regression Models 3 and 4 show that significant results were obtained on the importance of AV and privacy concern theory; advertising value and privacy concerns are important to consumer adoption attitudes in permission-based mobile advertising. As well, advertising value and privacy concerns are effective at improving consumer attitude towards the adoption of permission-based advertising. In Model 5, while considering the factors of advertising value and privacy, advertising value appears to have a significant effect on consumer adoption attitude, while privacy was shown to have no impact on consumer adoption attitudes.

Table 2. Factors of permission-based advertising content on value and adoption attitude

		Advertising value		Adoption intention		
		Model 1	Model 2	Model 3	Model 4	Model 5
		Beta	Beta	Beta	Beta	Beta
Advertising content	informativeness	0.161**	0.160**			
	entertainment	0.115*	0.124*			
	irritation	-0.074				
	credibility	0.522***	0.522***			
Advertising value				0.363***		
privacy					0.186**	
Advertising value						0.338***
Privacy						0.090
R		0.621	0.617	0.363	0.186	0.373
ΔR^2		0.378	0.374	0.129	0.032	0.134
Durbin-Watson		1.935	1.942	1.949	1.978	2.031
F		48.321***	63.060***	1571.6494***	11.143***	25.033***

a. Dependent Variable: advertising value, adoption intention
b. Linear Regression through the Origin

In Table 3, the results of regression model 6 (F=30.680 , ΔR2=0.276) and model 7 (F=117.512 , ΔR^2=0.273) suggest that the credibility (β=0.508/0.524) have positive effects on the advertising value regarding incentive-based mobile advertising. In regression models 8 and 9, significant results are obtained on the importance of AV (β=0.312) and privacy concern (β=0.175): advertising value and privacy concern are important to consumer adoption attitudes in incentive-based mobile advertising. In Model 10, if considering advertising value and privacy, advertising value appears to have a significant effect on

consumer adoption attitudes, while privacy is shown to have no impact on consumer adoption attitude.

Finally, see Table 4, the results of regression model 11 (F=66.988 , ΔR^2=0.459) and model 12 (F=134.201 , ΔR^2=0.461) suggest that the entertainment (β=0.164/0.190) and credibility (β=0.609/0.607) have positive effects on the advertising value in location-based mobile advertising. In Models 13 and 14, significant results were obtained regarding the importance of AV (β=0.413) and privacy concerns (β=0.324): advertising value and privacy concerns are important to consumer adoption attitudes in incentive-based mobile advertising. In Model 15, while considering the factors of advertising value and privacy, advertising value and privacy both are shown to have significant effects on consumer adoption attitudes in regard to location-based advertising.

Regarding the effects of permission-based advertising content on advertising value, the results of linear regression analysis support *H1a*, *H1b*, *H1d* but do not support *H1c* regarding the effects of incentive-based advertising content on advertising value; the linear regression analysis supports *H2d*, *but does not support H2a*, *H2b*, *H2c*. For the effect of location-based advertising content on advertising value, the results of the linear regression analysis support *H3b* and *H3d*, *but do not support H3a*, *H3c*. Regarding the effects of advertising value and privacy concern on consumer adoption attitudes, the results support *H4a*, *H4b*, *H4c* and *H5a*. Advertising content that includes informativeness, entertainment and credibility, plays a variety of important roles in the three types of advertising value; advertising value and privacy concerns influence the consumer's attitude in regards to any adoption of mobile advertising information.

Table 3. Factors of incentive-based advertising content on value and adoption attitude

		Advertising value		Adoption intention		
		Model 6	Model 7	Model 8	Model 9	Model 10
		Beta	Beta	Beta	Beta	Beta
Advertising content	Informativeness	0.069				
	Entertainment	0.022				
	Irritation	0.022				
	Credibility	0.560***	0.573***			
Advertising value				0.311***		
Privacy					0.175***	
Advertising value						0.312***
Privacy						0.06
R		0.579	0.573	0.311	0.175	0.350
ΔR^2		0.327	0.326	0.094	0.028	0.123
Durbin-Watson		2.001	2.019	2.024	1.874	1.805
F		38.609***	151.028***	33.136***	9.486***	21.603***

a. Dependent Variable: advertising value, adoption intention
b. Linear Regression through the Origin

Table 4. Factors of location-based advertising content on value and adoption attitude

		Advertising value		Adoption intention		
		Model11	Model12	Model13	Model14	Model115
		Beta	Beta	Beta	Beta	Beta
Advertising content	Informativeness	0.039				
	Entertainment	0.164***	0.190***			
	Irritation	-0.019				
	Credibility	0.609***	0.607***			
Advertising value				0.413***		
Privacy					0.324***	
Advertising value						0.351***
Privacy						0.228***
R		0.683	0.682	0.413	0.324	0.486
ΔR^2		0.459	0.461	0.168	0.105	0.219
Durbin-Watson		1.938	1.938	1.809	1.864	1.833
F		66.988***	134.201***	63.905***	36.374***	43.340***

a. Dependent Variable: advertising value, adoption intention
b. Linear Regression through the Origin

DISCUSSION AND CONCLUSION

This study explores mobile advertising service in the Taiwan market. Consumers are surveyed and statistical methods used to verify key factors of a firm's mobile advertising strategy. The contribution of this research is to incorporate advertising content [8], advertising value [8] and privacy [27] as well as consumers' adoption attitude [35] in order to construct a meta-dialogue for their relationships. Research findings provide support for the theoretical base that some advertising content factors have a significant impact on advertising value and that advertising value and privacy lead to consumer adoption intentions concerning the three types of mobile advertising.

The study findings show that in permission-based advertising, informativeness, entertainment and credibility have positive effects on advertising value. Therefore, if permission-based advertising provides practical information, entertainment properties and credibility advertising content it can increase the advertising value of permission-based advertising. Advertising value relates positively to the consumer adoption intention. Therefore, adding advertising value will enhance consumer adoption intentions concerning permission-based advertising. The findings indicate that privacy has a positive effect on consumer adoption intentions. Increasing the perception of privacy for permission-based advertising will increase the adoption intentions of consumers.

In incentive-based advertising, only credibility positively affects advertising value. Credibility enhances the value of incentive-based advertising and increases consumer adoption intentions. Therefore, advertisers must emphasize the credibility of advertising content in order to gain the trust of consumers. Furthermore, privacy still has a positive effect on consumer adoption intentions. In location-based advertising, entertainment and credibility positively affect advertising value. Hence, while possessing high entertainment value and

credibility, advertising value and the adoption intention of location-based advertising will be improved accordingly. Also, advertising value and privacy are both important for influencing consumer adoption intentions.

In academia, Ducoffe (1996) suggested that entertainment and informativeness have positive effects on advertising value while irritation produces negative effects [8]. Brackett and Carr (2001) and Haghirian et al. (2005) also argues that entertainment, credibility and informativeness have positive effects on advertising value and that irritation produces the opposite result ([4];[18]).

The study's findings indicate that values in all types of advertising will positively affect consumer adoption intentions. Furthermore, a higher perception of privacy leads to higher adoption intentions. However, when advertising value was compared to privacy in regard to consumer adoption intention, results showed that the perception of high privacy levels will not affect consumer adoption intention for both permission-based and incentive-based advertising. According to the respondents, under permission-based and incentive-base advertising, consumers recognize that they will receive those advertising messages; so, the importance of privacy is lower than that of advertising value. However, for location-based advertising, compared with mobile advertising value, privacy still has significant effects on consumer adoption intentions. Hence, location-based advertisers should not only increase their advertising value, but also pay attention to the perceived privacy concerns of consumers and promote their superior privacy mechanisms with the consumer in mind.

Mobile advertising systems are well developed throughout the world, however, in Taiwan, the mobile advertising still has not been broadly adopted by consumers. Management implications and promotional strategies are suggested as follows: (1) *Enhancing substantial information:* substantial information is important. It helps consumers to understand what they can buy, especially in permission-based advertising. Providing clear information is very important to advertising value. For example, cooperation between Nike and Yahoo has led to Nike banner ads in Yahoo! Mobile. If consumers accept this advertising, they will see the stories of eight sport stars; (2) *Increasing entertainment content:* in both permission-based and location-based advertising, entertainment features within advertising content invite consumers to browse. Consumers expected to receive both permission-based and location-based advertising. If advertisers can pay attention to entertainment features, it will increase advertising value. For example, in the collaboration between Hyundai and Sprint, if consumers view the advertising, they can download their favorite songs; (3) *Reducing irritation*: although irritation in the three types of advertising appears to have had no impact on advertising value in this study, respondents indicated that consumers accept advertising content passively; if they receive too much similar advertising, it leads to irritation. Therefore, advertisers should be careful about the frequency of mobile advertising message to avoid negative effects; (4) *Importance of credibility*: mobile advertising with real-time functions and the credibility of advertising content become very important. In this study on the three types of advertising content, consumer recognition of credibility can increase advertising value; (5) *Privacy protection:* improving privacy protection will increase consumer adoption intentions. Even with permission-based advertising and incentive-based advertising, privacy is of lower value than advertising value in the consumer's mind; advertisers should still emphasize consumer privacy protection. In summary, when

advertisers send mobile advertising, they should ensure they are providing substantial information, increasing entertainment, reducing irritation, and emphasizing both credibility and privacy protection, thereby increasing advertising values and encouraging consumer adoption intentions

More smart phones are being promoted by firms and being adopted by consumers than in the past. Advertisers should pay attention to the application of mobile phone ads. For instance, advertisers can provide simple and timely advertising to attract consumers using location-based advertising, especially in the travel and tourism industry. Regarding incentive-based advertising, providing various benefits (e.g. money rewards or no-charge application software) to increase the browse rate of mobile ads is useful. In permission-based advertising, providing customized ads targeting the various characteristics of customers is important. These methods can be adapted to a variety of industries. The limitation of this research is that it is based on only 343 respondents. However, respondents who are involved in the adoption decision of mobile advertising decision. Future research could extend the scope of samples, and add other discussion factors, such as 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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DECOMPOSING PROFIT AND PRODUCTIVITY CHANGE IN DATA ENVELOPMENT ANALYSIS: AN APPLICATION OF TAIWAN SEMICONDUCTOR INDUSTRY

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ABSTRACT

This study applies Grifell-Tatjé and Lovell's (1999) profit change decomposition methodology to analyze the profit changes of Taiwan's semiconductor industry, including designs, fabrications, packaging and testing firms during the period 2005-2007. The profit change will be decomposed into three sources: (1) the productivity effect (including the technical change effect and operating efficiency effect), (2) an activity effect (including product mix effect, resource mix effect and scale effect), and (3) price effect. From the decomposition, we can not only understand the total profit change but also the relative contribution of each effect on the total profit change. From the decomposition results of the profit change can provide useful information to the managers of Taiwan's semiconductor industry to the establishment of future profit enhancement strategies.

Keywords: Data envelopment analysis, Profit, Productivity, Semiconductor industry.

INTRODUCTION

When the growing demand for knowledge-based products and services are shaping the global economic landscape, the role of knowledge in achieving competitive advantage has become a major consideration in management. And the semiconductor industry plays an important role in Taiwan's Economic activities. Table 1 shows Taiwan Semiconductor industry Production Output Value which involves design, fabrication, package, and test output value. In 2008, the output value of the IC design industry has accounted for 25.8% of the world, ranking the second in the world. The output value of Taiwan's IC foundry industry has accounted for 67.2% of the world. The IC packaging industry ranks the world's first. Therefore, the relative performance of Taiwan's semiconductor industry is an important topic. Huang (2007), Chen (2008), and Huang (2008) analyze the operational efficiency of Taiwan's semiconductor industry based on the productivity approach. On the other hand, Chen (2004) uses the cost efficiency approach to analyze the semiconductor industry. Liu and Wang (2008) employ data envelopment analysis (DEA) to measure the Malmquist productivity of semiconductor packaging and testing firms in Taiwan. They use slacks-based measurement (SBM) and Super-SBM models to obtain more accurate measurements. They also made comparisons between the results from SBM, Super-SBM and CCR models. Lu and Hung (2010) use DEA

to measure the operating performance of the vertically disintegrated chain in the integrated circuits (IC) industry. And the research indicates that the IC design firms perform better than IC fabrication and IC packaging/testing firms. Altogether, semiconductor firms in Taiwan still have room for performance improvement. In addition, the empirical results suggest that an IC company's scale of size does play an important role in influencing its operating efficiency.

Table 1 Taiwan Semiconductor Production Output Value Unit: Hundred Million NT$

	2004	2005	2006	2007	2008
IC Design	2,608	2,850	3,234	3,997	3,749
IC Fabrication	6,239	5,874	7,667	7,274	6,542
IC Package	1,566	1,780	2,108	2,280	2,217
IC Test	577	675	924	1,023	965
IC total output value	10,990	11,179	13,933	14,574	13,473

Most previous studies focus on the relative performance of the semiconductor industry. But few studies analyze the linkage between the source of profits and the relative performance of Taiwan's semiconductor industry. Sahoo and Tone (2009) use radial and non-radial methods to decompose the input-based physical capacity utilization into technical inefficiency, ray economic capacity utilization and optimal capacity idleness of the India banks. Coelli, Grifell and Perelman (2002) use a ray economic capacity to decompose the gap between the capacity utilization and the optimal capacity utilization of the international airline companies. Lim and Lovell(2009) apply a different decomposition approach to the unbalanced panel of US Class I railroads, a short-run profit change decomposition model is used to attribute intertemporal profit change to its causal factors. This study finds that productivity improvements and an increased scale of production contributed to increases in profit, and that variation in operating efficiency had a mixed impact on profit. And this study also finds that relative changes in rail rates and variable input prices exerted downward pressure on profit. Asaftei (2008) divides the changes in ROA of the US commercial banks and analyzes the impact of financial innovations and deregulation. Hadley and Irz (2008) implement the profit change decomposition methodology developed by Grifell and Lovell (1999) to investigate profit changes for cereal farms drawn from the Farm Business Survey in England and Wales for the period 1982 to 2000. The results of the analysis show an overall decline in profit levels. Tseng (2007) applies Grifell and Lovell's (1999) decomposition approach to the banking industry of Taiwan and investigates the influence of profit change during the Asian financial crisis and economic recessions in Taiwan.

According to previous literatures, no one have applied the decomposition approach to Taiwan's semiconductor industry, therefore our study applies Grifell and Lovell's (1999) decomposition approach to analyze the profit changes of Taiwan's semiconductor industry. The profit change will be decomposed into three sources: (1) the productivity effect (including the technical change effect and operating efficiency effect), (2) an activity effect (including product mix effect, resource mix effect and scale effect), and (3) price effect. From the decomposition, we can not only understand the total profit change but also the relative contribution of each effect on the total profit change.

This study uses Data Envelopment Analysis to decompose the profit change of Taiwan's semiconductor industry. Following Grifell and Lovell(1999), firstly, the profit change will be decomposed into the price effect and the quantity effect. Secondly, the quantity effect will be decomposed into the productivity effect and the activity effect; the productivity effect will be decomposed into the operating efficiency effect and the technical change effect; while the activity effect will be decomposed into the scale effect, the resource mix effect and the product mix effect. From this study, we hope that the decomposition results of the profit change can provide useful information to the managers of Taiwan's semiconductor industry to the establishment of future profit enhancement strategies.

METHODOLOGY

The Production Technology

We consider a business using N resources represented by the nonnegative input quantity vector $x=(x_1,...,x_N)$to produce M products represented by the nonnegative output quantity vector $y=(y_1,...,y_M)$. The business pays resource prices represented by the strictly positive input price vector $w=(w_1,...,w_N)$, and receives product prices represented by the strictly positive output price vector $p=(p_1,...,p_M)$. These prices may be exogenously determined by the forces of market competition, or by a regulatory agency, or they may be endogenously determined by the business itself. Business profit in period t, π^t, is defined as the difference between total revenue and total cost, and $\pi^t = p^t \times y^t - w^t \times x^t = \sum_i p_i^t y_i^t - \sum_i w_i^t x_i^t$, $t=1,2,...,T$. We are interested in identifying the determinants of the change in profit from one period to the next, ($\pi^{t+1} - \pi^t$), which can be positive, zero, or negative.
We now provide the structure of production technology. The production set in period t is the set of output quantity vectors and input quantity vectors that is feasible with technology in place in period t :

$$S^t = \{ (y^t, x^t) : y^t \text{is producible with } x^t \}, \quad t=1,2,...,T$$

An output set is the set of all output quantity vectors that are producible with a given input quantity vector and with the technology in place, and is defined in terms of S^t as following:

$$P^t(x^t) = \{ y^t : (y^t, x^t) \in S^t \}, t=1,2,...,T$$

Output sets are assumed to be closed and convex, and to satisfy strong disposability of outputs. The outer boundary of an output set is its output isoquant

$$\text{Isoq } P^t(x^t) = \{ y^t : y^t \in P^t(x^t), \lambda y^t \notin P^t(x^t), \lambda > 1 \}, t=1,2,...,T$$

The output sets [$P^t(x^t)$ or $P^{t+1}(x^{t+1})$] are within-period output sets containing the set of output quantity vectors which could be produced by an input quantity vector with technology prevailing in that same period. We also make use of the mixed-period output sets $P^{t+1}(x^t)$, which contain the hypothetical but analytically useful set of output quantity vectors which input quantity vector x^t could have produced with the help of technology prevailing in the subsequent period $t + 1$; and $P^t(x^{t+1})$, which contains the equally hypothetical and equally useful set of output quantity vectors which input quantity vector x^{t+1} could have produced had

it been forced to use technology prevailing in the previous period t. Mixed-period output isoquants Isoq $P^{t+1}(x^t)$ and *Isoq* $P^t(x^{t+1})$ are the outer boundaries of these mixed-period output sets, and are interpreted similarly.
An output quantity vector y^t must belong to its contemporaneous output set $P^t(x^t)$, but it need not be located on its outer boundary Isoq $P^t(x^t)$. We need a measure of the distance from an output quantity vector y^t to Isoq $P^t(x^t)$.
A within-period output distance function is defined in terms of a within-period output set as
$D_o^t(x^t, y^t) = \min\{\phi : y^t / \phi \in P^t(x^t)\}$
$D_o^t(x^t, y^t) \le 1$ because $y^t \in P^t(x^t)$, and $D_o^t(x^t, y^t) = 1$ mean $y^t \in Isoq\ P^t(x^t)$. Thus $D_o^t(x^t, y^t) = 1$ signals that x^t is producing maximum feasible output with technology prevailing in period *t*, and $D_o^t(x^t, y^t) < 1$ suggests that x^t is producing only $[100 \times D_o^t(x^t, y^t)]\%$ of maximum feasible output with technology prevailing in period *t*.

An *input set* is the set of all input quantity vectors capable of producing a given output quantity vector with technology prevailing at the time, and so
$L^t(y^t) = \{x^t : (x^t, y^t) \in S^t\}, t = 1,2,...,T$

Input sets are assumed to be closed and convex and to satisfy strong disposability of inputs. The inner boundary of the input set is its *input isoquant*
$Isoq\ L^t(y^t) = \{x^t : x^t \in L^t(y^t),\ \lambda x^t \notin L^t(y^t),\ \lambda < 1\}, t = 1,2,...,T$

Mixed-period input sets $L^{t+1}(y^t)$ and $L^t(y^{t+1})$ are defined exactly as mixed-period output sets ,and mixed-period input isoquants Isoq $L^{t+1}(y^t)$ and Isoq $L^t(y^{t+1})$ are defined as mixed-period output isoquants. Although an input quantity vector x^t must belong to the input set $L^t(y^t)$, it need not necessarily belong to its inner boundary Isoq $L^t(y^t)$.

An input distance function, which is the reciprocal of the Debreu–Farrell input-oriented measure of operating efficiency, provides a radial measure of the distance from an input quantity vector to an input isoquant. It is defined as:
$D_i^t(y^t, x^t) = \max\{\theta : x^t / \theta \in L^t(y^t)\}$
$D_i^t(x^t, y^t) \ge 1$ since $x^t \in L^t(y^t)$, and $D_i^t(x^t, y^t) = 1 \Leftrightarrow x^t \in Isoq\ L^t(y^t)$. Mixed-period input distance functions $D_i^{t+1}(x^t, y^t)$ and $D_i^t(x^{t+1}, y^{t+1})$ are defined in the same manner as mixed-period output distance functions, and $D_i^{t+1}(x^t, y^t) \gtreqless 1$ and $D_i^t(x^{t+1}, y^{t+1}) \gtreqless 1$.

Profit Change Decomposition

In this section, we will decompose business profit change between periods *t* and *t* + 1. The method is to proceed in three stages, which are described in Figure 1. In the first stage we decompose the profit change resulting from a movement from (x^t, y^t) to (x^{t+1}, y^{t+1}) into a pure quantity effect that holds prices constant, and a pure price effect that holds quantities constant.

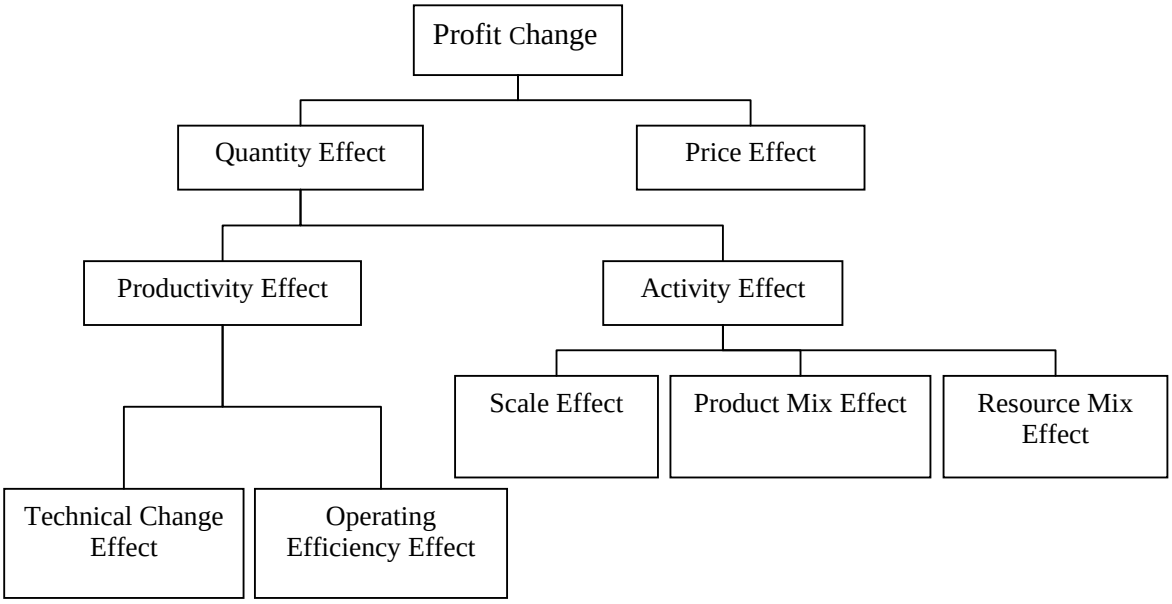

Figure 1. The Profit Chang decomposition

1. The profit change between period t and period t + 1 decomposes as:

$$\pi^{t+1} - \pi^{t} = \left[p^{t} \times \left(y^{t+1} - y^{t}\right) - w^{t} \times \left(x^{t+1} - x^{t}\right)\right] + \left[\left(p^{t+1} - p^{t}\right) \times y^{t+1} - \left(w^{t+1} - w^{t}\right) \times x^{t+1}\right]$$

quantity effect ***price effect***.

The profit change between period t and period t + 1 decomposes as quantity effect and price effect. The quantity effect shows the impact on profit of an expansion or contraction of the business, holding prices fixed. The price effect shows the impact on profit of changes in the price structure of the business, holding quantities fixed.

2. The quantity effect between period t and period t + 1 decomposes as

$$\left[p^{t} \times \left(y^{t+1} - y^{t}\right) - w^{t} \times \left(x^{t+1} - x^{t}\right)\right]$$
$$= \left[\left(p^{t}\right) \times \left(y^{B} - y^{t}\right) - \left(p^{t}\right) \times \left(y^{C} - y^{t+1}\right)\right] + \left[\left(p^{t}\right) \times \left(y^{C} - y^{B}\right) - \left(w^{t}\right) \times \left(x^{t+1} - x^{t}\right)\right]$$

productivity effect ***activity effect.***

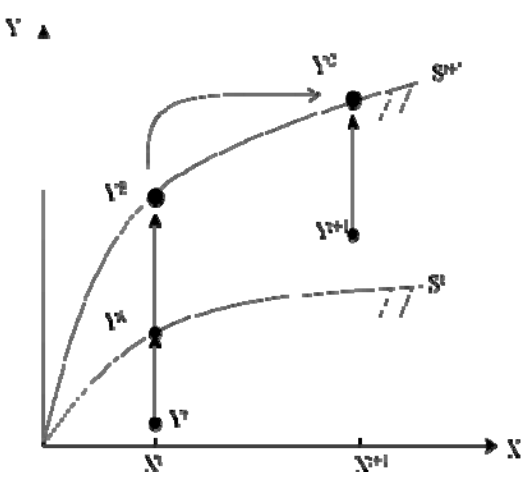

Figure 2 The Profit Decomposition (M = N = 1)

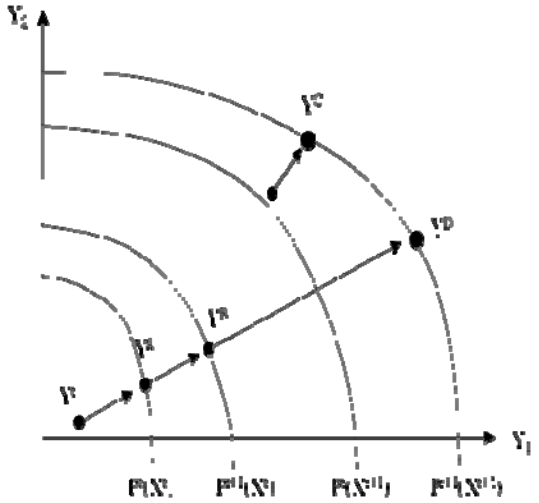

Figure 3. The Profit Decomposition (M = 2)

Figure 2 assumed that $M = N = 1$, it provides a picture of decomposition of the quantity effect. In period t (x^t, y^t) $\in S^t$ and in period $t + 1$ (x^{t+1}, y^{t+1}) $\in S^{t+1}$. The track from (x^t, y^t) to (x^{t+1}, y^{t+1}) can be decomposed into three components and this exerts an influence on profit change, with importance and guidance depending on the prices and how they change from the base period to the comparison period.

The activity effect is measured along the path from y^B to y^C, and represents the change in output ($y^C - y^B$) caused by the change in resource utilization ($x^{t+1} - x^t$). It appears that if output production increases proportionately more (less) than resource usage does then scale economies (diseconomies) cause the activity effect to contribute positively (negatively) to profit change. The activity effect is generally conceived as reflecting the consequence of changes in the scale and scope of the organization. However, there is more to the activity effect than just economies or diseconomies of scale, since the scope size of the activity effect has yet to be introduced. Moreover, both the output change and the input change are weighted by base period prices, and so the price structure matters as well. The productivity effect compares the path from y^B to y^t in period t with the path from y^C to y^{t+1} in period $t + 1$. Although (x^t, y^t) and (x^{t+1}, y^{t+1}) are observed but the output quantity vectors y^B and y^C are unobserved. Consequently, in order to make this decomposition procedure empirically useful, it is necessary to be able to find the unobserved output quantity vectors from the observed quantity data.

3. The productivity effect between period t and period t + 1 decomposes as $\left[\left(p^t\right)\times\left(y^B - y^t\right) - \left(p^t\right)\times\left(y^C - y^{t+1}\right)\right]$

$$= \left[\left(p^t\right)\times\left(y^B - y^A\right)\right] - \left[\left(p^t\right)\times\left(y^C - y^{t+1}\right) - \left(p^t\right)\times\left(y^A - y^t\right)\right]$$

technical change effect ***operating efficiency effect***.

The decomposition of the productivity effect is illustrated in Figure 2. Both the technical change effect and the operating efficiency effect influence the revenue side of profit change.

The technical change effect is the increase in output quantity ($y^B - y^A$) allowed by the improvement in technology, the output quantity increase being measured with base period output prices. The operating efficiency effect is compared the difference between period productive inefficiency ($y^C - y^{t+1}$) and base period productive inefficiency ($y^A - y^t$), both evaluated at base period output prices. The decomposition of the productivity effect is also illustrated in Figure 3. In Figure 3, which allows M = 2, the technical change effect is the equiproportionate increase in output quantities ($y^B - y^A$) allowed by the improvement in technology [$P^{t+1}(x^t) \supset P^t(x^t)$], measured with base period output prices. The operating efficiency effect is the difference between comparison period productive inefficiency ($y^C - y^{t+1}$) and base period productive inefficiency ($y^A - y^t$) are evaluated at base period output prices.

4. The activity effect from period t to period t + 1 decomposes as

$$\left[\left(p^t\right)\times\left(y^C - y^B\right) - \left(w^t\right)\times\left(x^{t+1} - x^t\right)\right]$$
$$= \left[\left(p^t\right)\times\left(y^C - y^D\right)\right] - \left[\left(w^t\right)\times\left(x^{t+1} - x^t\right)\right] + \left[\left(p^t\right)\times\left(y^D - y^B\right) - \left(w^t\right)\times\left(x^E - x^t\right)\right]$$

product mix effect resource mix effect scale effect.

The decomposition of the activity effect is not adequately illustrated in Figure 2, because the movement from y^B to y^C combines the scale effect with the product mix effect and the corresponding movement from x^t to x^{t+1} combines the scale effect with the resource mix effect. The scale and product mix effects are disentangled in Figure 3. In Figure 3 the output side of the scale effect holds the product mix fixed along the path from y^B to y^D which used base period output prices to estimate the adjustment, as input use increases from x^t to x^{t+1}. The product mix effect is measured along the path from y^D to y^C which used base period output prices to evaluate the adjustment. The sum of the scale effect and the product mix effect produces a movement from y^B to y^C, which corresponds to the output side of the activity effect.

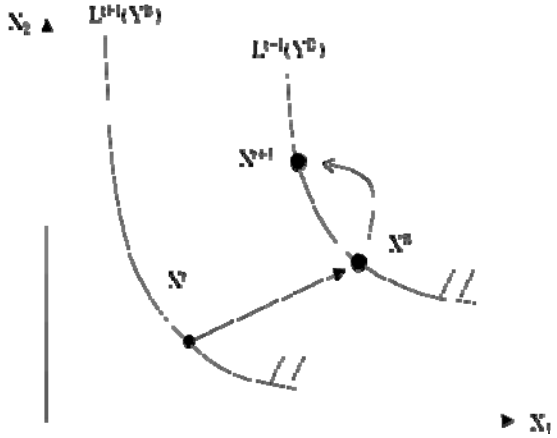

Figure 4 The Profit Decomposition (N = 2)

The final decomposition is illustrated in Figure 4, partial because the output quantity vector is fixed either at y^B or at y^D. In Figure 4, which allows N = 2, the input side of the scale effect holds the resource mix fixed along the path from x^t to x^E using base period input prices to evaluate the adjustment. The resource mix effect is measured along the path from x^E to x^{t+1}, it

also use base period input prices to evaluate the adjustment. The total of the scale effect and the resource mix effect produces a movement from x^t to x^{t+1}, which corresponds to the input side of the activity effect.

Decomposition step 1-4 and Figures 2–4 aim to prove that is possible to decompose the profit change come of producer's movement from (x^t, y^t) to (x^{t+1}, y^{t+1}) into several sources in principle, even in the multiple input and multiple output case. Through the profit change dismantling process, profit change can decompose into the six major sources: price effects, operating efficiency effect, technical change effect, scale effect, resource mix effect and product mix effects. And the six sources are mutually exclusive and exhaustive sources of profit change between period t and period $t + 1$.

EMPIRICAL RESULTS

The data are from the Taiwan Semiconductor Firms' List published by Taiwan Semiconductor Industry Promotion Office. And we use the Grifell-Tatjé and Lovell's (1999) profit change decomposition methodology to analyze the performance changes in semiconductor design, fabrications, packaging and testing firms in Taiwan for the period for 2005- 2007. There are 92 companies in this category, and the calculations are based upon two inputs: operating cost, employees, and two outputs: domestic value, export value. All data were retrieved from Taiwan Economics News Service (http://tej.com.tw) and Market Observation Post System (http://newmops.tse.com.tw). The data presented in this paper has been normalized and/or transformed as required.

Table 2.Profit Change Decomposition for Taiwan Semiconductor industry during 2005–2007

Unit: Thousand NT$

Year	profit change	=	quantity effect	+	price effect
2005-2006	13,747,143		11,048,507		2,698,636
2006-2007	55,968,320		60,115,250		-4,146,930
Average	34,857,732		35,581,879		-724,147

In table 1, the profit change is positive in 2005-2007 most of profit coming from quantity effect. On the average, quantity effect is a positive effect and price effect is a negative effect to the profit.

Table 3.Quantity effect decomposition for Taiwan Semiconductor industry during 2005–2007

Unit: Thousand NT$

Year	quantity effect	=	productivity effect	+	activity effect
2005-2006	11,048,507		5,094,729		-5,953,778
2006-2007	60,115,250		31,673,261		-28,441,989
Average	35,581,879		18,383,995		-17,197,884

The productivity effect has contributed positively to quantity effect however activity effect has contributed negatively to quantity effect in every year 2005–2007.

Table 4.Productivity effect decomposition for Taiwan Semiconductor industry during 2005–2007

Unit: Thousand NT$

Year	productivity effect	=	technical change effect	+	operating efficiency effect
2005-2006	5,094,729		39,843,666		34,748,937
2006-2007	31,673,261		72,710,528		41,037,267
Average	18,383,995		56,277,097		37,893,102

The technical change effect in every year is positive effect as well as operating efficiency effect. The technical change effect and operating efficiency effect have contributed positively to productivity effect in every year 2005–2007. Generally, the productivity effect was positive contribution to profit change.

Table 4.Activity effect decomposition for Taiwan Semiconductor industry during 2005–2007

Unit: Thousand NT$

Year	activity effect	=	product mix effect	+	resource mix effect	+	scale effect
2005-2006	-5,953,778		3,569,425		7,926,072		-1,597,131
2006-2007	-28,441,989		-23,840,348		5,722,888		1,121,246
Average	-17,197,884		-10,135,462		6824480		-237943

Table 4 indicates the product mix and resource mix effects are positive contribution but the scale effect is negative during 2005-2006; the scale effect and resource mix effect are positive contribution but the product mix effect is negative during 2006-2007. Generally, the resource mix effect was positive contribution however the product mix and scale effect were negative contribution to activity effect.

CONCLUSION

This study applies the profit decomposition approach employed by Grifell-Tatjé and Lovell (1999) to decompose the profit change in order to obtain in-depth information by analyzing each individual component. This study has explained the profit decompositions using data describing the operations of a sample of Taiwan Semiconductor Firms. We are able to implement the decompositions for each firm and the results of the decomposition of the profit change can provide useful information to the managers of Taiwan's semiconductor industry to the establishment of future profit enhancement strategies. In this paper, the result indicates average profit change is positive in Taiwan Semiconductor industry during a period of 2005-2007; the quantity effect, productivity effect, technical change effect, operating efficiency effect and resource mix effect are positive; the price effect, activity effect, product mix effect and scale effect are negative to profit change.

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INNOVATION TRIGGERS AND ROLE OF INDIAN EDUCATIONAL INSTITUTES.

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ABSTRACT

In the new millennium the daunting challenge of eradicating unemployment and underemployment among educated youths should be accepted collectively by the Government, Universities, Business Schools, Students and Industrial forums. Universities are centres of learning and have always been places where the skills and knowledge of students are chiseled to suit the requirements of the work place. The interactions of the students of the University with local industry and several socio-economic organizations would be useful in understanding the dynamics of business. 'Globalization' has created an inter-related and an inter-linked world, generating opportunities and also throwing up challenges. In order to cope up with these challenges education system must respond to these changes and without compromising on quality. Keeping in view the technological change and impact of globalization on job requirements, innovative approach in the design of the curriculum, organizational policies and practices and of course faculty attitude need to be modified. Using US model of reaping 70% of GNI from Small Businesses, India should also take a coordinated and integrated approach in executing the already framed plans in true spirit to excel by transforming job-seekers into job-providers. The role of educational institutes is undoubtedly to enhance students' knowledge which helps them to earn their bread and butter. Students who join various courses will have apprehensions regarding their career prospects. Institutions, on the other hand need to provide curricula that can match Industry i.e. expectations and add value to education. This calls for innovative ways of doing things. This paper describes the initiative of Indian Universitys in general and Manipal University in particular to transform knowledge of students and faculty towards building an innovative world through BOP experiment.

Keywords: Entrepreneurship, positive environment, Gross National Income, Base of the Pyramid (BoP).

Innovation triggers and Role of Indian Educational Institutes.

"Preparing today's students for success and eventual leadership in the new global marketplace is one of the most important responsibilities in education today.
-**John T. Chambers,** Chairman and CEO, Cisco

Universities aiming at world class standards would act as exemplars for other universities in benchmarking standards of teaching and research to those prevailing in the best universities in the world. There is no doubt that India possesses a number of educational institutions that have made their mark, and will continue to make their mark, on the world stage. But the rise of this country to become one of world's economic powerhouses begs for expansion in

India's higher education system. India is already the world's largest democracy. In two decades, it will be the most populated country in the planet, and by 2050, it is likely to become the second largest economy in the world.

The process of globalization along with rapid advances in Science and Technology has created an inter-related and an inter-linked world, generating opportunities and also throwing up challenges. In order to cope up with these challenges, education system must respond to these changes without compromise on quality. Quality faculty is important to maintain high standards of Universities, so that world class graduates, post-graduates and Doctoral students are produced. This is the challenge of the future, which all Indian Universities have to overcome jointly with the Government. Universities are centres of learning and have always been places where the skills and knowledge of students are chiseled to suit the requirements of the work place. The interactions of the students of the University with local industry and several socio-economic organizations would be useful in understanding the dynamics of business. Keeping in view the technological change and impact of globalization on job requirements, innovative approach in the design of the curriculum, organizational policies and practices and of course faculty attitude need to be modified. Using US model of reaping 70% of GNI from Small Businesses, India should also take a coordinated and integrated approach in executing the already framed plans in true spirit to excel by transforming job-seekers into job-providers. The role of educational institutes is undoubtedly to enhance students' knowledge which helps them to earn their bread and butter. Students who join various courses will have apprehensions regarding their career prospects. Institutions, on the other hand need to provide curricula that can match Industry i.e. expectations and add value to education. This calls for innovative ways of doing things. India has the necessary potential to become a global leader in the knowledge economy. However, this cannot be achieved without the universities playing a prominent and leading role. Globally, higher education is poised to become more responsive to societal needs. Although many developments have taken place in the Indian higher education system, it still has to come to terms with modern society.

The Role of Universities:

-Need for innovation and skill oriented education:

In the words of Honorable President of India, Mrs Prathibha Patil –
"In India the problem is more of employability, than of unemployment. The skills that people have are not appropriate for securing employment. Universities are centers of learning and have always been places where the skills and knowledge of students are chiseled to suit the requirements of the work place. Universities help a nation in giving it economic vitality, scientific prowess, a broad outline of social change and global competitiveness, through innovation and research".

With 54 crore youth, India has one of the largest young populations of the world. A nation, that is growing, requires a talented and well trained population to harness opportunities into visible and concrete results. Globally, higher education is poised to become more responsive to societal needs. The university outreach programme concept is fast picking up globally, and many universities use it for community development and building relationships with

industries. The need is to find ways of use the 'whole' university, incorporating the various recent developments and meeting the requirements of various stakeholders of higher education.

R&D and India- need for Innovation

In India the system of innovation remains rather weak and fragmented (Chaminade and Vang, 2006a and 2006b, Vang et al 2007). The collaboration with other firms, final users or universities is very limited. And the importance of the home market neglectable. Even though India is catching up in terms of accumulating S&T capabilities, the capacity to transform those resources into new products and new services is still rather limited.

According to the famous columnist Thomas L. Friedman (Friedman, 2005). China and India will become the new innovation power houses of the world. Indeed, in just one decade the number of firms locating R&D departments in India and China has grown very rapidly. In 2005 China and India were hosting 18% of the world R&D sites (only 8% in 1997) (UNCTAD, 2005). Only that year, 252 new foreign direct investments in R&D projects were located in China & India (80% of South, East and SE Asia). India is currently considered to be the second most popular destination of offshore R&D for certain industries (The Economist Intelligent Unit, 2007). Looking at this numbers, there is no doubt that there is something happening in that corner of the world and that there are reasons to be watchful. There is a very extensive stream of literature on innovation studies that highlights that there is a very long way between investments in research (R&D) and innovation (launching new products, processes or services in the market). Innovation is definitively not a linear process that starts with R&D but is the result of a complex interactive process (Kline and Rosenberg, 1984), where new ideas emerge as a result of the interaction with universities, other firms, etc.

Role of Universities in Innovation:

Mr Kapil Sibal, Minister for Higher Education opines that A great research university is not built from the bricks and mortar of its campus, but of the students and scholars who inhabit it, and the discourse and ideas they share. A university exists not for the purpose of handing out diplomas to those who go through its doors, but to advance knowledge and to educate young people to become critical thinkers and society's leaders. A world-class university avails its students not just of courses of study, but of an environment that facilitates learning and growth in all areas of human endeavor. At the most fundamental level, a world-class university contributes to the world in three ways: through research, through education, and through institutional citizenship.

First, by facilitating advancements in science, technology, and medicine, research universities help spur economic prosperity and the advancement in the health and quality of life in communities across the world.

Second, by educating students, great universities prepare the next generation of leaders, leaders who will be able to tackle new problems and new situations with maturity and flexibility and who see the world with curiosity and an open mind.

Third, by acting as models of institutional citizenship, world-class universities contribute to the betterment of society and instill in their students social responsibility and an appreciation of service to their communities.

How to achieve it:

-Inspiring innovation

In a "knowledge economy," nations prosper by virtue of their capacity to innovate – to develop and introduce new products, processes, services, and even, new ways of thinking. The extent to which such innovation happens is a function of the continuing advance of science. As the principal source of basic research, comprehensive universities play a fundamental and irreplaceable role in encouraging economic development and national competitiveness. This basic research is motivated by the quest for intellectual discovery, not some practical objective-but in the long run, it is the wellspring for all commercially oriented research and development. That fact, that fundamental research occurs within the university – rather than in government laboratories, non-teaching research institutes, or private industry – is an essential element of allowing a university to realize its full potential. When researchers are isolated in research institutes, students – especially undergraduates are deprived of exposure to first-rate scientists, their methods, and their research.

The research undertaken in universities must not stay in the academic buildings and laboratories where it is born. To drive national innovation, it must move from theory to practice, and the university plays a key role in this process as well. Engagement with industry is a central function of the modem research university, as commercializing faculty inventions benefits both the university and the broader society.

-Training future leaders

Second, just as faculty members contribute, through their scholarship and research, to the intellectual vigor of their nation and the world, they also serve to shape the future leaders of their nation and, again, the world. The phrase "the knowledge economy" that is so often spoken about would seem to suggest that universities impart to young people what is most obvious – that is, knowledge. But the best universities do not practice the mere transfer of knowledge from teacher to student. They focus not on the mastery of content, but on the development of their students' capacity for independent, critical thinking.

Universities exist to teach young people how to think, not what to think. Professors must serve as mentors, as sources of inspiration, not merely as lecturers and graders. Students, too, should not find their development limited to the classroom.

- Bettering society

A university leads by example, both in its local community and in the-world. Acts of institutional citizenship have benefits on two levels: they represent a positive force for human welfare, and they also inspire students to embrace social responsibility in their own lives. The global economy places great emphasis on science-rooted technologies. Hence university-

educated students and university–industry research collaborations have become the focus of future plans of both government and industry worldwide. Traditional academic and business cultures have begun to accommodate each other in mutually supportive arrangements in the larger interests of a global economy.

Manipal University and BOP Initiative:

Manipal University is a name to remember, not just across the length and breadth of India, but worldwide. The fact that students from 52 countries are studying here is a testimony to this fame. Fired by the desire to provide health care and other essential services to the people of this region, Dr TMA Pai transformed the plateau into what it now is. He turned the wilderness into a sanctuary of education.

Located on the west coast of South India, Manipal was a barren wasteland, a plateau with wild animals. It was this plateau that Dr TMA Pai decided to change. His vision for Manipal covered a wide spectrum of interests because he himself donned many hats. Then in 1993, MAHE was accorded a deemed university status under Section 3 of the UGC Act 1956, by the Ministry of Human Resource Development, Government of India. Today, it has 20 constituent institutions comprising medical, dental, engineering, architecture, nursing, allied health, pharmacy, management, communication, information science, hotel management, biotechnology, regenerative medicine etc. The university offers Bachelors', Masters' and Doctoral degrees in various specialties.
The University provides excellent educational facilities to over 17,000 students in its constituent colleges. It also has an active alumni base of over 65,000 students across the world.

With all the experience gained from producing several thousands of graduates, backed by experienced faculty, excellent academic and clinical facilities, Manipal University boasts of an educational environment with a touch of world class.

Manipal University is providing the finest infrastructure and facilities to its students for learning and research. In fact some of the facilities, like the Innovation Centre, have served as a valuable 'incubation centre' for industry and research. The state-of-the art innovation centre bridges the gap between university and industries for industrial academic research.

Base of the Pyramid (BOP) Approach:

Over the past three years, Manipal University and Philips have been working together to acquire a greater understanding of the challenges and opportunities in addressing the emerging consumer, earlier known as Base of the Pyramid. A chair was setup at Manipal University to promote- Idea Generation, Concept Development, Research, Community Development, Rural Linkages and Student Exchange programmes. This partnership started with more funding of projects at Manipal University. This attempt has now matured to include ideation, market data collection and prototyping of ideas into proofs of concepts. Philips brought to the table the industry perspective on commercialization of ideas, concepts on IP generation, infrastructure and access to the best talent within the company. In turn Manipal University contributed diversity of disciplines that is unique to a well-grown

University. We have experts from technical, managerial, life science and healthcare sitting around the same table creating ideas and solutions for the prospective consumers.
Both Philips and Manipal University have shared this experience with other likeminded parties from industries, the academia, NGOs and Government Organisations. The ambition is to create an ecosystem built around ' Open Innovation' that will ultimately meet the aspirations of emerging consumers. This has resulted in the collaboration with other organizations such as MS Swaminathan Research Foundation (MSSRF), kTwo Technology Solutions, Intel, Electrocare Systems and Perfint Health care Solutions, Nokia Research, Intellectual Ventures etc. in this program.

The Innovation platform at Manipal

Avishkara (Idea Generation): The broader theme for the awareness session is ' development of cost effective solutions and services for emerging consumer segment'. Over a period of time Manipal BOP has developed a platform which helps Idea Generation, Submission, Evaluation and shortlisting of the ideas. It has also built a cross disciplinary team consisting of students and staff from various disciplines such as science, engineering and Management groups. So far approximately 220 ideas in the areas of healthcare, lifestyle, education, energy, nutrition, community development have been selected for the processing. Each one is a new business idea and can be translated into a product or service.

Ankura (Proof of Concept): The purpose of this exercise is to develop ' Proof of Concept' through knowledge integration. The concept development project activities are carried out in 'multi-disciplinary customer centric innovation' with student interns sponsored by industry. The tasks are mainly concept enrichments based on a User Need Analysis, Technology development and Patent and Design. Under this programme, nearly 20 concepts have been developed through multi-disciplinary teams comprising medical, technology and management teams.

Arpana (Market Analysis and BOP knowledge development) : The basic idea behind this programme is understanding the pulse of BOP community and providing the solutions at the grassroots level. Various projects are undertaken to carryout the following:

- User research study for designing the solutions for BOP
- Market analysis to understand the felt needs at the grassroot level
- Process model for Local development of the products
- Development of BOP knowledge base.

As a result of the above programme, more than 40 studies have taken place to identify market trends, 15 user research studies for designing products for BOP consumers, enabling IT for Manipal Rural health care delivery model, publication of Book on BOP integrated approach and knowledge portal.

Role of Manipal University

Manipal University has taken the initiative to make several innovations in nurturing student's innovative capabilities through BoP platform.

Idea Generation workshops, Student Internship Programmes, Problem Based Student Projects, Research to Product Scheme are a few to highlight. All constituent institutes take part in the programmes and hence provide a wide spectrum of interested student and faculty stream. It has experimented a novel idea of ideation workshops, wherein, societal problems are kept in mind. Each institute while conducting their Ideation Workshops takes into account their field of interest, available resources and social problems to be addressed. It is a multi disciplinary approach where any short fall in the resources will be discussed with other institutes through a mechanism and thus will be able to carry forward the idea germinated to the next level.

The experience

Students of various disciplines were grouped taking into account their educational background. Accordingly, each heterogeneous group was made to understand the problems of the given theme and find out the best solution to it in terms of a product or service. The exercise was carried out on a weekly basis and the outcomes were recorded. In each stage of a new idea, faculty experts in the said field accompanied students' groups in polishing the idea germination stream. The ideas, after screening by the faculty experts were tried into their technical and other necessary requirements in the second stage of workshop. The result was so productive that almost 14 ideas only in the field of child and health care could be transformed into a product/ service. The rest of teams who were entrusted with the work of Market Research now became active to sense the marketability of such new products. Hence, Institutes of Manipal University has been contributing its inputs and expertise in the operation of BOP initiative of Manipal University. The role of each institute is to provide expertise and from the operational view point, each institute has a Coordinator to who will provide useful link to other teams for expert services.

The Basic MANTRA followed:

1. Explicit the assumptions: To unlock innovation one should start by exposing the rules and behaviors inside one's institution that might be hindering innovation in the first place. Often times more important than getting answers is asking the right questions.
2. Challenge the assumptions: The second step is to challenge the outlined assumptions. Ask oneself "what if we decided to do the complete opposite?".
3. Welcome failures: One need to pursue failure to innovate and consequently to succeed.
4. Use multiple sources of innovation: Innovation can emerge from anybody surrounding us. Keeping eyes, ears open to explore new idea is the mantra of success.
5. Go beyond product innovation: Instead of focusing exclusively on product innovation one should think how they can innovate their processes, their structure, their business model and even their market.
6. Spot changes both as threats and opportunities: Each time focus on threat and apply reverse thinking process to modify the threat part of the idea.
7. Execute: Good ideas come from acting and not from thinking. Many people sit in front of the drawing table and try to come up with the so-called "killer application" or the "next big thing". This is a plain waste of time.

Learning's for the Constituent Institutes:

Through the above exercises, Each Institute could deliver right kind of goods to its students. As it is clear that students' expectations are very high when they join the course, they were highly satisfied when they were asked about their experience in such workshops. This type of exercise is very useful in attaining the vision of the institute and thus goes along with University Mission. The reality is as a University, it could oblige the students by providing the following:-

1. The alternative for job: Students, instead of job oriented study, will focus on strengthening their innovative skills. In due course of time, they can be best- suited to any kind of situations.
2. Employability: The employability and marketability increases compared to any other traditional Universities.
3. Knowledge pooling: With lots of fellow team members, students' capacity to pool knowledge increases. At the same time, University can also make use of such information as the base of future activities.
4. Interesting and interactive sessions: More focus on interaction can be given and thus even the class rooms become their laboratory.
5. Healthy environment and understanding between Constituent Institutes
6. Friendly Faculty-student relationship through out the University
7. Innovative spirit among the student community
8. Positive contribution to the social and economical problems.

Learning for the University:

Manipal University could achieve success in delivering Knowledge due to its committed and concerned effort. In the process the following emerged as the results:

1. Multi disciplinary team: A multi disciplinary team comprising of experts from Medicine, Engineering, Information System, Industry and Management is available for projects and consultancy.
2. Research to Product: Faculty and students concentrate more on issue based research and such articles published validate their concept thus leading to a new product or process.
3. Rural Based Study: With the BoP platform, exploring the potential market of BoP and providing useful community service is made possible. Students and faculty could gauge the real problems of rural people and could find out viable solution to them. In real sense this should be the priority of every Indian University.
4. Industry-Academia Linkage: Even though it is difficult to trace the primary-secondary relationship between Academics and Industry, in true sprit, both students and faculties do keep in touch with Industries for matters like Industrial projects, Student and Faculty exchange programmes, Board of Studies, etc.
5. NGO Linkages: Manipal University also has NGO linkage as the direct impact of BoP initiative.

CONCLUSION

The role of a University can be multidimensional in nature. Apart from producing a good number of graduates, it can also aim at producing good citizens who are capable of transforming present social, economical and political problems into opportunities. The students are mostly unaware of such opportunities and therefore it is the responsibility of every University to provide and nurture the innovative instinct of students admitted. If needed 'Innovative thinking and New idea generation' could be the part of the curriculum so that everybody will be in a position to experience the beauty of knowing one's own potential. Positive climate of such nature open up not only the students' innovative ability but also transform their ways of thinking in all parts of their life.

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A KM MODEL FOR ORGANIZATIONAL COMPETITIVENESS: VALIDATION THROUGH A CASE STUDY IN HIGHER EDUCATION

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ABSTRACT

Ju (2006) proposed a KM research framework for organizational competitiveness, which has the following characteristics:

- *KM consists of four distinct processes: knowledge creation/acquisition, storage/retrieval, sharing/dissemination, and utilization/enhancement. These processes can be carried out in any order.*
- *These KM processes are supported by four contextual elements: organization structure and culture, work practices, enabling technologies and tools, and individuals and Ba.*
- *Organization structure facilitates employee empowerment so that employees are compelled to acquire and utilize knowledge to solve their problems.*
- *Organization culture encourages employees to share knowledge with their colleagues. Leadership is instrumental in shaping such culture.*
- *Work practices are such that any task must be executed according to a standard operating procedure. If deficiency or improvement is found in an SOP, then the lessons learned must be documented for later update. Theses work practices facilitate knowledge utilization, creation, and enhancement.*
- *Enabling technologies and tools such as knowledge codification standards, knowledge repositories, intranet, semantic web, and application software, should facilitate knowledge storage, retrieval, transfer, and dissemination.*
- *Individual's expertise that is still in the form of tacit knowledge must be described in a database so that the individual can be called upon when needed. Ba is any setting or arrangement that facilitates knowledge creation and acquisition.*

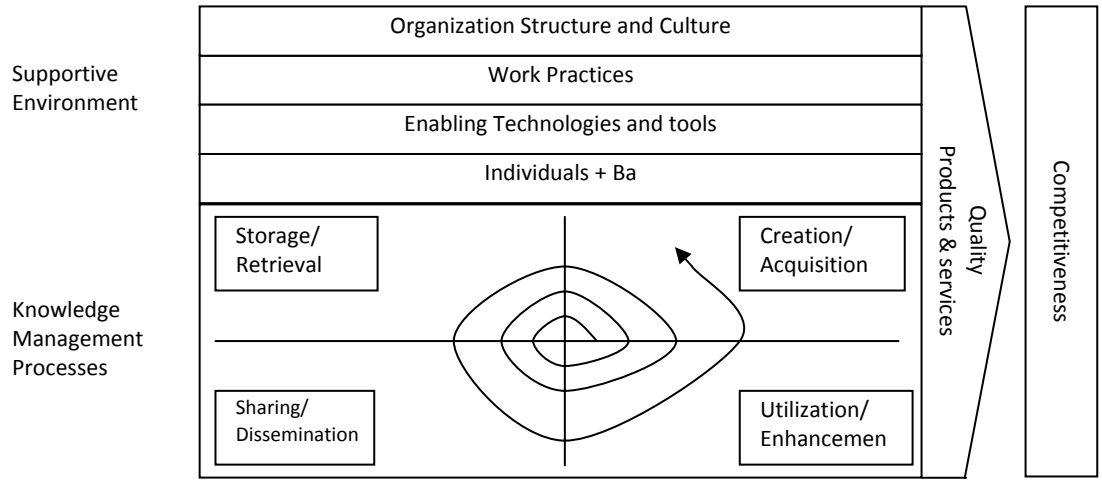
Ju's framework has every flavor of a KM model but it has not gone through rigorous empirical study. Therefore, this study develops four propositions and justifies its validity as a KM model.

Keywords: Knowledge management, Knowledge management Model, Organizational competitiveness

INTRODUCTION

Research interest in knowledge management (KM) has grown rapidly in academic and industrial communities. Utilizing knowledge accumulated in an organization can be a strategic weapon to acquire a competitive advantage. Today, KM becomes more important because globalization of business, leaner organization, organizational memory lost, and technological advance. Because of the emergent nature of the KM field, there is a lack of suitable and practical KM models to use in organizational applications.

Ju [11] proposes a research framework (hereafter called "the framework" for short) (Figure 1) to provide a context for developing a feasible and practical methodology for process-oriented KM. The framework describes the KM processes in an organization and a desirable supportive environment for the KM processes. The KM processes are performed for organization competitiveness; any activity may add value or provide input to another activity. In the supportive environment, the "Organization Structure and Culture" component fosters knowledge creation, use, sharing and innovation. The "Work Practices" component ensures that work-related insights and experiences are documented. The "Technology" component provides existing and emerging technologies for knowledge representation, storage, dissemination, utilization, etc. The "Individuals + Ba" component promotes the synergy between individuals and the settings in which knowledge creation, sharing, and innovation take place. These components provide across-the-board support to the KM processes



Source: Adapted from Ju (2006)

Figure 1 Ju's KM research framework

The framework resembles a KM model but lacks rigorous scrutiny. Therefore, this study will bridge the gap by answering the following research questions:

- How do we justify the framework as a valid KM model?
- Why organizational competitiveness can be attained or enhanced if the organization's KM practices subscribe to the KM model?

REVIEW OF LITERATURE

A pragmatic definition of data, information and knowledge

Data, information and knowledge are points along a continuum of increasing value and human contribution [3]. Data – the signals about human events and activities that we are exposed to each day – has little value in it self, although to its credit it is easy to store and manipulate on computers. Information is what data becomes when we as humans interpret and contextualize it. It is also the vehicle we use to express and communicate knowledge in business and in our lives. Information has more value than data and, at the same time, greater ambiguity – as any manager will attest who has ever argued over how many interpretations the terms "customer", "order" and "shipment" can have inside the same company. Knowledge is information within people's minds; without a knowing, self-aware person there is no knowledge. Knowledge is highly valuable, because humans create new ideas, insights and interpretations and apply these directly to information use and decision making.

Information Management vs. Knowledge Management

Information Management concerns how an organization can effectively acquire and utilize IT resources to develop superb IT capability, and combines this IT capability with other related capabilities within and outside of the organization to support organizational processes and management, which in turn will enhance organizational performance and competitiveness.

Because all knowledge starts as information, many companies regard KM as synonymous with IM. Carried to the extreme, such a perspective can result in the profoundly mistaken belief that the installation of a sophisticated information-technology infrastructure is the be-all and end-all of KM. Effective KM depends not merely on IT platforms but more broadly on the social ecology of an organization. [8]

Knowledge Management Essentials

KM dimensions and KM Methods

The bulk of current thinking about KM has four dimensions: "process", "type", "level" and "context" [4]:

- Process – Thoughts are not spring into existence out of nothing, it is the result of a series of factors that come together over time.
- Type – Knowledge is not a simple, stable quantity. Different schools of philosophy and sociology give different accounts. Currently, the importance of tacit and explicit knowledge is recognized by managers and is the subject of considerable work within KM.
- Level – Individuals are the fundamental building blocks, particularly in knowledge-intensive systems, but most individuals accomplish their work in groups, using resources provided by the organization.
- Context – Fundamentally, nothing has any meaning outside a context – hence, where a piece of information is meaningful or not depends on its context. KM efforts should begin by specifying their meaning-making context(s) and build from there.

KM methods can be categorized into four styles: dyamic, system-, human-oriented, and passive [2]. The emphasis of the dynamic style is on both (i) knowledge reusability through information technologies and (ii) knowledge sharing through informal discussions among employees. This dynamic style results in higher performance. Human- and system-oriented styles do not show any difference in terms of corporate performance; the passive style is less effective. This outcome is in line with previous observations that both tacit and explicit knowledge are important in capitalizing on corporate knowledge.

Making knowledge visible

Three aspects of knowledge are, or can be made, visible. They are activities involving knowledge, outcomes based on knowledge, and investments in knowledge [20]:

(1) Knowledge activities that can be made visible
- The identification and development of informal networks and communities of practice within organizations. These self-organizing groups share work interests and passions, usually cutting across a company's functions and processes. Knowledge maps are valuable guides that can assist employees of large or medium-sized companies to ascertain who knows what.
- The development of symbols and signals that highlight the importance of knowledge.

(2) Knowledge outcomes that can be made visible
- Accumulation and use of patents, new drug approvals
- Product development and service innovation
- Cycle time, customer retention and measurable corporate reputation

(3) Knowledge investments that can be made visible
- How much technical and nontechnical training are individuals consuming?
- What is the rationale for purchasing groupware and collaboration technologies other than to improve knowledge flow?
- How much is invested in competitive and environmental scanning and in other forms of strategic research?

These visible manifestations of knowledge enable comparisons of knowledge projects within and across companies, as well as providing a base set of numbers (of people, currency, time, and so forth) from which to derive metric for evaluating knowledge efforts.

Effective KM

The continuous conversion of knowledge into information and information into knowledge is a key element of what companies must do to develop and apply knowledge successfully. If knowledge resides primarily in people and it is people who decide to create, use and share their ideas to attain business results, then KM is as much about managing people as it is about managing information and IT. Building an effective social environment within which people operate is a crucial requirement for effective KM. [3]

Fahey and Prusak [6] point out eleven deadliest sins of KM:

Error 1: Not developing a working definition of knowledge
Error 2: Emphasizing knowledge stock to the detriment of knowledge flow
Error 3: Viewing knowledge as existing predominantly outside the heads of individuals
Error 4: Not understanding that a fundamental intermediate purpose of managing knowledge is to create shared context
Error 5: Paying little heed to the role and importance of tacit knowledge
Error 6: Disentangling knowledge from its uses
Error 7: Downplaying thinking and reasoning
Error 8: Focusing on the past and the present and not the future
Error 9: Failing to recognize the importance of experimentation
Error 10: Substituting technological contact for human interface
Error 11: Seeking to develop direct measures of knowledge

Factors that influence KM in organizations include [10]:

- Managerial influences: leadership, coordination, control, measurement
- Resource influences: financial, human, material, knowledge
- Environmental influences: competition, fashion, markets, technology, time, and the government, economic, political, social, and educational climate.

Critical success factors of KM initiatives can be categorized into five primary categories [9]: leadership; culture; structure, roles, and responsibilities; information technology infrastructure; measurement.

Company approaches to KM

The truly distinctive aspects of KM fall into two key categories: the creation of knowledge and the use of knowledge. There is a strong connection between knowledge creation and innovation in product and service development. KM programs, therefore, are explicit attempts at:

- Designing and installing techniques and processes to create, protect and use explicit knowledge
- Designing and creating environments and activities to discover and release tacit knowledge
- Articulating the purpose and nature of managing knowledge as a resource, and embodying it in other initiatives and programs.

Some repositories included what might be called “information about knowledge”. This is information that guides the seeker to knowledge, whether in the form of a document or an expert. So-called “knowledge maps” and “knowledge yellow pages” or expertise directories describe a set of knowledge categories, the location of the knowledge and, in some cases, its condition and value

Applying KM in Higher Education

Higher education is a major sector dealing with knowledge. On the academia side, there are curriculums, monographs, publications, patents, etc. On the administration side, there are rules and regulations, directives, standard operating procedures, and other official documents. From human resource point of view, there is expertise related to academic knowhow and administrative knowhow. All of these artifacts and tacit knowledge contribute to organizational knowledge [11].

KM can be applied in higher education in the following ways [13]:

(1) For the research process, a repository of:
- Research interests within an institution or at affiliated institutions (potential subcontractors).
- Research results (where possible) and funding organizations (federal agencies, foundations, and corporations) with easy search capabilities to facilitate interdisciplinary opportunities.
- Commercial opportunities for research results.

(2) A portal for research administration procedures and best practices related to funding opportunities:
- Pre-populated proposals, budgets, and protocols.
- Proposal-routing policies and procedures.
- Award notification, account setup, and negotiation policies and procedures.
- Contract and grant management policies and procedures.
- Technical and financial report templates and policies and procedures.
- Overview of internal services, resources, and staff.

(3) For the curriculum development process
- Repository of curriculum revision efforts that includes research conducted, effectiveness measures, best practices, lessons learned, and so forth.
- Repository of content modularized and arranged to facilitate interdisciplinary curriculum design and development.
- Portal of information related to teaching and learning with technology, including faculty development opportunities, outcomes tracking, lessons learned, best practices, technology overviews, and so forth.
- "Hubs" of information in each disciplinary area, including updated materials, recent publications, applicable research, and so forth.
- Repository of pedagogy and assessment techniques, including best practices, outcomes tracking, faculty development opportunities, and research.
- Repository of analyzed student evaluations updated each semester for lessons learned and best practices for all faculty.
- Portal for new faculty with guides for developing curriculum, working with senior faculty, establishing effective teaching styles, advising do's and don'ts, supervising PhD students, and so forth.
- Repository of corporate relationships to identify curriculum design advisory task forces, guest speakers, adjuncts, case study sites, and so forth.

(4) For alumni services
- Portal for student services for both students and for faculty and staff at the institution so that they are well informed to advise students. Information could include policies and procedures related to admissions, financial aid, registration, degree audit, billing, payment process, advising and tutoring, housing, dining, and other services. This portal could be personalized for individual schools or student groups to customize service offerings.
- Portal for career placement services (potentially part of a large portal for all corporate connections) to provide a one-stop service center for students, but also for faculty and staff to ensure they are informed.
- Repository of student affairs services for faculty and staff to ensure all constituents understand existing services and can provide proper advising.
- Portal for alumni and development services to minimize redundant efforts; capture contact reports; and link to research, curriculum, and career development efforts.
- Portal for information on outreach constituents to integrate efforts and minimize redundant efforts.

(5) For administration services
- Portal for financial services (that is, budgeting and accounting) that includes FAQs, best practices, procedures, templates, and communities of interest to share information and serve as impetus for improvement efforts.
- Portal for procurement (that is, purchasing, accounts payable, receiving, warehousing) that includes FAQs, best practices, procedures, templates, and communities of interest (for example, by commodity, purchasing vehicle, vendor, and so forth) to share information and serve as impetus for improvement efforts (for example, leverage lessons learned from others in the institution, design on-line vendor sites such as Web-based catalogs).
- Portal for human resources (that is, vacancy-to-hire, payroll, affirmative action, and so forth) that includes FAQs, best practices, procedures, templates, and communities of interest to share information and serve as impetus for improvement efforts.

(6) For strategic planning
- Office of Knowledge Management, emerging from the previous Office of Institutional Research.
- Portal for internal information that catalogs the strategic plans, reports developed for external audiences (for example, IPEDS, accreditation reports), clear data definitions, presentations by executives, and so forth.
- Portal for external information, including benchmark studies, environmental scans, competitor data, links to research groups, higher education research groups and publications, presentations by executives, and so forth.
- Monthly “market watch” developed in tandem with Admissions, Continuing Education, Alumni and Development, and others that document key trends and potential implications.
- Repository of data related to accountability and outcomes tracking by monitoring assessments, performance indicators, benchmarking, and so forth.

Higher Education System in Taiwan

Higher education system in Taiwan is similar to the two-semester system in the U.S. but there are a few differences:

- All universities and colleges in Taiwan, whether they are government-funded or private-owned, are under the auspices of the Ministry of Education (MOE) [17].
- Their performance is evaluated periodically by MOE with a common set of performance criteria [16].

RESEARCH METHODOLOGY

Case Study Research

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. The case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points. Yin [21] identified relevant situations for five different research strategies: experiment, survey, archival analysis, history, and case study. If the form of research question is 'how?' or 'why?', if it doesn't require control of behavioral events, and if it focuses on contemporary events, then case study is a suitable research strategy. In this study, since KM takes place in real-life context and the research questions ask 'how' and 'why', therefore, case study research strategy is chosen.

Designing the Case Study

For case studies, five components of a research design are especially important [21]: its research questions; its propositions, if any; its unit(s) of analysis; the logic linking the data to the propositions; and the criteria for interpreting the findings. In this study, these components are manifested as:

Research questions

- How do we justify the framework as a valid KM model?
- Why organizational competitiveness can be attained or enhanced if the organization's KM practices subscribe to the KM model?

Propositions

Proposition 1: If the framework doest not cater to the critical issues addressed in the Review of Literature section, then it is not a valid KM model.

Proposition 2: If the framework doest not represent every legitimate KM practices in the case university, then it is not a valid KM model.

Proposition 3: If organizational competitiveness is not attained or enhanced even though the KM practices in the case university satisfy the conditions stated in the framework, then the framework is not a valid KM model.

Proposition 4: If an amended framework is rid of the above deficiencies, then it is a valid KM model.

Unit(s) of analysis

Since the universities and colleges in Taiwan are all under the auspices of MOE, their organizational structure and workflow are largely similar. Since they are evaluated and accredited by MOE with a common set of criteria, their organizational goal and constraints are also similar. Therefore, any university or college can be considered a representative or typical case. In this study, a university of science and technology has been chosen because the primary investigator of this study has close social connection with the key personnel of this case university, thus enjoys full cooperation from the interviewees and easy access to the relevant information for the case study.

Data collection covers both administrative and academic sides. Observation is carried out at the university level, and interview is conducted at the department level.

Logic linking the data to the propositions

To answer the research questions, this case study will be conducted in five phases:

(1) The framework is checked against the KM issues compiled in the Review of Literature section, and any deficiencies are amended.
(2) Evidence of KM practices is collected through observation and interview.
(3) The amended framework is checked against the evidence, and is further amended if any legitimate KM practice is not covered by the framework.
(4) Whether the evidences that subscribe to the amended framework foster organizational competitiveness is determined.
(5) If the (amended) framework fosters organizational competitiveness, then it can be justified as a valid KM model.

Criteria for interpreting the findings

In this study, any findings that are not directly related to organizational competitiveness will be discarded.

COLLECTING CASE STUDY EVIDENCE

Evidence collected falls in the 10 years of the founding president's tenure, from August 1994 through July 2003. Whatever happened during this period reflects the president's leadership. Also, many of the interviewees have taken different administrative positions through those years, thus afford a holistic perspective about and continuing involvement in the KM practices in the university.

Observation

The investigators gain a tentative overview of the case university by observing the work environment and scanning available documents. A good narrative about the case university is found in its 10th Anniversary Commemorative Edition.

Interview

Interviews are aimed at understanding the KM practices that are geared to organizational competitiveness; more specifically, to earn commendation from MOE's periodic evaluation, gain recognition in the academic community, and recruit top quality students.

Interviewees are key personnel of the university who have served in different capacities during the 10 years time. These interviewees and the titles they served are listed below:

- Dr. J (Vice president, Dean of the Academic Affairs, Chairman of the Department of Information Management)
- Dr. M (Dean of the Student Affairs, Director of the Center for General Education)
- Ms. O (Dean of the General Affairs, Secretarial General of the Secretarial Department, Director of the Personnel Department)
- Dr. H (Dean of the College of Management, Director of the Research and Technology Cooperation, Director of the Library and Information Center)
- Ms. H (Director of the Accounting Department)

As can be seen from this list, they have been the head of 12 administrative or academic departments, quite comprehensive and representative.

Interview questions are open-ended, based on the framework, and tied to the propositions. Responses from the interviews are summarized in the following categories:

About the supportive environment

- Leadership and Culture
  The president is fully aware of the power of IT and allocates sufficient investment in information infrastructure. All staff must be conversant with e-mail, Web browser, word processing, spreadsheet, and presentation software.

  He appoints many teachers from the Department of Information Management to key administrative positions because of their information management expertise. He also relies heavily on the vice president to play the role of CKO.

  Although the term "KM" is not often cited, uses of information for problem-solving and decision making are abundant.

- Structure and Incentives
  To streamline the use of information, the university has merged the library and the computing center into one Library and Information Center

There is a policy that hands out small prize for individuals who contribute ideas to streamline workflow.

- KM guidelines
  There are no KM guidelines in place.

- Work practices
  The administration side has implemented the ISO 9001 system, which requires standard operating procedure (SOP) for all routine tasks. Documentation update is strictly enforced.

  There is a policy for job rotation every three years.

- Enabling technology and tools
  The library and Information Center has maintained an integrated database and document repository, and an information portal. The latter is embedded in the university web site.

  Every worker is provided with a personal computer and job-related software, and access to the internet.

- Individuals + Ba
  The university encourages its employees to form special interest group for knowledge sharing. It also holds seminars on various topics regularly for administrative staff.

About the KM processes

- Knowledge Creation/Acquisition
  Administrative staff are not aware of knowledge creation but ISO 9001 system requires them to document what they have done and what they have learn. Knowledge creation is mostly done by the teachers in the form of lecture notes, research papers, patents, etc. Knowledge acquisition is mostly done through library service. There are no explicit activities relating to Nonaka, Toyama and Konno's [19] SECI style of knowledge creation.

- Knowledge Storage/Retrieval
  Official data and documents are stored in the integrated database and document repository. Retrieval is done through the information portal. Accounting information and personnel information are stored in proprietary databases as required by government regulations.

  The Office of Academic Affairs has accumulated some canned programs to retrieve data for various purposes.

- Knowledge Sharing/Dissemination
  Collaborating with the Library and Information Center, a Teachers' PDA system was developed for teachers to track what they have done and what they have achieved

during the academic year. The information is accessible by the administrative need-to-know and the individual teacher. This is an interesting proposition for knowledge sharing because teachers hate to waste time in entering the 'trivial thing' but they love the system's report generating capability that can produce the teacher's resume for NSC funding application and even more significantly, to provide a complete account of the teacher's achievements several years back for tenure and promotion review. The administrative and academic departments can aggregate teachers' data into reports for various needs by the university and MOE.

Conference attending suppose to be a good channel for knowledge sharing, but the university does not fund these activities due to government regulations. One of the Department Chairman tried to organize a forum for his colleagues to meet regularly to exchange ideas of their research but only got a lukewarm reception.

There is no explicit effort in knowledge dissemination.

- Knowledge Utilization/Enhancement
  Because people do not have clear definition of knowledge they cannot distinguish knowledge utilization from information utilization. A significant use of knowledge for competitiveness is the Yearly Quantified Performance Review Chart for the academic departments. The performance indices are those used by MOE in higher education evaluation and accreditation. This chart put all the departments of the same college in competition, essentially gives those fall behind a kick in the butt. This measure certainly gives a boost to the university's competitiveness.

  Knowledge enhancement is not clearly seen.

ANALYZING CASE STUDY EVIDENCE

Amending the Framework

Regarding the framework, through review of literature, this study find that it is desirable to replace the 'Organization Structure and Culture' component with two separate components, namely, 'Leadership and Culture', 'Structure and Incentives', and add two more components, namely, 'KM Guidelines' and 'Metadata for Shared Context'. Leadership comes primarily from the CEO but it can also come from CKO. Culture normally is shaped by leadership. Structure and incentives refer to those specifically linked to the KM practices. KM guidelines could be reminders such as the "Eleven deadliest sins of KM". Metadata for shared context allows knowledge sharing and exchange.

Reviewing the Amended Framework against the Eleven Deadliest Sins of KM

On Error 1, the KM model requires a KM program to establish KM guidelines in which a working definition should be given.
On Error 2, Knowledge flow is clearly identified with the KM processes.
On Error 3, The 'individual+Ba' component caters to the tacit knowledge.
On Error 4, The 'Metadata for Shared Context' component caters to shared context.

On Error 5, The 'individual+Ba' component pays great respect to tacit knowledge.
On Error 6, The 'Knowledge Utilization/Enhancement' activity emphasizes knowledge use.
On Error 7, The 'Leadership and Culture' component can call for thinking and reasoning.
On Error 8, The 'Leadership and Culture' component can also put focus on the future.
On Error 9, The 'Structure and Incentives' component can encourage experiment.
On Error 10, The 'individual+Ba' component enforce human contact.
On Error 11, The KM model measures competitiveness, not knowledge.

So the amended framework is free of the sins.

Reviewing the Amended Framework against the Evidence Collected from Interview

In view of the responses from the interviewees, any activity that has a connotation of KM is covered by the amended framework. It should be noted that the case university does not have a KM initiative per se, therefore, there are no sufficient KM evidences to probe the amended framework.

CONCLUSION

Returning to the propositions, they are all substantiated; therefore, the amended framework is deemed to be a valid KM model for organizational competitiveness. The contribution of this case study is that this KM model can guide an organization to initiate a KM program, and as long as it subscribe to the KM model, competitiveness will be achieved.

After this case study we found that the university we selected is not an ideal case in terms of KM practices, but at least we have earned how to select next case and what to look for. At that time, we will tackle the generalization issue.

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FACTORS INFLUENCING DESTINATION IMAGE FORMATION WITH THEIR IMPACTS ON BEAHAVIORAL INTENTIONS

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ABSTRACT

The development of tourism in many countries not only provides a lot of employment opportunities, but also brings huge foreign exchange earnings. All countries have attached great importance to develop the tourism industry hence. In order to let the world know the true, the good and the beautiful of Taiwan, we should make good use of the characteristic of nature environment, culture heritage, infrastructures, atmosphere, and affective image to enhance tourism attraction and to promote the national visibility. It is important to lead the vivid destination image to go deep into passengers' heart and reach the real competitive advantage of tourism market. However, few authorities neglect the influence of the destination image toward the destination of the choice of passengers; it may decrease the visit willing. The objectives of this study are described as follows: (1) to understand the factors influencing the destination image; (2) to assess the effects of the destination image on tourists' behavioral intentions; (3) to provide the tourism manager, the business and the authority with some suggestions.

This study uses website to distribute questionnaires. The number of useful sample is 277. Structural equation modeling (SEM) is used to test the hypotheses presented by the use of AMOS 6.0. The results are as follows:

1. *Socioeconmic Environment/ Infrastructures approximate positively influences behavioral intentions.*
2. *Atmosphere and Natural environment have no influence on behavioral intentions.*
3. *Affective image and Cultural environment have positively influence on behavioral intentions.*

The study suggests that the tourism manager, the business, and the authority should understand which destination images would have effects on the behavior of tourist before they pursue the tourism development. They also have to listen to the advices of the tourists and improve the tourism environment in the further. Therefore, the tourists make word-of-mouth marketing for the destination to ensure the successful tourism development.

Keywords : Destination image, Behavioral intentions, Affective image, Cultural environment Business

1. INTRODUCTION

According to the World Tourism Organization (WTO) published data, the received number of international tourism were 760 million persons, offshore tourism income were US$622 billion in 2004, as well as the received number of international tourism were 846 million persons, offshore tourism income were US$733 billion in 2006. The World Tourism Organization forecasts that 1 billion persons will travel abroad all over the world in 2010 and it will reach 1.6 billion persons in 2020. Therefore, the global tourism industry will be prosperous development (Executive Yuan, R.O.C. (Taiwan), International Taiwan Service Portal, 2009, http://www.i-taiwan.nat.gov.tw/ct/index.php).

In order to develop the tourism of Taiwan, we should make good use of the characteristics of nature environment, culture heritage, infrastructures, atmosphere, and affective image to enhance tourism attraction and to promote the national visibility. It is important to lead the vivid destination image goes deep into passengers' heart and reach the real competitive advantage of tourism market. The objectives of this study are described as follows: (1) To investigate factors influencing destination image formation; (2) To assess the effects of the destination image on tourists' behavioral intentions; (3) To provide the tourism managers, the business, and the authorities with some suggestions.

2. LITERATURE REVIEW

Based on the model of San Martín & Rodríguez del Bosque (2008), this study added a dependent variable, behavioral intentions, to mainly integrate construct of destination image and behavioral intentions exploring how destination image influences behavioral intentions.

2.1 Destination Image (DI)

Destination image has been defined in various ways. All impressions, beliefs, ideas, expectations and feelings compiled towards a destination over time (Kim & Richardson, 2003). Destination image includes two parts, the traditional cognitive approach and the recent cognitive–affective approach. The cognitive structure of destination image includes factors such as "natural environment", "cultural heritage", "tourist infrastructures" or "atmosphere" (San Martín & Rodríguez del Bosque, 2008). Combining two components may have a better explanation for the destination image, but not be entirely determined by its physical properties (Baloglu & Brinberg, 1997).

The competitiveness of tourism industry becomes severer so realizing the image formation process may improve the attractiveness and market competitiveness of tourist destinations (San Martín & Rodríguez del Bosque, 2008).Destination image refers to an individual's mental representation of knowledge, beliefs, feelings, and overall perception of a particular destination (Lee et al., 2005). Natural resources, social environment, infrastructure, recreation environment, culture heritage, political and economic factors, and atmosphere of the place are involved in the destination images (Yen & Rajamohan, 2008). The individual collets varied

information and reorganizes a meaningful mental concept of destination image for themselves (Leisen, 2001).

2.2 Behavioral Intentions (BI)

Zeithaml et al. (1996) found that customers perceived service quality to produce behavioral intentions after actual service experience. Behavioral intentions can be regarded as indicators whether customers will remain with or defect from the company, and be separated into favorable and unfavorable behavioral intentions. Favorable behavioral intentions mean the customer has positive and significant relationship with the company, such as increase the volume of their purchases and willingness to recommend the company to others. On the contrary, unfavorable behavioral intentions mean the customer has negative responses or dissatisfaction relationship with the company, such as a reduction in the amount of business with the company or complaining the company with third party. It shows that customers' behavioral intentions be influenced by service quality and satisfaction strongly.

Lot of literature of behavioral intentions has been found. Service quality was found to have a direct impact on visitors' future behavioral intentions (Cole & Illum, 2006). González et al. (2005) illustrated the influence of service quality and customer satisfaction on behavioral intentions in the tourism industry clearly. Lee et al. (2004) proposed that service quality is an antecedent of satisfaction and satisfaction plays a mediating role between service quality and behavioral intention. Further, service quality has a direct effect on behavioral loyalty, implying that the effect of service quality on behavioral intention is as important as that of satisfaction. Behavioral intentions are defined as the opinion visitor about the goodwill to revisit the destination or the willingness to recommend the destination to others (Chen & Tsai, 2007).

2.3 The relationship between Destination Image and Dehavioral Intentions

Cho (2008) interpreted that location attractiveness, which concerns the overall perception of a location, is a main factor that prompts travelers to a destination. Tourists' satisfaction is a indicator of their intentions to revisit and recommend the destination to others in the tourism research (Yoon & Uysal, 2005, Chi & Qu, 2008). Furthermore, the destination characteristic has positive influence on perceived destination image and intention to recommend (Eklnci & Hosany, 2006). As satisfied tourists are more possible to revisit the same destination, and are more willing to share their pleasant experience with their relatives and friends (Baker & Crompton, 2000). In addition, destination image and perceived value into the "quality–satisfaction–behavioral intentions" paradigm belong to an integrated tourist behavior model. Destination image have both direct and indirect effects on behavioral intentions. Moreover, the causality of path "destination image → trip quality → perceived value → satisfaction → behavioral intentions" has been proved by Chen & Tsai (2007). Therefore, destination image has the positive relationship with behavioral intentions.

3. METHODOLOGY

3.1 Research Framework

According to San Martín & Rodríguez del Bosque's (2008) model, research motives, research objectives, and the literature review, the research framework is presented in Figure 1.

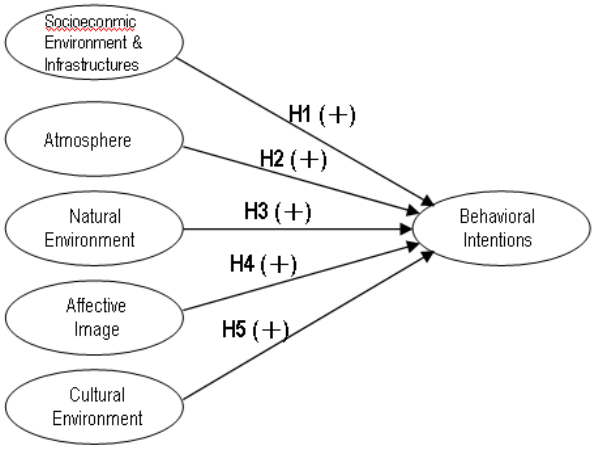

Figure 1 Research Framework

3.2 Data Collection and Sampling Design

This study's data are collected by means of website questionnaire survey. The 323 respondents produced a total of 277 usable questionnaires resulting in a response rate of 85.8%.The sample was comprised of 55.6% females. In terms of age, 35% in the 20s and 36% in 30s constitute the majority respondents. Less than half of the respondents are married (41%) and in terms of education level, senior high school (5%), college or university (57%), and graduate school (38%), constitute the respondents.

The respondents are asked to indicate their agreement or disagreement with the statements provided, using 7-point Likert type scales with anchors of 1 to indicate "extremely disagree" and 7 to indicate "extremely agree".

4. DATA ANALYSIS

This study examined the formation of destination image and the relationship between the destination image and the behavioral intentions. Structural equation modeling (SEM) was used to test the hypotheses presented earlier by the use of AMOS 6.0. According to Anderson and Gerbing's two-stage procedure, confirmatory factor analysis (CFA) is used in the first stage and structural equation model is used in the second stage in turn (Anderson & Gerbing ,1988).

4.1 Measurement Modeling Analysis

CFA is a measurement model, used to relate the observed, recorded, or measured variables to the latent variables (constructs) and examine whether or not the data can represent what the researcher really wants to measure. This study used a hierarchical confirmatory factor analysis to exam goodness of fit statistics, including the second-order, the five factors, and the single factor. Then, the five factors model shows the fittest statistics of measurement model in this study (Table 1). So we use the five factors measurement model to search the influence of relation between the destination image and the behavioral intentions.

Table 1 Goodness of Fit Statistics of the Alternative Measurement Models

Fit Measures	Second-Order Model	Alternative First-Order Models		Fit Criteria
		Five Factors	Single Factor	
Chi-Square	**254.0**	**239.6**	**1064.1**	
Chi-Square DF	**99**	**94.0**	**104**	
Chi-Square/ Chi-Square DF	**2.57**	**2.55**	**10.23**	**< 3**
Goodness-of-Fit Index (GFI)	**0.90**	**0.90**	**0.65**	**> 0.9**
The Adjusted Goodness-of-Fit Index (AGFI)	**0.86**	**0.90**	**0.54**	**> 0.8**
Comparative Fit Index (CFI)	**0.93**	**0.93**	**0.53**	**> 0.9**
Normed Fit Index (NFI)	**0.88**	**0.90**	**0.51**	**> 0.9**
Root mean square residual (RMR)	**0.07**	**0.06**	**0.15**	**< 0.05**
Root Mean Square Error of Approximation (RMSEA)	**0.075**	**0.075**	**0.18**	**< 0.08**

Convergent validity, discriminant validity, and reliability analysis are further examined for the measurement model. The *t*-test of factor loading is commonly used to examine convergent validity. As Table 2 shows, all *t* values are significant at $\alpha = 0.001$. Hence, convergent validity is successfully achieved. In addition, each item's reliability is higher than 0.5 and each construct reliability is higher than the general recommended level of 0.70 for the research instruments (Nunnally, 1967). The variance extracted reflects the overall amount of variance in the indicators accounted for by the latent construct. In Table 2, all variance-extracted estimates are above 0.50; thus, the overall variance extracted is successfully achieved (Fornell & Larcker, 1981).

The chi-square difference test is applied to evaluate the discriminant validity of two constructs by calculating the difference of the chi-square statistics for the constrained and unconstrained measurement models. Discriminant validity is achieved if the chi-square difference (with 1 d.f.) is significant, meaning that the model in which the two constructs are viewed as distinct (but correlated) factors is superior (Hatcher, 1994). All the chi-square difference statistics for each pair of constructs in this study are significant; therefore, discriminant validity is achieved.

Table 2. Overall Results from Test on Reliability and Validity

Framework Component	Standardized Factor Loading	*t* value [a]	Item Reliability	Construct Reliability [b]	Variance Extracted [c]
Socioeconomic Environment /Infrastructure(SI)				**0.885**	**0.658**
SI1	**0.778**	**40.947**	**0.605**		
SI2	**0.836**	**21.436**	**0.699**		
SI3	**0.846**	**28.200**	**0.716**		
SI4	**0.782**	**17.000**	**0.612**		
Atmosphere(AT)				**0.975**	**0.575**
AT1	**0.711**	**28.440**	**0.506**		
AT2	**0.742**	**12.793**	**0.551**		
AT3	**0.818**	**16.694**	**0.669**		
National Environment(NE)				**0.837**	**0.634**
NE1	**0.771**	**32.125**	**0.594**		
NE2	**0.896**	**28.000**	**0.803**		
NE3	**0.710**	**15.778**	**0.504**		
Affective Image(AI)				**0.896**	**0.742**
AI1	**0.899**	**37.458**	**0.808**		
AI2	**0.860**	**20.476**	**0.740**		
AI3	**0.823**	**19.595**	**0.677**		
Cultural Environment(CE)				**0.898**	**0.747**
CE1	**0.920**	**41.818**	**0.846**		
CE2	**0.878**	**27.438**	**0.771**		
CE3	**0.789**	**17.152**	**0.623**		

Note: a: $t > 1.96$; b: Construct Reliability > 0.7; c: Variance Extracted > 0.5

4.2 Structural Equation Modeling Results

Structural equation modeling (SEM) is used to test the hypotheses presented by the use of AMOS 6.0, after validating the data fit the proposed five factors measurement model. The overall structural model exhibits a good level of fit: Chi-Square/Chi-Square DF = 2.49; the goodness-of-fit index (GFI) = 0.90, the adjusted goodness-of-fit index (AGFI) = 0.90, the comparative fit index (CFI) = 0.93, and the normed fit index (NFI) = 0.90 are all exceeded or equaled 0.9; the root mean square residual (RMR) = 0.056 was approached 0.05; the root mean square error of approximation (RMSEA) = 0.07 was lower than the recommended minimum of 0.08. Therefore, the structural model fits pretty well.

One-tailed test is used to verify the hypotheses supported or not (Table 3). With One-tailed α=0.05, critical value=1.645; *t* value ($t > 1.96$) of Hypothesis 4 and Hypothesis 5 are 2.95 and 2.77. It means Affective Image and Cultural Environment positively influences behavioral intentions. For One-tailed α=0.10, critical value=1.282; *t* value of Hypothesis 1 is 1.68. It presents Socioeconmic Environment/ Infrastructures marginally positive influences behavioral intentions, so Hypothesis 1 is regarded as supported in this study. However, *t*

value of Hypothesis 2 and Hypothesis 3 are 0.14 and 0.54 not above 1.96. So Atmosphere and Natural Environment not influence behavioral intentions (Figure 2).

Table 3 Results of Hypotheses Test

Research Hypothesis	Path	Standardized Path Coefficient	*t* Value	Results
H1	Socioeconmic Environment & Infrastructures → Behavioral Intentions	0.17	1.68	Supported
H2	Atmosphere → Behavioral Intentions	0.03	0.14	Not Supported
H3	Natural Environment → Behavioral Intentions	0.08	0.54	Not Supported
H4	Affective Image → Behavioral Intentions	0.39	2.95	Supported
H5	Cultural Environment → Behavioral Intentions	0.16	2.77	Supported

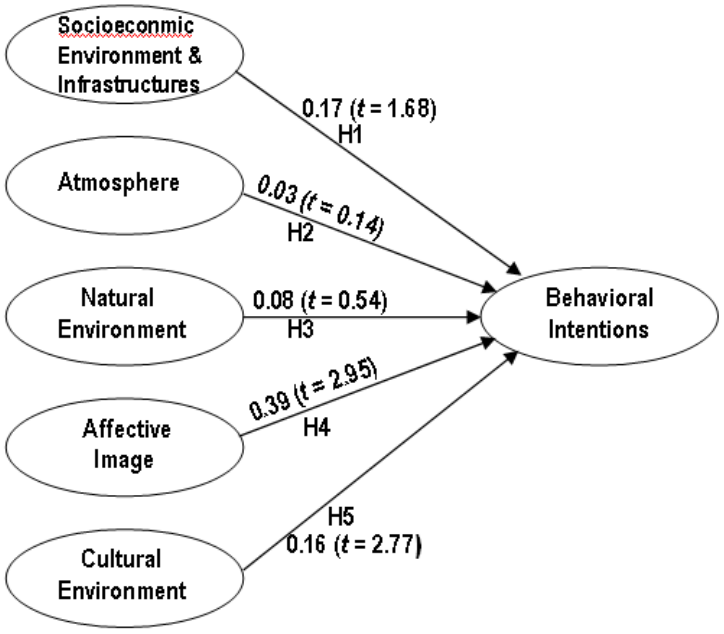

Figure 2 Structural Model Results
Note: t >1.96

5. CONCLUSION

The objective of this study is to assess the effects of the destination image on tourists' behavioral intentions. To go a step further, it would facilitate the tourists to revisit or recommend the destination. In sum, atmosphere and Natural Environment not influence behavioral intentions. Socioeconmic Environment/ Infrastructures, Affective Image and Cultural Environment positively influence behavioral intentions.
The tourism manager, the business, and the authority should understand which destination images would affect the behavioral intentions of tourist when they pursue the tourism development. They also should listen to the advices of the tourists and improve the tourism environment in the further. Therefore, the tourists make word-of-mouth marketing for the destination to ensure the successful tourism development.

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ORGANIZATIONAL TRUST – A CRITICAL REVIEW OF THE EMPIRICAL RESEARCH[1]

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ABSTRACT

The concept of trust has become popular in public debate and academic analysis. The growing importance of trust has been related to global organizational developments such as increasing flexibility of organizational relations, growing knowledge intensity of tasks, rising importance of lateral relations and continuous change. The purpose of this article was to analyze how the concept of trust is approached and defined in various disciplines, in order to reach a generally acceptable definition that could be used in business research. The concept of trust appears in many disciplines. In this article the concept is reviewed from the perspective of social psychology, philosophy, economics and market relationship. The study reviewed empirical research on organizational trust. Although trust has emerge as an important factor in organizational relationships, there are still major conceptual and methodological challenges to be met studying this complex concept.

Keywords: trust management, organizational trust, trust between coworkers, trust between leaders and employees

INTRODUCTION

The concept of trust has become popular in public debate and academic analysis. In high income countries this interest is associated with concern for the decline of trust in governments and professionals, and in developing countries has been prompted by debates around the motion of social capital. Trust has been identified as a major factor influencing such thing as capital investment, the sales of high-value investment goods, relationship marketing, cross-cultural communication, learning and various types of cooperation such as high-tech development projects, as well as transaction governance and costs. Trust management become also very important inside organization.

The purpose of this article was to analyze how the concept of trust is approached and defined in various disciplines, in order to reach a generally acceptable definition that could be used in business research. The study reviewed empirical research on organizational trust. The purpose of the study was also evaluation the advancements and setbacks in current empirical research in terms of measuring organizational trust. This paper analyzed the theoretical approach and the measurement issues covered in studies on organizational trust. Although trust has emerge as an important factor in organizational relationships, there are still major conceptual and methodological challenges to be met studying this complex concept.

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TRUST IN VARIOUS FIELDS

The concept of trust appears in many disciplines. In this article the concept is reviewed from the perspective of social psychology, philosophy, economics and market relationship.

Trust in social psychology

Trusting behavior as seen in social psychology implies allowing oneself to be in a potentially vulnerable position relative to another, while possessing some knowledge of the other that inspires trust in his goodwill, i.e. in his good intentions (Luhmann 1979). Thus risk and some information about the potentially trusted person or situation are seen as necessary conditions for trust to exist. Many of the psychologists define trust as a personal trait (Rotter 1967), while other researchers stress its social aspects. J.R. Gibb (1978) a psychologist has created theory that trust is instinctive, and, as a feeling, is so close to love. Trust in everyday life is a mix of feeling and rational thinking. Personality psychologists such as Wrightsman (1966) and Rotter (1967) have viewed trust as a personality trait that reflects the general expectancies of the trustworthiness of others. These expectancies are relatively stable dispositional characteristics that depend on personal experiences and previous socialization.

Trust in philosophy

The great philosophers have written very little about trust. For example Plato and Aristotle, have only indirectly implied trust while discussing cooperation and friendship and the virtues of the human being (Beier 1986; Hosmer 1995). Philosophers see trust in a variety of forms and versions. For example Herzberg (1988) trusting another person means having trusting attitude towards the other person, without specifying where he is trusted, as could be said that after judgment somebody is relied in upon certain aspects. Thus trust is implicit, not given on grounds and is never a rational option. Herzberg similarly like Baier (1986) and Lagerspetz (1992) draw attention to the implicit nature of trust, which is not given on grounds and is not a rational option. Philosophers emphasize the trusting attitude, often unconscious, as being part of basic conduct of life. Reliance is seen as a narrower concept somebody might be relied upon in certain respects. Reliance is therefore also viewed as an outcome of grounded expectations, and as separate from trust.

Trust in economics

Economics have not traditionally paid much attention to the role of trust in market exchange. The neo-classical ideal market, with perfect information and pure competition between independent and faceless traders, does not involve trust as a central concept, since the competitive market is supposed to control any deception. Also, rational choice theory excludes differences among actors, which means that no one of them is more, or less, trustworthy then the others. That is to say, of the actors were all perfectly honest, doing their best to fulfill their commitments, then there would be no problem of trust (Blomqvist 1997).

The shifts in focus towards imperfectly competitive markets in which a small number of traders build long-term relationships and make relation-specific investment, has drawn attention to this issue. Those economists who do see the notion of trust as relevant and useful,

regard it as mutual confidence, where by an individual or firm trusts second individual or firm to do has it has promised to do (Zucker 1986). For example according to M. Sako (1992) trust can be treated as a state of mind, an expectation held by one trading partner about another, that the other behaves or responds in a predictable and mutually acceptable manner. Arrow (1974) considered trust as a basic element not only for organizations but also for the economy in general, affirming that trust is a lubricant to economic exchange.

Trust in market relationships

Many researchers have identified certain critical success factors in relationships inside organizations, one of the most critical, is trust. Trust facilitates more open communication, information sharing and conflict management (Seppanen, Blomqvist, Sundqvist 2007). Trust is believed to be critical as it is seen to increase predictability, adaptability, and strategic flexibility. In general trust is seen to reduce transaction costs such as management costs, internationalization costs, social complexity. It also paves the way for informal network collaboration and collaborative innovation. It is also acknowledged that trust may be a critical factor in enhancing business performance and a source of sustainable competitive advantage (Seppanen, Blomqvist, Sundqvist 2007).

Trust leads to the kind of constructive and cooperative bahaviour that is vital for long-term relationships (Morgan, Hunt 1994). In the literature trust has been also recognized as an important attribute of industrial networks (Haansson 1982).

The success of personal sales is believed to depend upon trust, i.e. on the customer's willingness to trust the salesperson and the salesperson's ability to demonstrate trustworthiness. Both these are regarded as necessary conditions for completing a sale.

According to Anderson and Naurus (1990) trust is the firm' belief that another company will perform actions that will result in positive outcomes for the firms as well as not take unexpected actions that result in negative outcomes. In this definitions trust was modeled as an outcome of cooperation. In the literature the importance of trust in reducing the dysfunctional interaction in strategic alliances has also been noticed (Kiling 1989). Trust is usually seen as an outcome of an interaction process in which trust relationship develop gradually. However, reputation and fist impression are very important, as in many cases people never get another chance to prove their trustworthiness.
Barney and Hansen (1994) have developed a three level trust: weak-form trust, semi-strong-form trust and strong-form trust. According to them, weak-form trust exists in competitive commodity markets, where there are limited opportunities for opportunism and thus no real vulnerabilities. Semi-strong trust exists when parties find it irrational to behave opportunistically, perhaps for the fear of losing their reputation. In strong-form trust (also called principled trust) the parties have internalized values, principles and behavioral standards, which reflect the two partners' history, culture and personal beliefs and which counteract opportunism.

Author see trust as the belief that another party: a) will not act in a way that is harmful to the trusting firm, b) will act in such a way that it is beneficial to the trusting firm, and c) will act

reliably d) will behave or respond in a predictable and mutually acceptable manner. Trust can be seen as a bridge between past experiences and anticipated future.

However, although trust has been studied in a variety of disciplines, each of these disciplines has produced its own concepts, definitions and findings. In fact, even within a given field, there is often a lack of agreement and focus of effort (Lewicki, Bunker 1995). The outcome is a multi-dimensional family of trust concepts, each with a unique focus. Despite the eclectic nature of trust research, researchers from every discipline do acknowledge the value of trust. Trust enables people to live in risky and uncertain situations (Mayer, Davis, Schoormann 1995). It provides the means to decrease complexity in a complex world by reducing the number of options one has to consider in a given situation (Lewis, Weigert 1985). Trust can also be viewed as a kind of social capital that makes coordination and cooperation between people possible (Misztal 1996; Putnam 1995).

A REVIEW OF APPROACHES IN THE MEASUREMENT OF INTER-OGANIZATIONAL TRUST

Up till now, most studies on trust in organizations have focused on trust among members of an organization, such as trust between an employee and his/her direct supervisor or the organizational leader (Aryee et al., 2002; Deluga, 1994; Dirks, 2000; Dirks & Ferrin, 2002) or between peers (Dirks, 2000; Langfred, 2004). Also in the literature we can find studies of trust in an organization as a system (Creed & Miles, 1996; Huff & Kelley, 2003, 2005).

Trust among members of organization

Trust among members of organization was examined by many researches for example Chattopadhyay & George (2001), Ferres, Connell, & Travaglione, (2004), McAllister, (1995), Dirks & Ferrin, (2002), Dirks & Skarlicki (2004).
Among studies on trust in coworkers, McAllister's (1995) study of trust in peers showed that interaction frequency, peer-affiliative citizenship behavior, and cognition-based trust influenced affect-based trust. Cognition-based trust is based on individual thinking about and confidence in the other and based on "good reasons" as evidence of trustworthiness. Affect-based trust, is grounded in the emotional bonds between individuals involving mutual care and concern. Kiffin-Petersen and Cordery (2003) found that trust in coworkers partially mediates the relation between individuals' propensity to trust strangers and their preference for working in a team. Ferres et al. (2004) found coworker trust to be related to higher perceived organizational support, lower turnover intention, and higher affective commitment. However, these outcome variables were organization-focused and present a potential mismatch in the level of independent variables and outcomes.

According to Sonnenberg (1994), trust increases when people are perceived as competent. If employees believe that they can depend on their coworkers to produce a quality piece of work that would affect their job in a positive way, they will be willing to trust the judgment of those competent coworkers.

The employer, as the "trustee" in the relationship with employees, can develop and sustain a high level of trust by improving the employees' confidence in the organization and increasing

the employees' indebtedness to the employer through certain human resource management practices such as extensive welfare benefits or investments in employees' careers (Creed & Miles, 1996).

Trust between an employee and his/her direct supervisor or the organizational leader

Most of the work on trust in specific targets has focused on trust in a direct leader, such as supervisor, manager, or work-group leader (e.g., Aryee, Budhwar, & Chen, 2002; Butler & Cantrell, 1984; Deluga, 1994; Tan & Tan, 2000).

Researchers have found trust in different referent types to be related to different sets of outcomes. For example, Tan and Tan (2000) explored supervisor and organization as trust referents and found that the former is affected by the perceived ability, benevolence, and integrity of the supervisor and leads to satisfaction with supervisor and innovative behavior, whereas the latter is affected by procedural and distributive justice and results in higher organizational commitment and lower turnover intentions.

Wintrobe and Breton's (1986) argument that there is a potential conflict between vertical trust (trust between the employer and employees) and horizontal trust (trust among employees). They argue that when employees do not trust their management, they band together for collective action.

Immediate supervisors often have frequent and direct contact with subordinates in daily work. Supervisors' actions and behaviors, which are essential in determining the subordinates' attitudes, provide the foundation for trust (Whitener et al., 1998). Supervisory support is a strong indicator of the quality of exchange relationships between employees and supervisors (Stinglhamber & Vandenberghe, 2003). When supervisors express concern for their employees' well being, help them with career development, and value their work, they signal to their subordinates that they are interested in a close and social exchange relationship. To equalize or ensure a balance in their exchanges, employees will feel obligated to reciprocate the good deeds and goodwill of the supervisor. By discharging their obligations for services provided, they demonstrate their trustworthiness and the gradual expansion of mutual services (Blau, 1964). Reciprocation between supervisors and their subordinates reinforces and stabilizes trust, the axis upon which social exchange revolves (Blau, 1964). Trust relationships further enable people to make emotional investments, because they believe in the intrinsic virtue of such relationships and that these sentiments are reciprocated (Lewis & Weigert, 1985). Wayne, Shore, and Liden (1997) suggested that employees often generalize their experiences with their supervisors to the organization. Indeed, it has been observed that employees' trust in supervisors is associated with their trust in the organization (Wong, Ngo, & Wong, 2003). As their trust in the supervisor increases, their favorable perceptions of the organization also increase (Pearce, 1993). Thus, as supervisors build a social exchange relationship with employees and fulfill employee perceptions of the organization's obligations through providing social support, employee trust in the organization increases (Whitener, 1997).

In some studies positive relations between trust and team performance were found (Klimoski and Karol 1976; Costa et al. 2001; Costa 2003), other studies found trust in team members unrelated to team performance (Porter and Lilly 1996; Aubertand Kelsey 2003). A study of Langfred (2004) of self-managed teams even shows that trust can be negatively related to performance. He found that in teams with a high degree of individual autonomy, high trust leads to a reduction in team monitoring, which leads to lower performance than in teams with high individual autonomy and a high level of monitoring.

Organizational trust

Even though trust in the leader has been found to correlate with organizational trust (Aryee et al., 2002), the antecedents of trust in the organization are different from those of trust in the leader (Tan & Tan, 2000). Findings from some studies suggest that the insecure future of the organization, inadequate working conditions, and poor treatment (Kiefer, 2005) or job insecurity (Wong, Wong, Ngo, & Lui, 2005) could lead to employees' distrust in the organization. Whitener et al. (1998) suggested that organizational factors such as structure, human resource policies and procedures, and organizational culture would affect employees' perceptions of trust.

Interpersonal trust is considered an important mechanism to stimulate satisfaction and commitment of members and enhance organizational effectiveness. Interpersonal trust building is an interactive process in which individuals learn or unlearn to establish and maintain trustworthiness, under given organizational (contextual and structural) settings, and subject to policies directly or indirectly, positively or negatively sanctioning the building of interpersonal trust. Stable intentions for behaviour can be stimulated by durable policies, structures and contextual settings.

Lee and Stajkovic (2005) tested Mayer et al.'s (1995) model of organizational trust and found that trust in a specific team member led to great cooperation in work teams, a likely result of accumulated social capital. In their study, Chattopadhyay and George (2001) found that temporary workers scored lower on trust than did internal workers in temporary worker-dominated groups, but Chattopadhyay and George found no parallel effect in the internal worker-dominated groups, and that difference is likely a result of differential work status.

Trust in organizations involves employees' willingness to be vulnerable to their organization's actions. This willingness can be rendered only when an organization clearly communicates its actions to its employees through informal and formal networks. An important source of information is the employee's immediate social environment, which largely comprises coworkers. According to the social information-processing theory (Salancik & Pfeffer, 1978), the social environment provides cues that employees can use to construct interpretations and model their attitudes and behaviors. Festinger (1954) suggested that information from the social environment is salient and relevant particularly when the receiving employee regards the individual sources as very similar to him- or herself. Also, Festinger argued that if information from formal channels is absent or ambiguous, employees will start to rely on the social environment to derive interpretations. Therefore, individual employees' impressions can be influenced by the attitudes and behaviors of those coworkers whom they perceive as similar to themselves. Then, the individual employees regard the

attitudes of coworkers as socially acceptable and model their beliefs according to those of their coworkers (Salancik & Pfeffer). Thus, it is reasonable to suggest that employees' trust for their coworkers influences trust in their organization, because employees who trust their coworkers are likely to regard their coworkers' perceptions as relevant and socially acceptable. Hence, when these trusted coworkers perceive that the organization's actions are beneficial, the employees are likely to be influenced by this same belief and subsequently construct similar perceptions that the organization can be trusted. Studies that have shown that employees who communicate with one another frequently share similar interpretations of organizational issues (Schmitz & Fulk, 1991).

According to Zucker (1986) organizational trust can stem from the owner's personality (small firms) or from strongly centralized decision structure and organizational culture, which makes the organization regularly interact in a particular, "trusting" way. Barney and Hansen note that the organization's values and beliefs may be supported by internal reward and compensation systems, together with decision-making systems reflecting culture. This organizational trust can also be called routine trust, and it comes up especially in connection with long term, institutionalized relationships. In organization there is also general trust at the company level, and that is based on a company's good reputation or resources.

Trust in the workplace has been shown to have a strong and robust influence on a variety of organizational phenomena, including job satisfaction, stress, organizational commitment, productivity, and knowledge sharing (Kramer 1999). Abrams et al. (2003) suggest that "trust leads to increased overall knowledge exchange, makes knowledge exchanges less costly, and increases the likelihood that knowledge acquired from a colleague is sufficiently understood and absorbed that a person can put it to use". Precursors of trust include environmental and contextual factors and "malleable relational features" such as shared language and shared vision (Levin, Whitener, Cross 2006). Other research has explored the effect of characteristics of the relationships in which trust occurs, such as strong versus weak ties (Levin, Cross 2004; Hansen 1999), and of characteristics of the individuals in the relationships, such as the length of their tenure and their perceived trustworthiness (Levin, Whitener, Cross, 2006).

PRACTICAL IMPLICATIONS

In an era of competition, organizational resources are precious and limited. Any opportunity for the organization to improve the effectiveness of its people and reduce impediments in the organization is limited. Because of the significance of trust in coworkers in determining trust in organizations and important outcomes like organizational commitment and performance, it would be reasonable for organizations to develop a climate of trust among employees. As part of the implications of the present study, organizations should also cultivate cultures that promote trust among coworkers, trust between managers and employees and organizational trust. Because of the significance of benevolence and integrity as factors of trustworthiness, organizations can promote, through visions and campaigns, the need to be benevolent to fellow coworkers and to exhibit high levels of integrity.

CONCLUSION AND DIRECTIONS FOR FURTHER RESEARCH

The theory of trust is still developing. Researches disagree on the nature and definition of this complex concept. Studies conducted so far take very different theoretical backgrounds and the chosen empirical context. This paper provides an overview of the range of approaches that have been used in investigating trust in different settings. Various disciplines have different basic assumptions about trust. Te economists; rational and calculative view of trust, for example, contrasts strongly with the philosophers' attitudinal and ethical view. Social psychologist underline the reliability of the word or promise and the fulfillment of obligations, whereas economists see trust as a response to expected future behavior and recommend the use of hostages to ensure rational behavior. Social psychologists and philosophers emphasize the personal and inter-personal aspects, while economics, lawyers and most market researches emphasize inter-organizational trust.

The investigation showed that most employers would be eager to cultivate employees' trust in the organization. The benefits of trust should be obvious to all, but how to develop such trust remains a challenge to most employers. The mutual investment employee-organization relationship approach could initiate trust in employees, but support from the immediate supervisor is both synergistic and fundamental. The findings should be useful to human resource management practitioners in firms. The study also contributes to the accumulating evidence that the mutual investment in employee relations in organization approach may be a wise human resource management tool for many, if not all, employers.

Trust is measured mainly according how much, is any, a respondent trusts the other party. But this does not increase our understanding of what trust really is. Respondents may easily ascribe various meaning and contents of trust, thus actually answering different questions. It could well be argued that existing attempts to measure trust are not able to capture the whole phenomenon, trust being both context- and situation – specific, and being perceived subjectively by separate individuals having their own distinct histories.

It will be challenging in the future research to study how trust is assessed, signaled and created. The findings from the article indicate the possibility of studying the question further.

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REDUCING COMPETENCE GAP WITH THE HELP OF PROFESSIONAL CONSULTANTS

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ABSTRACT

Contemporary enterprises functioning in a turbulent environment have to continuously adapt to new challenges. Therefore, it is necessary for an enterprise to have adequate competencies which will provide it with a permanent competitive advantage and let it function and develop in a long-term perspective. 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 difference between the current status of the company's competences and their desirable level defines as the competence gap.
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. The problem is to what degree enterprises are able to identify the expectations of the environment and how quickly they can undertake some corrective actions through the processes of corporate learning. Substantial support in this area can be provided by professional consultants who, due to their knowledge and experience, back up their client's enterprise in an objective and independent way, identifying and reducing the competence gap.
The paper presents the results of empirical research performed in order to determine the factors that support or hinder the identification of competence gap and the course of corporate learning processes in Polish enterprises.

Keywords: professional consulting, organizational competencies, competence gap, reducing competence gap

INTRODUCTION

Contemporary enterprises functioning in a turbulent environment have to continuously adapt to new challenges. Therefore, it is necessary for an enterprise to have adequate competencies which will provide it with a permanent competitive advantage and let it function and develop in a long-term perspective. 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.

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 business models.

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. 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. The problem is to what degree enterprises are able to identify the expectations of the environment and how quickly they can undertake some corrective actions through the processes of corporate learning. Substantial support in this area can be provided by professional consultants who, due to their knowledge and experience, back up their client's enterprise in an objective and independent way, identifying and reducing the competence gap.

PROFESSIONAL CONSULTING

Professional consulting services „are commissioned by companies and provided by adequately qualified and educated individuals who objectively and independently support their client's organisation through identifying its problems, analysing them and recommending solutions as well as, if the client wishes so, offering help in their implementation" (5).

In such a formulation of the definition its main elements should be noted which make the essence of consulting services:

- The service is provided by a single person/institution for the benefit of another person/institution who has commissioned such a service,
- The services are provided by competent individuals, which should guarantee some definite added value within that particular service.
- The objective and independent character of the consultant's own assessment, which makes him/her a partner rather than a subordinate in relation to the principal.

The tasks that are faced by professional consultants and the services offered by them are formulated in many different ways in professional literature, which is reflected in the definitions of this type of services. For example, consulting is described as (11):

- taking over the assignments,
- acting as an agent in transferring knowledge and special information,
- helping in problem solving and decision taking,
- communicating both the information which reduces risk and specialist knowledge which is supposed to facilitate functioning,
- preparing and providing the information aimed at sorting out complex problems,
- identifying and solving problems,
- offering recommendations on rationalising actions and helping in their implementation,
- providing guidelines referring to further behaviour.

The above points suggest that the range of assignments commissioned to consultants is very broad and they face varied requirements and expectations. In practice, three types of consultants are distinguished (7):

- a dealer – there is a purchaser-trader relationship, namely buying the expert's knowledge,
- a doctor – the client informs the consultant what is going wrong in the organisation (the symptoms of a „disease" are described) and expects the consultant to offer a method of improving the situation (prescribing the right „medication"),
- a process consultant – there is a close co-operation between the consultant and the client, the consultant is directly involved in the process of transforming the enterprise, working within the organisation or in its environment.

The processes of corporate learning are typically supported by process consultants who are, first of all, specialists in the area of planning and implementing changes in organisations. They make the members of the organisation aware of the need of introducing some changes

and, at the same time, create adequate conditions for accepting such changes. In a properly developed programme of changes it is necessary that process consultants and their clients should co-operate in creating suitable relationships between the factors affecting the course of the implemented processes and also in overcoming some potential resistance to changes. It is vital, and very difficult at the same time, that the goals for process consultants' work should be defined since their activities are conditioned by a number of specific criteria. These aims include e.g. (3):

- creating effective working teams,
- improving the atmosphere, corporate morale, human relationships,
- handling the problems related to trust and conflicts,
- increasing the level to which employees identify themselves with corporate objectives.

While striving to reach the above goals and bearing in mind the level of involvement of both the consultant and the client, consultants may play a number of different roles (7), such as those of:

- an inspirer who offers clues for the diagnosis – he/she enables the members of the organisation to pose questions which help people better understand corporate problems and also change the situation; the corrective measures lie in the hand of the client, yet it is the consultant who guides the principal's reflection on the existing situation,
- a specialist in shaping social relationships which support changes and in engaging the employees in actions leading to such changes,
- a searcher for the data concerning the corporate reality, especially in the area of social facts,
- an individual identifying different possibilities – someone who points at a number of options concerning potential actions, though the final choice is left to the client
- a partner in problem solving who helps the client to identify the reasons of a difficulty, presents different solutions, plans adequate actions and, together with the client, takes decisions related to implementing changes,
- a technical expert providing a detailed analysis in a given area (e.g. how to chair effectively a meeting, how to motivate people for work, etc.),
- a coach and a teacher who is familiar with the processes of adult learning and able to develop an effective training session which has a character of a social intervention,
- a counsellor or a consultant who tries to influence the client; such an influence may refer to the values preferred by the client, the goals he/she determines or the choice of methods used in the process of changes.

All these roles overlap in most situations, which results from the complexity of the activities implemented by the consultant. However, there may be situations in which the choice of a single role is recommended.

Professional consulting is an element of the sphere of services which have been developing very dynamically in the recent years – specialists assess its dynamics at as high as 50% a year (13).

However, the particular character of this market and the mechanism of its development have not been sufficiently explored yet, which is a consequence of a very wide range of issues belonging to the sphere of consulting. It can be observed nowadays that the main current of services is moving from strategic planning and recommendation formulating towards a more practical and individualised implementation of changes in companies (10). A new procedure of professional consultants' performance has been created in practice which includes the following sequence of activities (6):

- problem identification,
- acquiring the indispensable information,
- analysing and synthesising,
- determining facilitation proposals,
- communicating the proposal (communication with the environment),
- planning changes,
- overcoming resistance to changes,
- supporting the client in adopting new experience,
- transferring new management techniques at the international scale.

While implementing the whole consulting process, the consultant, acting as an independent expert, should aim at persuading the staff of his /her client's organisation collaborating with him/her to participate consciously in learning processes concerning such areas as (12):

- acquiring new knowledge and information,
- a different reasoning style,
- a different behaviour,
- expanding one's awareness,
- deeper understanding of one's self and one's own motivation,
- changing one's beliefs and values,
- questioning assumptions,
- realizing one's own feelings and their effects.

The support offered by professional consultants is taken advantage of by companies to a varied degree. It should be noted that their help in corporate learning processes is indispensable in many cases. This is related primarily to the fact that the managerial staff is often insufficiently prepared to initiate, implement and control the organisation's learning processes. The form and the range of collaboration depend on the type of implemented works, the level of awareness among the managerial staff and also on their financial status (consulting services are not among the cheapest ones).

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 (2) 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 (8):

- 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.

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 (8):

- „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 business 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 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.(8):

- 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 (4, 9):

- 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 (8):

- 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.

PROFESSIONAL CONSULTING SERVICES 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.
The empirical studies aimed at determining, among others, the influence of using professional consulting services on eliminating the identified competence gap.
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

The frequency of co-operating with consulting firms

On the basis of a research model, a questionnaire for a categorized survey was developed in which a five-degree scale was used to examine the level of the examined phenomenon (e.g. 1 – never, 2 – seldom, 3 – occasionally, 4 – often, 5 – continuously).
The question regarding the frequency of using consulting services was answered by 96% of the respondents (see Table 1). On the average, such services are taken advantage of occasionally (3.00). It should be noted that on the average 11.1% of the respondents use such services continuously. They are used slightly more often by small companies. Only 7.4% of the respondents stated that they did not need consulting services at all.

Table 1. The frequency of using consulting services

Enterprises	Mean	Number of responses		Opinion distribution				
		N	%	5	4	3	2	1
Total	3.00	54	96.4%	11.1%	13.0%	44.4%	24.1%	7.4%
Big	3.00	19	100.0%	10.5%	15.8%	42.1%	26.3%	5.3%
Medium-size	2.89	27	93.1%	10.3%	10.3%	41.4%	20.7%	10.3%
Small	3.13	8	100.0%	12.5%	12.5%	50.0%	25.0%	0.0%

Source: own work

When asked to indicate the areas in which they use the services of professional consultants, the respondents stated that they were using different types of services (see Table 2), although more than one third of the respondents did not answer this question at all. As it was an open question, the respondents suggested a wider range of areas than that analysed in the previous questions.

Table 2. The areas of using consulting services

Enterprises / Area	Total		Big	Medium-size	Small
	N	%			
Finance	13	23,2%	31,6%	24,1%	0,0%
Techniques and technologies	12	21,4%	21,1%	20,7%	25,0%
Legal issues	9	16,1%	21,1%	13,8%	12,5%
Human resources management	8	14,3%	26,3%	10,3%	0,0%
Operating activities	5	8,9%	0,0%	10,3%	25,0%
Taxes	4	7,1%	5,3%	6,9%	12,5%
Marketing	4	7,1%	5,3%	10,3%	0,0%
Quality	4	7,1%	5,3%	6,9%	12,5%
Research-and-development activities	3	5,4%	10,5%	3,4%	0,0%
Strategy	3	5,4%	5,3%	3,4%	12,5%
Management	2	3,6%	10,5%	0,0%	0,0%
Change management	2	3,6%	0,0%	6,9%	0,0%
Acquiring EU funds	1	1,8%	0,0%	3,4%	0,0%
Investment processes	1	1,8%	0,0%	3,4%	0,0%
No data available	20	35,7%	36,8%	34,4%	37,5%

Source: own work

In most cases the respondents used consulting services in the sphere of finance (23.2%), technique and technology (21.4%), legal issues (16.1%) and human resources management (14.3%). Fixing such an order in searching for help from external consultants reflects the types of problems occurring in companies – finance, implementing new technologies (including introducing information technology), the necessity of adaptation to changing legal regulations and the constantly growing role of human resources. What is alerting is a relatively low interest in consulting services in the sphere of management (3.6% of the respondents on the average, and in reference to big companies only). A slightly better situation was observed in the area of strategy (the total of 5.4% of the respondents, with the highest share of small companies).

The order concerning the highest frequency of using consulting services in particular areas is similar in big and medium-size businesses. In small companies their needs concerning the use of consulting services are concentrated on the sphere of techniques and technologies, as well as operating activities (25.0%).

The respondents took advantage of consulting services in maximum 5 functional areas (see Table 3) and such a wide range of services was typical of big enterprises only. A certain tendency was observed, namely the smaller the company, the narrower the range of consulting services used. In most cases one or two areas requiring the help of consultants were indicated.

Table 3. The number of areas in which companies used consulting services

Enterprises	Number of responses		Number of areas				
	N	%	5	4	3	2	1
Total	36	64,3%	2,8%	2,8%	19,4%	38,9%	36,1%
Big	12	63,2%	8,3%	0,0%	33,3%	25,0%	33,3%
Medium-size	19	65,5%	0,0%	5,3%	15,8%	42,1%	36,8%
Small	5	62,5%	0,0%	0,0%	0,0%	60,0%	40,0%

Source: own work

The influence of collaborating with consulting companies on the increase in the potential directed at eliminating competence gap

The respondents estimated the influence of their collaboration with consulting agencies on the increase in their company's competence potential at the level below the average (2.69). The relatively biggest effect was suggested in the sphere of finance (the mean level at 3.0), whereas the lowest influence was indicated in the area of supply (low level – 2.06).
The analysis of the obtained results in the context of the indicated areas in which companies use consulting services (Table 4) shows that they are consistent only in the area of finance. In case of the remaining areas, the results of the studies are not so unambiguous. Relatively most often enterprises use consulting services in the sphere of techniques and technologies

(21.4% of total choices) with a relatively low influence on the company's competence potential (mean 2.51). An inversed relationship was observed in case of management, where a relatively high importance is given to the co-operation with consulting firms (mean level of 2.92), whereas consulting services are used to a very low degree in this area.

Analysing the influence of collaboration with consulting firms on the increase in the companies' potential following the criterion of their size, it can be concluded that according to the respondents such an increase is inversely proportional to the company's size. In big companies the highest influence of consulting activities on the improvement of their competence potential was observed, similarly as the mean value for all the examined companies, in the areas of: finance (3.15), management (3.0) and marketing/sales (3.0); in medium-size enterprises, respectively, quality (2.94), finance (2.83) and management (2.81), whereas in small businesses the respondents indicated finance (3.14), management (3.00) and operating activities (2.88). It can be also observed that there is a very insignificant effect of their collaboration with consulting companies on the competence level in the area of quality. This may result from the fact that quality is associated with certification processes, and in case of small companies such processes are often beyond their financial reach.

Table 4. The influence of using consulting services on the increase in the company's potential (an increase in resources and skills, as well as eliminating competence gap) in particular functional areas

Functional areas / Enterprises	Operating activities	Techniques and technologies	Research-and-development activities	Marketing/sales	Finance	Quality	Human resources management	Supplies	Management
Total	2,5	2,51	2,24	2,82	3	2,68	2,74	2,06	2,92
Big	2,27	2,60	2,50	3,00	3,15	2,79	2,86	2,14	3,00
Medium-size	2,53	2,41	1,88	2,65	2,83	2,94	2,59	2,07	2,81
Small	2,88	2,57	2,67	2,86	3,14	1,86	2,86	1,83	3,00

Source: own work

The effect of collaborating with consulting firms on improved effectiveness

The respondents were asked to indicate to what degree the initiated activities influence different symptoms of their company's effectiveness.

All the respondents replied to this question, although they decided that collaboration with consulting firms had a relatively insignificant meaning – it affects to a relatively highest degree a lower number of errors and defects (39.3% of choices), an increase in the speed of adaptation to clients' requirements (23.2%), reducing the time of process implementation (23.2%) – Table 5.

A diversity in the respondents' opinions is observed in different sections of the analysed companies. In big companies consulting has a higher than average effect on reducing the number of errors and defects (52.6%), an increase in the speed of adaptation to clients' needs (26.3%0, improved financial status of the company (26.3%) and higher customer satisfaction (21.1%). It may be concluded that big companies experience to the highest degree the support provided to them in the area of marketing and financial activities.

In medium-size companies the use of consulting services has the most significant effect on reducing the time of process implementation (31.0%), limiting the number of errors and defects (31.0%) and lowering the costs of operating activities (24.1%), so this type of co-operation is most effective in reference to the operating activities of such companies.

Small companies indicated, similarly to the remaining ones, a reduction in the number of errors and defects (37.5%) and also an increase in the speed of adaptation to customers' needs (37.5%) and an increase in employees' creativity (37.5%). This suggests a direct contact with consultants and higher skills of the employees concerning their handling current issues.

Table 5. The influence of collaborating with consulting firms on improved effectiveness of companies

Enterprises / Area	Total	Big	Medium-size	Small
A reduced number of errors and defects	39,3%	52,6%	31,0%	37,5%
An increase in the speed of adaptation to clients' requirements	**23,2%**	**26,3%**	**17,2%**	**37,5%**
Reduced time of process implementation	23,2%	15,8%	31,0%	12,5%
An improvement in the financial status of the company	21,4%	26,3%	17,2%	25,0%
Increased creativity of the employees	19,6%	10,5%	20,7%	37,5%
An improved image of the company	19,6%	26,3%	17,2%	12,5%
Lower costs of operating activities	17,9%	5,3%	24,1%	25,0%
Higher customer satisfaction	16,1%	21,1%	10,3%	25,0%
An increase in revenue from operating activities	14,3%	15,8%	13,8%	12,5%
A decrease in personnel	5,4%	5,3%	6,9%	0,0%

Source: own work

CONCLUSION

In order to meet dynamically changing requirements of the environment, a company must possess some adequate competence potential. Therefore, it is necessary to constantly monitor the requirements expressed by the environment and to identify an emerging competence gap. Being aware of the existence of such a gap releases the processes of its elimination. The knowledge and skills of the managerial staff in the company may be often insufficient to face new challenges independently.

In such situations it is recommended that professional consultants should be asked for help. The studies resulted in a conclusion that the frequency of using professional consulting services remains at the average level. This is related, to a high degree, with relatively high costs of such collaboration and, at the same time, a fear that the effects could not be proportional to the expenses. Such an opinion was reflected in the results of the studies – the effectiveness of co-operation with consulting firms and its effect on enhanced competence potential of the companies and effective elimination of competence gap was rated rather low by the respondents.

It is thus necessary to initiate activities aimed at making managers realise the role of professional help in identifying and eliminating the emerging competence gap and the improved effectiveness of such collaboration at the same time. In order to achieve this the following steps are recommended:

- A complex approach to determining objectives, defining precise measures of assessment and their adequate correlation in the company as a whole.
- Updating the analyses of the results and, in case of stating a gap existing between the results and the objectives, identifying the reasons for such a gap, assessing the company's

potential to solve the problems independently and, possibly, using the help of professional consultants.
- A precise definition of the scope of co-operation with consultants and the expected results.

Regular collaboration with consultants while providing a service, learning from them and also introducing the mechanisms of knowledge transfer in the company

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THE USE AND IMPORTANCE OF STRATEGIC KNOWLEDGE MANAGEMENT ENABLERS IN MALAYSIAN PUBLIC HIGHER EDUCATION INSTITUTIONS

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ABSTRACT

Knowledge Management (KM) has gained much strength as a potential source of competitive advantage amidst this dynamic yet turbulent environment. In order for KM to thrive, strategic enablers are therefore necessary to provide the environment conducive for its implementation. In this regard, the literature contends that culture, leadership, technology, and measurement are key KM strategic enablers which improve organizational performance. These enablers work together to streamline and enhance the capture, flow, and transfer of an organization's data, information, and knowledge for the purpose of delivering it to individuals and groups engaged in accomplishing specific tasks. On this note, this paper aims to examine the use and the importance of the key strategic enablers for KM processes in the higher education setting. A 57-item survey utilizing rating strategies on two dimensions- "use" and "importance" as well as demographic profile were used as instrument for this study. The questionnaire was administered to the academics of public universities which fall under the Malaysian Technical University Network (MTUN). As KM program requires investment decision, the findings and consequently the recommendations proposed will provide strategic directions for higher education of similar set up to deal more effectively with KM processes.

Keywords: Key KM strategic enablers, culture, leadership, technology, measurement, KM processes, public higher education institutions, Malaysia

INTRODUCTION

It has been widely acknowledged that the importance of managing knowledge and know-how in the present day is critical to organizations for a sustainable tomorrow. This is not difficult to apprehend because, without understanding their own process for knowledge creation, establishments may not be able to continue as performing enterprises. As such, successful

21st-century organizations are those that best use utilize their information and knowledge and use them to create sustained additional value for their stakeholders (Sallis and Jones, 2002).

Knowledge management (KM), which used to be high on the list of many industries, has become a high priority for higher education as well. As a matter of fact, higher education by nature has long been regarded as knowledge-intensive organizations (Goddard, 1998). The roles and functions of higher education are always based on the knowledge agenda (Cronin and Davenport, 2000) of knowledge production, distribution, and application (Rowley, 2000). There is therefore a growing acknowledgement that an institutional-wide approach to KM can enable higher education to evolve more effortlessly to a highly effective and dynamic educational environment (Sharimllah Devi *et al.*, 2007) which promises considerable improvements in institutional-wide knowledge sharing activities and subsequently improvement in overall performance.

However, in the face of many examples in the business world, few educational institutions have risen to the challenge of developing appropriate strategies for KM. This is because of the failure of higher education institutions (HEIs) to recognize and incorporate within their KM processes the key KM strategic enablers - strategy and leadership, organizational culture, information technology (IT), and measurement – which have received considerable attention in the corporate literature (Chong, 2006a, 2006b; Chong *et al.*, 2009; Niza Adilah and Woods, 2004). This is largely due to lack of research in the context of the HEIs, more so on the government sector (Kalsom and Syed Noh, 2006). The majority of similar studies have concentrated on the corporate sector with only a handful on the HEIs. Among the research that targeted on HEIs, the majority of the "handful" was not supported by empirical evidence except for few (e.g. Sharimllah Devi *et al.*, 2007; 2008; 2009).

Since the KM processes and key KM strategic enablers have been well-grounded both theoretically and empirically, it is timely to empirically assess them in the HEIs' setting. This study takes existing research on KM, which is currently limited to abstract concepts, ideas, frameworks, models, and anecdotes, and adds significantly to both the theoretical and applied frontiers of KM research especially in the HEI environment. Specifically, the objectives of this paper are to:

1) To examine the importance of the key strategic enablers for KM processes in HEIs; and
2) To examine the use of key strategic enablers of KM processes in HEIs.
3) To examine the significant differences between the importance and use of key strategic enablers for KM processes in HEIs

As KM requires significant investments of time, money and personnel (Chong and Lin, 2008; Parikh, 2001), a careful examination of the KM processes and its key strategic enablers can determine its implementation success in the HEIs which are in their beginning stage of implementing KM. The findings will serve to inform the extent of importance and implementation of these KM processes and key KM strategic enablers and suggest ways of how the resulting gaps, if any, can be reduced for a more effective KM implementation.

The rest of the paper is organized as follows. The next section reviews the literature pertinent to the study, which result in the development of a research framework. 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.

LITERATURE REVIEW

Definition of KM in HEIs

The university environment is essentially a collection of individual experts who comprise an accepted body of knowledge for many degree-granting disciplines. As such, universities have traditionally been utilized as transfer mechanisms for providing students with a knowledge base that will enable the students to function and thrive upon graduation (Tippins, 2003).

The definition of KM from the perspective of HEIs has been aptly provided by Joseph (2001). He states that KM is a process where institutions formulate ways in an attempt to recognize and archive assets from within that are derived from the employees/academics of various departments or faculties, and in some cases, even from other institutions and/or organizations sharing similar areas of interest. Thus, the HEIs do not solely provide knowledge to students, but are also engaged in managing and collaborating the existing knowledge for future reference (Goud *et al.*, 2006; Maizatul Akmar and Chua 2006; Yusof and Suhaimi, 2006). These arguments suggest that an institutional-wide approach to KM processes and its key strategic enablers can therefore lead to considerable improvements in sharing explicit and tacit knowledge and thus improve the performance of the HEIs. The following sub-sections review the KM processes and key KM strategic enablers which have garnered impressive theoretical and practical support.

KM Processes

Given the importance of knowledge, it is not surprising that organizations everywhere are giving prominence to knowledge discovery and ways to organise, share, and apply it more effectively. This is because, unless knowledge is efficiently managed, it may not transfer into intellectual capital or assets in which organizations can use to be more competitive and productive (Skyrme and Amidon, 1997). In this context, many researchers concur that KM is more than just the storage and manipulation of information, but a process that requires the responsibility to create and disseminate knowledge throughout the organization (Parikh, 2001; Marshall *et al.*, 1996). Thus, in general, KM is widely recognized as a process involving knowledge generation, codifying, and transfer (Chong and Chong, 2009; Chong *et al.*, 2009).

Generating knowledge basically refers to the sub-processes of searching, capturing, and creating knowledge. Knowledge is generated through discovery, that is, employees develop new ways of doing things or it is brought in through external sources. Research and development is one such knowledge creation activity. Codifying knowledge means translating data and information into symbols that others can understand. Codification encompasses a process where knowledge is codified and stored in a reasonable format so that others in the organization can access it. Database management and data warehousing technologies can help in this process. In universities, databases, directories, procedural

handbooks, and email messages are among the examples of the knowledge codification process. Transferring knowledge refers to the sub-processes of data-mining, distributing, and sharing organizational knowledge. It involves personalizing knowledge and distributing it in a useful format to meet the specific needs of users. The knowledge is articulated in a common language using tools that are understood by all users. Among all the KM processes, the transfer/dissemination of knowledge is vital to organizational success, quality, and competitiveness. In universities, publications, presentations, websites, white papers, teaching and learning activities, policies, and reports are examples of mechanism used to disseminate/transfer knowledge.

Key KM Strategic Enablers

A comprehensive review of the literature reveals that there are four key KM strategic enablers - strategy and leadership, organizational culture, information technology (IT), and measurement which exert strong influence on KM processes. The enablers are presented in the following sub-sections.

Organizational Culture

Culture is a set of beliefs, which provides an identity for the organization, which in turn defines how the organization runs day to day. The set of beliefs include organizational purpose, criteria of performance, the location of authority, legitimate base of power, decision-making orientation, leadership style, compliance, evaluation and motivation (Schermerhorn *et al.*, 1991). There is a general agreement organizational culture is a critical factor that influences KM implementation success through the support it provides to making the KM processes effective (Chong, 2006a, 2006b; Gold *et al*, 2001). The significance of culture to KM is that a culture that best fits an organization's KM practices is one when employees do not feel any inhibitions about sharing knowledge. As such, the existence of an egalitarian (open and trusting) culture in which employees are willing to share and be involved in KM activities is therefore fundamental (Smith and McLaughlin, 2004). However, since culture is a complex entity of values, beliefs, behavior models, and symbols that an organization creates for itself (Schein, 1997), these so-called "artefacts" may not be easily interpreted. Further, the underlying beliefs which represent the values of an organization are seldom challenged, or even discussed, and are therefore difficult to change (Pettigrew, 1990). This explains why organizational culture can also become a major obstacle to KM implementation success.

Information Technology

Many researchers have insisted that effective and efficient KM processes are unthinkable without the support of information technology (IT) (Alavi and Leidner, 2001; Chong and Choi, 2005; Fairuz *et al.*, 2008a, 2008b). IT is firmly connected to KM because it helps to disseminate structural knowledge as well as makes it easily searched and utilized. Similarly, Beckman (1998) opines that KM enablers in the domain of IT are the infrastructures for IT that support KM activities, such as knowledge databases, knowledge platforms, performance evaluation systems, and performance integration systems. In this context, the educational background has evolved from a traditional teaching environment to a highly open and dynamic knowledge-based environment in the last decade. Many academic institutions have

been involved in the development and in the use of computer-supported cooperative work systems as well as instructional software applications to support e-learning initiatives (Ainslie, 2005; Thorn, 2001) These present new challenges to HEIs as far as KM implementation is concerned. Studies suggest that there is no tangible evidence that faculty members use information and communications technology (ICT) in performing their daily tasks in an effective manner. As a matter of fact, it is recognized that there is rather a dormant or open hostility from some academic and administrative staff to fully exploit the functionalities of information systems (McDermott and O'Dell, 2001). This leads Thorn (2001) to suggest a need for more research on how ICT can support the move of HEIs toward becoming an e-campus.

Measurement

Bavon (1995) defines performance measurement as the collection of information about effectiveness and productivity of individuals, groups, and larger organizational units. Performance measurement is related to the key areas of the organization, such as expansion, innovation and productivity, which is critical to the development of prosperity of an organization (Carneiro, 2001). Although KM has been widely debated and practiced, it appears that measurement is the least developed feature of KM (Boumarafi and Jabnoun, 2008). Many companies that have embarked on KM programs by spending huge amounts of money and time have begun to wonder if their efforts have been worthwhile. This could be due to the difficulty in defining KM, let alone measuring it. Because of the absence of consensus regarding the definition of KM, organizations have little or no understanding of the performance outcomes resulting from KM implementation (Ahmed *et al.*, 1999; Ahn and Chang, 2005; Chong, 2006b; Chong and Yeow, 2005; Ruggles, 1998). A measurement tool is thus necessary as a foundation to control, evaluate, and improve knowledge processes (Ahmed *et al.*, 1999) to ensure that KM stays on track (Coukos-Semmel, 2002). In this regard, many researchers concur that, since the value or an organization in the knowledge-based economy has to be based on intellectual capital (Lin and Tseng, 2005), using financial measures alone are not sufficient (Austin and Larkey, 2002; Chong *et al.*, 2006) especially in knowledge-intensive organizations such as the HEIs.

Leadership

Leadership refers to the ability of the leaders in an organization to align KM behaviors with organizational strategy, identify opportunities, promote the value of KM, communicate best strategies, facilitate the evolution of the learning organization, and provide metrics for assessing the impact of knowledge. It is for this reason that many researchers have insisted that top management leadership and commitment is the most critical factor for a successful KM project (Chong and Choi, 2005). In fact, poor leadership quality has been identified as a major threat to successful KM implementation (Civi, 2000). Since KM is people- and not technology-oriented, the move to integrate KM initiative in higher education not only involves deliberate and sustainable changes in policies and processes but also in terms of the culture of HEIs (Ahmed *et al.*, 2000). Leaders must have a correct mindset and cascade the knowledge-oriented culture of KM processes to make KM implementation successful (Davenport and Prusak, 1998). The cultural problem is considered a major challenge in KM implementation in HEIs because, instead of considering knowledge as an asset that increases

in value when shared, many faculty members consider knowledge as proprietary and something that is not shared freely (Wind and Main, 1999). Given the nature of academia and the emphasis placed on conducting primary research, it is not surprising that some faculty members view knowledge as a possible source of differentiation, and thus defer sharing certain aspects of their knowledge. When knowledge is viewed as a source of power it acts as a "separator" between the haves and the have-nots (Wiig, 1999) and in some cases, knowledge loss occurs. In this case, the top management is responsible to create a perception in their employees that "knowledge is not power", but "knowledge sharing is power" so as to prevent knowledge hoarding among the employees (Chong and Choi, 2005).

Having reviewed the literature, the next section presents the methodology used in this study.

RESEARCH METHODOLOGY

The public college universities which fall under the Malaysian Technical University Network (MTUN) were chosen. These HEIs were established based on models such as the *fachhochscule* (FH) in Germany, the IIUT system in France, the polytechnic university system in Hong Kong, and a few others. The common ground for the models was that of the "hands-on" approach, whereby students undergo practical sessions. Since the HEIs were established circa-2000s and are in their beginning stage of KM implementation, it would be interesting to study their KM processes as compared to long established full-fledged universities which are mostly set in their ways. However, these HEIs were upgraded to full university status in 2007. Nevertheless, since in essence the HEIs remain the same faculty wise and in physical structure, the institutions were retained as unit of analysis.

Within each of the HEI, all the academics were targeted to ensure a maximum return rate of the questionnaires. This is because since KM is relatively new in Malaysia, more so in the HEIs, a large collective response is pertinent before any conclusion is drawn. The academics were chosen because of their responsibility in generating knowledge through research and disseminating knowledge via teaching. Moreover, the academics are the ones who are faced with pressure to produce results from educational reform efforts, which in return results in more practitioner-based research initiatives (Jones, 2003).

Prior to administering the self-reporting questionnaires, permission was sought from the management of each institution either via telephone or letters. The questionnaires were then administered to all the academics with a cover letter explaining the nature of the study. To preserve anonymity, the HEIs are labeled to as A, B, C and D. Out of the 1353 questionnaires administered, 191 were returned, yielding a response rate of 14.4%.

The major research instrument used in this survey was a slightly modified version of the Knowledge Management Assessment Tool (KMAT) developed in 1997 by Arthur Andersen Consulting and the American Productivity and Quality Center. The questionnaire is divided into two sections to specifically address the two objectives determined in this study. A 57-item survey (rating strategies on two dimensions-"use" and "importance", as well as demographic profile) was used as the constructs in this study. The items on the importance and use of the key KM strategic enablers consist of four to eight descriptive statements utilizing a six point Likert scale ranging from 1 = not important at all to 5 = very important

for measuring the degree of importance, and 1 = not used at all to 5=extensively used for measuring the degree of use.

The instrument was piloted on 20 faculty members to check for appropriateness, readability, and comprehensiveness in the Malaysian context prior to its dissemination. As such, face validity is achieved. The Cronbach Alpha score is 0.876, indicating that the instrument is reliable (Sekaran, 2006).

RESULTS

Table 1 shows the profile of the respondents. Respondents from University C formed the majority, followed by University B and C.

Table 1: Demographic Profile

University	%
University A	11.5
University B	19.9
University C	53.4
University D	15.2

Table 2 shows the average mean and standard deviation scores for the degree of importance and level of use of the key KM strategic enablers in the institutions surveyed. IT scored the highest mean, followed by leadership, measurement, and culture. The mean scores are above 3.70, indicating that the enablers are considered important and are used. The standard deviation scores are all below one, implying that the respondents have consistently rated on all the elements. There are significant differences between all the key KM strategic enablers and the differences are highly significant

Table 2: Degree of Importance and Use of Key KM Strategic Enablers

KM Enablers	Degree of Importance		Rank	Degree of Use		Rank	t-value	*Sig.* (2-tailed)
	Mean	S.D.		Mean	S.D.			
Culture	3.96	.829	4	3.71	.667	4	3.261	.001
Leadership	4.14	.646	2	3.93	.646	2	3.214	.002
IT	4.39	.648	1	4.01	.667	1	5.673	.000
Measurement	4.14	.751	3	3.84	.868	3	3.533	.001

DISCUSSION AND IMPLICATIONS

The first objective of the study was to examine the degree of importance of the key KM strategic enablers for KM processes in HEIs. Table 2 shows that the academics placed higher importance to all the four enablers although the mean score for culture is slightly below 4.00. Two conclusions can be made here. First, corresponding to prior studies, all the four enablers are critical factors for KM implementation success in the HEIs (Ahmed *et al.*, 1999, 2000; Alavi and Leidner, 2001; Beckman, 1998; Chong, 2006a, 2006b; Chong and Choi, 2005;

Chong *et al.*, 2006; Civi, 2000; Coukos-Semmel, 2002; Fairuz *et al.*, 2008; Gold *et al*, 2001; Long, 1997; McKenzie *et al.*, 2001; Smith and McLaughlin, 2004). Second, since prior studies are conducted in the corporate sector, it can be concluded that both the academic and corporate sectors share the same concerns over the importance of the key KM strategic enablers to KM implementation success.

The second objective, which is to examine the use of key KM strategic enablers for KM processes in HEIs, has also been achieved. Similar to the rankings for the degree of importance, IT has been identified to be the most extensively used enabler in the HEIs. This is expected due to the campus-wide adoption of the relatively young HEIs of computers, Internet, Intranet, and instructional software applications. In addition, many HEIs are now subscribing to online databases and resources for teaching, learning, and research activities. To some extent, the use of ICT has allowed many KM activities to take place such as knowledge capture, storage, and transfer. The findings also imply that top management of the surveyed HEIs is giving priority to the adoption of innovative strategies such as KM. This makes sense judging from the year of establishment of these HEIs (circa-2000s). Measurement appears to have been used to assess KM activities but not in an extensive form. There are two possibilities. One, since HEIs are considered knowledge-intensive organizations, KM is measured in many ways similar to the modus operandi of the academics. However, since many of the HEIs have just begun to institutionalize KM, the academics cannot see how measurement contributes to their HEI's overall KM success, hence the lower mean scores. Similarly, the mean score for culture is relatively lower because many of the HEIs are still in their defining stages of their culture. They might even be unsure of what type of culture that is conducive to facilitate KM.

In relation to the third objective of the study, there are significant differences in the degree of importance and use of all the key KM strategic enablers, suggesting that the HEIs need to make more use of the enablers to facilitate their KM processes. First of all, the importance of establishing a proper KM structure in the HEIs cannot be overemphasized. Very few HEIs have a specific KM department and the degree and nature of knowledge sharing therefore depend entirely on the initiatives of individual faculty or small groups of academic members who share similar interests and enjoy the trust of each other. In this respect, the management of HEIs has an important role to play to initiate KM. One way is by placing the KM department on the map of their organization structure in order to elevate the importance of KM. The HEIs can either hire a KM specialist from outside or to second a member of the academic who is knowledgeable about KM to lead the department. At best, KM should be embedded in the vision and mission of the HEIs. In addition, it is not uncommon for the public HEIs to cite budget and hierarchical procedures as barriers to KM implementation. As such, the leaders must also ensure that all the possible constraints that impede KM implementation are removed as organizational constraints provide few incentives to the HEIs to innovate (West, 1992). Besides top management, leadership should also come from deans, directors, and head of departments of faculties, centers, and units. Further, the HEIs' bulletins should be capitalized to showcase success stories of KM implementation, particularly of other HEIs. From the human resource perspective, a criterion should be set where prospective hires must be able to contribute significantly to the KM processes.
The findings on IT imply that the HEIs must continue to capitalize or invest on its infrastructure to further mobilize their KM efforts. A proper KM system (KMS) has to be

put in place and implemented institutional-wide. According to Tiwana (2000), there is no silver bullet in KMS and every HEI can develop its own KMS that suits its knowledge agenda. By doing this, huge expenditure on KMS can be avoided. Once established, contributions to the KMS in the form of knowledge sharing must be made mandatory to all the academics and employees of HEIs from the highest to the lowest level by means of tying annual performance assessment and confirmation on the job to such contributions. From the measurement perspective, the KM efforts of the overall HEI need to be continuously tracked and measured by an evaluation system (for example, Key Performance Index) to create a check and balance of KM processes. The outcomes must be shared with the community within the HEI which can act as an incentive for the HEIs to further enhance their KM activities.

From the cultural perspective, the academics must be given proper training, both in terms of the importance of KM to institutional-wide performance and the use of KMS. Incentive programs have to be established, even in the public HEIs. The HEIs are in a better position to implement KM if employees know and are rewarded for openly and willingly sharing and applying each other's intellectual capital. Besides monetary incentives, longer-term incentives such as promotion, career development opportunities, training and development opportunities, annual leave, best academic award and other intangible benefits have to be drawn to attract the contributions of academics to KM.

Finally, a synchronized strategy of KM principles which should be applied to HEIs must be developed in tandem with their overall operating goals and aims. In the higher education environment, it is possible for a HEI's KM strategy to be extended to other stakeholders through partnerships and networking in order to design curriculum so that the graduates produced meet the competencies needed by the industry. On the other hand, the KMS can serve to inform what new academic or training programs is required by the industry so as to guide the efforts of program design and development. All these efforts moot the idea of knowledge creation, sharing and dissemination, specifically in the HEI setting.

CONCLUSION

This study contributes to the existing body of knowledge in terms of narrowing the gap by investigating the degree of importance and use of key KM strategic enablers in the HEI setting. The novelty of this study is that insofar, this has not been addressed in prior research. It is hoped that the findings would help the HEIs to undergo self-check of the various key KM strategic enablers so that actions can be taken to advance them and close the gaps. As stressed by Melton *et al.* (2006), the proper management of knowledge can provide an opportunity for organizational learning environment that improves and in turn creates a competitive advantage for organization as it reacts to today's organizational demands in a much more dynamic environment. In Malaysia, HEIs with improved performance will definitely help the nation towards achieving its status as the regional education hub of Asia.

In addition, the study also opens up the avenue for future research possibilities. Perhaps one of the major weaknesses of this study is the small sample size. A larger sample size across all the HEIs, both public and private may validate the arguments presented in this paper. It is possible for future studies to consider other important enablers such as employee training,

employee involvement, teamwork, employee empowerment, organizational constraints, benchmarking, knowledge structure (Chong and Lin, 2009), organizational strategy, and the like which have received significant research attention. In addition, prior research has shown evidence on the possible significant correlations between the KM processes, key strategic enablers, and organizational performance. An attempt on this may yield interesting results. Finally, this is a cross-sectional study; a longitudinal study is needed to capture the details.

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THE IMPACT OF THE INFECTIOUS DISEASES OUTBREAK ON BIOTECHNOLOGY STOCK PERFORMANCE

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ABSTRACT

Statutory infectious diseases breakout not only affects people's health and lives, but also stagnates the economic growth. However, in order to prevent or strain infectious diseases, the prevalence of infectious diseases also provides the development opportunities of biotechnology corporations. The impact of substantial diseases to stock prices had been investigated in previous literature (Chen, Jang, and Kim 2007, Rajiv, Henderson, and Raines 1993, and Wang, Tam, and Chang 2005). The effect of the statutory infectious diseases outbreak on Taiwanese biotechnology stock price movements is examined in this paper by using an event study. The expected return was derived using the market model and Ordinary Least Square (OLS). After observing nearly 10 years of major statutory infectious diseases in Taiwan, sample events include ENTEROVIRUS 71 in 1998, DENGUE FEVER in 2002, SARS in 2003 and H1N1 in 2009. There are 39 observations and the event periods are 15 trading days following the first confirmed case respectively. The empirical results point out that there exists a significantly positive abnormal return of Taiwan's biotechnology industry because of the statutory infectious epidemic.

Keywords: event study, abnormal returns, biotechnology industry, infectious diseases

I. INTRODUCTION

The current world population is over 6 billion. However, crowded residence and population density is getting higher, so that an increasing number of diseases transmitted easily between people. Moreover, the internationalization trends is unavoidable, the relations among nations become increasingly close. Population movements become very fast. A regional outbreak of disease may evolve into a global disaster. This may cause the world economic recession. For example, SARS was estimated to reduce Taiwan’s economic growth in 2003 by 0.5 percent (Waugh, 2003). As the disease spread, medicines, vaccines and related medical products of demand is increasing. It may be favorable to biotechnology industry.

Since the electronics industry account for most of the market value in Taiwan stock market, fewer investors pay less attention to the biotechnology industry. Although the Government set a number of policies to reward biotechnology industry, Taiwan biotechnology industry is still in embryonic stage. According to the Taiwan Stock Exchange, there are only thirteen listed companies in the biotechnology industry. Relatively to the whole Taiwan stock market, the market value of biotechnology industry is low. However, the technology and products of the biotechnology companies in Taiwan continue developing .There is a great potential of sustainable growth.

In the past, there is little research or analysis of Taiwan biotechnology industry. Specifically, the purpose of this paper is to investigate the infectious diseases outbreak how affect Taiwan's biotechnology stock performance. To test the biotechnology stocks investment performance diseases caused by the prevalence of infectious diseases whether significant cumulative abnormal return is different from zero. Event study analysis is applied to examine the relationship between the infectious disease outbreak and the Taiwan biotechnology stock performance. This paper is organized as follows. Section 2 presents the related literature. Section 3 then presents event study approach and describes the data. Moreover, section 4 presents the empirical results. Finally, section 5 concludes.

II. LITERATURE REVIEW

Davidson I.I.I, Chandy, and Cross (1987) used Event Study to examine large losses and stock returns in the airline industry. The period is from 1965 to 1984. The total sample consists of 57 air accidents which belong to 22 firms' .The sample partitioned into two subsamples. The first subsample included all crashes in which ten or more people lost their lives. The second subsample was derived from the first subsample and included the worst crash. The results showed that all reported crashes exist significantly negative abnormal return on day zero, crashes with multiple deaths is not statistically significant, and the most severe crashes exist significantly negative abnormal return on day zero.

Shelor, Anderson, and Cross (1991) used the Event Study to examine how California earthquake on October 17, 1989 effect the stocks performance of real estate industry. The sample is the 63 listed real estate companies, and divided into two groups. The first group is that corporate headquarters or primary operations concentrated in San Francisco Bay Area, the second group is not. The results showed that the first group exists significantly negative abnormal return on day zero and the second group of samples is not significant. This paper also indicates that there was no significant change in systematic risk.

Rajiv, Henderson, and Raines (1993) examine how Chernobyl Nuclear Accident effect the stock performance prices of utility industry in U.S... The samples are 69 companies listed on NYSE, and were divided into three groups (Nuclear Utility, Mixed Utility, and Conventional Utility). The results showed that there is significantly negative abnormal return of Nuclear Utility and Mixed Utility and there is no significant abnormal return of Conventional Utility.

Wang, Tam, and Chang (2005) examine how SARS catastrophe affects the stock performance of the Biotechnology Industry in Taiwan. The samples are Biotechnology Industry listed companies on TSEC and OTC. The Biotechnology industry is divided into

three major categories, Biotech pharmaceutical industry, Medical product industry, and other medical-related industry. The results showed that there is significantly positive cumulative abnormal return of Biotech pharmaceutical industry and Medical product industry after day zero. There is no significant abnormal return of other medical-related industries.

Chen, Jang, and Kim (2007) examine how SARS catastrophe affects the stock performance of Taiwanese hotel industry. The samples are Taiwanese listed companies on TSEC and OTC. The results showed that there is significantly negative cumulative abnormal return of Chemicals, Construction, Department Stores, and Foods sector over the intervals of day 0 to day 10. There are significantly negative cumulative abnormal return of Hotel, Textiles, and Automobile sector over the intervals of day 0 to day 10 and day 0 to day 20. However, Hotel sector has been affected most among all industries.

Wang, Tam, and Chang (2007) examine how Avian Influenza affects the stock performance of Taiwan's Biotechnology Industry. The samples are Biotechnology corporations listed companies on TSEC and OTC. The Biotechnology industry is divided into three major categories, Biotech pharmaceutical industry, Medical product industry, and other medical-related industry. The results showed that there are significantly positive cumulative abnormal return of Biotech pharmaceutical industry, Medical product industry, and other medical-related industries after day zero.

Chang, Chen and Lai (2008) used event study to investigate the impact for Japanese and US firms that announce nonequity Strategic Alliances. The results showed that shareholders earn larger abnormal returns in these alliances when the partnering firms are relatively small in size, have higher growth opportunities, or are less profitable. It also shows that company's performance has improved significantly subsequent to the formation of international alliances.

To sum up, serious events outbreak affect the stock performance of the each industries. There are significant abnormal returns of the each industry.

III. DATA AND METHODOLOGY

3.1 Data

The related data in the paper were obtained from the prospectuses of Taiwanese listed companies on TSEC, the TEJ database and the udndata. There are four specific events of infectious diseases breakout in Taiwan. It includes ENTEROVIRUS 71 in 1998, DENGUE FEVER in 2002, SARS in 2003 and H1N1 in 2009. The estimated period is 90 trading days before event period and contains 39 observations presented in Table 1.

The event period is 30 trading days. The event period of ENTEROVIRUS 71 is from May 7, 1998 to June 16, 1998, the announcement date is on May 27. 1998. The event period of DENGUE FEVER is from June 24, 2002 to August 5, 2002, the announcement date on July 14. 2002. The event period of SARS is from April 7, 2003 to May 20, 2003, the announcement date is on April 27. 2003. The event period of H1N1 is from July 9, 2009 to August 21, 2009, the announcement date is on July 30, 2009. Table 2 exhibit the

announcement date of each that is the day of the confirmed death case in Taiwan respectively.

Table1. Biotechnology Company Listed in Taiwan Stock Exchange

Company	**Date of being listed**
CHINA CHEMICAL & PHARMACEUTICAL	February 9,1962
GRAPE KING	December 20,1982
Yung Shin Pharma	May 3,1993
Standard Chemical & Pharmaceutical	December 12,1995
PIHSIANG MACHINERY MFG	March 21,2001
Maywufa	September 17,2001
Apex Biotechnology	September 17,2001
SINPHAR PHARMACEUTICAL	August 26, 2002
Johnson Health Tech	January 9,2003
EXCELSIOR MEDICAL	December 31,2007
APEX MEDICAL	November 8, 2004
PhytoHealth	July 16, 2008
SCI Pharmtech	January 7,2004

Table2. The Infectious Diseases, the Event Date and Number of Sample

The event(The infectious diseases)	The event date	Number of Company listed in TSE
ENTEROVIRUS 71	May 27, 1998	5
DENGUE FEVER	July 14, 2002	10
SARS	April 27,2003	11
H1N1	July 30,2009	13
Total		39

3.2 Event study

In order to examine the impact of the infectious diseases outbreak on biotechnology stock performance in Taiwan, the event-study methodology (ESM) is applied, which has been widely used to measure the effect of specific event on the value of a company. The specific events maybe affect the certain market or a particular industry.

The expected return was derived from using the market model and Ordinary Least Square (OLS) which establish the following regression model

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \qquad (1)$$

Average abnormal returns (AR) of t days can be calculated as

$$\overline{AR_t} = \frac{\sum_{i=1}^{t} AR_{i,t}}{N} \qquad (2)$$

where t = -15, -14, …, 0, …, 14, 15

Cumulative abnormal return (CAR) can be calculated abnormal return through *t* days from *b* accumulated to *e*, (-15≦*b*≦*e*≦15) , can be calculated as

$$CAR(b,e) = \frac{1}{N}\sum_{t=1}^{N}\sum_{t=b}^{e}(AR_{t,t}) \qquad (3)$$

where, *CAR*(*b*, *e*) is the average abnormal return from event *b* day cumulative to *e* day ,(*b*, *e*) is the event window.

Standardized cross-sectional test solve the cross-sectional test method for the shortage of test power. Boehmer、Musumeci and Poulsen (1991) published Standardized cross-sectional test. This paper uses the standardized cross-sectional for its t-test. The resulting t-statistic for SAR_{jt} is calculated as

$$t = \frac{\frac{1}{N}\sum_{j=1}^{N} SAR_{jt}}{\sqrt{\hat{\sigma}^2_{SAR_t}}} \sim N(0,1) \qquad (4)$$

where $\sigma^2_{SAR_t} = \frac{1}{N(N-1)}\sum_{i=1}^{N}\left(SAR_{it} - \frac{1}{N}\sum_{j=1}^{N} SAR_{jt}\right)^2$ and $SCAR_{jt} = \sum_{k=1}^{t} SAR_{jt}$

The *t*-test statistic for the $SCAR_t$ for standardized cross-sectional is calculated as

$$t = \frac{SCAR_{jt}}{\sqrt{\hat{\sigma}^2_{SCAR_t}}} \sim N(0,1) \qquad (5)$$

where $\hat{\sigma}^2_{SCAR_t} = \frac{1}{N(N-1)}\sum_{i=1}^{N}\left(SCAR_{it} - \frac{1}{N}\sum_{j=1}^{N} SCAR_{jt}\right)^2$

IV. THE EMPIRICAL RESULTS

Table3 presents standardized abnormal returns (SAR) of the biotechnology stocks. Empirical results show that there are significantly positive abnormal returns in days-15, -12, -11, -9, -5, -3, -2and1. It's statistically significant at 0.01 level in days-15, -12, -3and -2. It's statistically significant at 0.05 level in days -9 and 1. It's statistically significant at 0.1 level in days -11 and -5.There are significant negatively abnormal returns in days - 14, -13, -7, -1, 0, 3, 6 and 11. It's statistically significant at 0.01 level in days -14,-13,-1 and 11. It's statistically significant at 0.05 level in days -7 and 6. It's statistically significant at 0.1 level in days 0 and 3.

Causes of this phenomenon, the opinions of investors for biotechnology stocks affected by the epidemic views are not consistent. Some think that stock price of biotechnology will rise, other do not. The different AR indicated the varied investment behavior. Relative to Taiwan stock market value the market value of the biotechnology industry is low. There are not too many listed companies of biotechnology industry. Investors often ignored the biotechnology stocks. Moreover, foreign corporations hold most medicines or vaccines of disease. In other words, Taiwan's biotechnology companies often not have the enough power the disease of medicines or vaccines. Investors are unable to affirm that spread of the epidemic is favorable to biotechnology stocks. Hence, investors consider that risk of holding stocks is too high and begin to sell shares. That resulted in stock price fall as a whole.

Although stock market value of the biotechnology is low in Taiwan, the biotechnology companies in Taiwan have world-class technology and products. Some investors believe that Taiwan's companies are good enough to produce relative medicines and vaccines. Therefore, some investors consider spreading of the epidemic that is favorable to biotechnology stocks .It resulted in increasing of share price.

Table 3. The standardized average abnormal returns of biotechnology industry during the period of infectious diseases.

Event window	SAR	t-test	Event window	SAR	t-test
-15	0.4711	2.8949 ***	**1**	0.2974	2.3384 **
-14	-0.3316	-2.6626 ***	**2**	-0.2368	-1.3849
-13	-0.6917	-4.7291 ***	**3**	-0.4104	-1.7212 *
-12	0.5003	4.3983 ***	**4**	0.3899	1.4502
-11	0.1934	1.7056 *	**5**	-0.1346	-0.8160
-10	0.0400	0.4969	**6**	-0.2887	-2.4979 **
-9	0.3632	2.5443 **	**7**	0.0967	1.0086
-8	0.1909	1.1957	**8**	0.1660	1.1859
-7	-0.3151	-2.0579 **	**9**	0.1331	0.8929
-6	-0.0550	-0.4133	**10**	-0.0744	-0.7612
-5	0.3752	1.8681 *	**11**	-0.4673	-5.0300 ***
-4	-0.2274	-1.5447	**12**	-0.0524	-0.3829
-3	0.6404	3.4854 ***	**13**	-0.0058	-0.0562
-2	0.5913	2.7713 ***	**14**	-0.0889	-0.9179
-1	-0.6116	-3.6113 ***	**15**	-0.1755	-0.9253
0	-0.3498	-1.6644 *			

Note: * Significant at the 0.1 level. ** Significant at the 0.05 level. *** Significant at the 0.01 level.

Everyone had a different view to spread of the epidemic in future. The market atmosphere was chaos. Even a little incident will result in tremendous volatility in stock prices. Moreover, Taiwan is located in East Asia's transport hub, and the surrounding areas are quite close, such as China, Hong Kong, South Korea, Japan and Southeast Asia. The epidemic trend of neighboring regions also affects Taiwan's weighted stock price index. This makes the stock market atmosphere even more uncertain. In addition, political policy of Taiwan is chaos. The attitude of Taiwan government for the handling of the infectious diseases is often indefinite. Sometimes, it is being an ostrich. Sometimes there is a positive response. Therefore, the volatility of the stock is very dramatic.

Table 4 and figure1 present the trend of standardized cumulative abnormal return (SCAR). The empirical evidence found that there are significantly positive cumulative abnormal returns in days-15, -9, -8, -5, -3, -2, -1, 0,1 and 2 ; it's significantly positive cumulative abnormal return at 0.01 level in days-15, -3, -2 and -1; it's statistically significant at 0.05 level in days -8, -5, 0, 1 and 2; it's statistically significant at 0.1 level in day -9.There are rise on the trend between the days -12 to -2. It reached highest point and began gradually to fall the trend.

Table 4. The standardized cumulative abnormal return of biotechnology industry during the period of infectious diseases.

Event window	SCAR	t-test	Event window	SCAR	t-test
-15	0.4711	2.8949 ***	**1**	1.0809	2.3550 **
-14	0.1395	0.6933	**2**	0.8440	1.9631 **
-13	-0.5521	-2.3071 **	**3**	0.4336	1.0310
-12	-0.0518	-0.1672	**4**	0.8235	1.5329
-11	0.1415	0.4972	**5**	0.6890	1.3597
-10	0.1815	0.5857	**6**	0.4003	0.7265
-9	0.5447	1.6497 *	**7**	0.4970	0.8836
-8	0.7356	2.1949 **	**8**	0.6630	1.2438
-7	0.4205	1.2030	**9**	0.7961	1.4989
-6	0.3655	0.9868	**10**	0.7217	1.3924
-5	0.7406	2.0610 **	**11**	0.2544	0.4698
-4	0.5132	1.4955	**12**	0.2020	0.3498
-3	1.1536	2.6577 ***	**13**	0.1961	0.3402
-2	1.7449	3.5395 ***	**14**	0.1073	0.1789
-1	1.1333	2.7068 ***	**15**	-0.0682	-0.1162
0	0.7834	1.8235 **			

Note: * Significant at the 0.1 level. ** Significant at the 0.05 level. *** Significant at the 0.01 level.

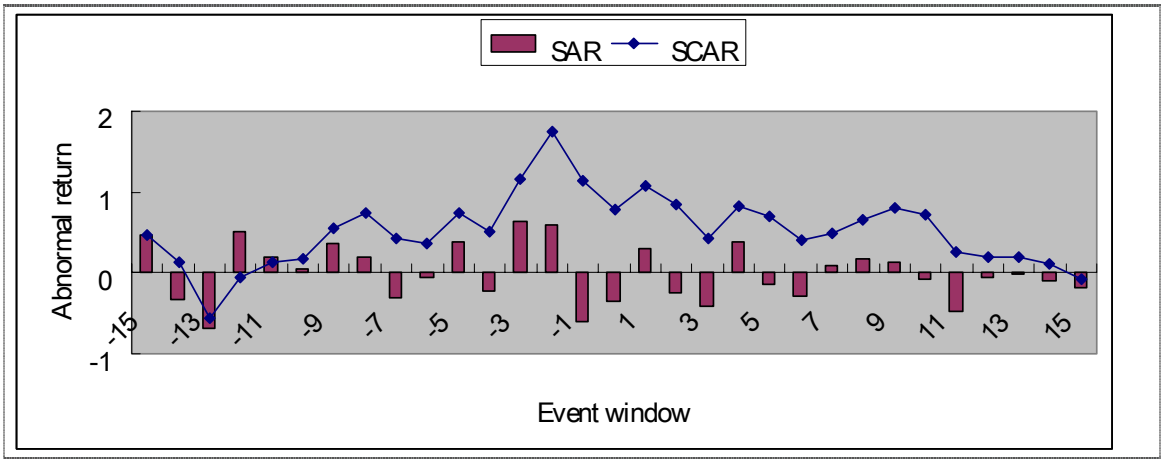

Fig. 1. ***The trend of SCAR***

As the whole, rising period of share prices is more than falling period, resulting in a significant positive cumulative abnormal return. Investors consider that the epidemic is favorable to biotechnology stocks before in day -1. As the disease spread, demand of medicines, vaccines and related medical products was increasing. That made cumulative abnormal return rises on the trend. There are fall in the trend of cumulative abnormal return after days -2. Investors consider that the effect is not arriving at the original expectations and cumulative abnormal return falls in the trend.

Table 5. Standardized Cumulative Abnormal returns over every event windows

Interval	SCAR	t-test
-15 to -1	2.235908	2.181853 **
-10 to -1	2.101354	2.019093 *
-5 to -1	1.447333	1.732808 *
-1 to 0	-1.75849	-2.53031 **
0 to 3	-1.63500	-2.19385 **
0 to 6	-2.02757	-2.25472 **
0 to 9	-1.00316	-1.01133
0 to 12	-2.22035	-1.89452 *
0 to 15	-3.10679	-2.83682 ***

Note: * Significant at the 0.1 level. ** Significant at the 0.05 level. *** Significant at the 0.01 level.

Table 5 presents Standardized cumulative abnormal returns separately over the periods, the SCAR over the event windows(-15, -1), (-10, -1), (-5, -1), (-1, 0) , (0, 3) , (0, 6) , (0, 9) , (0, 12)and(0, 15) are calculated. There are significantly positive cumulative abnormal returns of the period (-15, -1), (-10, -1) and (-5, -1). There are significantly negative cumulative abnormal returns of the period (0, 3), (0, 6), (0, 12) and (0, 15).

Obviously, the volatility of the stock is very dramatic. The SCAR is from positive into negative. According to reasoning as the disease spread, medicines, vaccines and related medical products of demand is increasing, it should be favor to biotechnology stock performance. But it's not come true when the first death was outbreak. It exhibits negative cumulative abnormal returns in event windows (-1, 0) and between the days 0 to15. Investors are overreacted caused this phenomenon. Investors are too optimistic about stock performance so that stock price overreacted. It began to amend stock price after day -1. Out of control of the epidemic may also be one of the reasons causing price revision. Investors judge that the information of first death was the epidemics maybe out of control. They consider that spread of the epidemic will result in economic recession. It may make biotechnology stock to drop.

V. CONCLUSIONS

This paper is to investigate the infectious diseases outbreak how affect Taiwanese biotechnology stock performance. Observations are stock performance of Taiwanese thirteen listed companies in the biotechnology industry. Observed events are major infectious diseases, including ENTEROVIRUS 71, DENGUE FEVER, SARS and H1N1 nearly 10 years. We observed that biotechnology stock price exists significant positive cumulative abnormal returns before the announcement date and significant negative cumulative abnormal returns after the announcement date. We found that the outbreak will cause the overreacted stock prices.

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RISK MANAGEMENT OF A BIO-TECHNOLOGY BASED COMPANY: APPLYING SYSTEMATIC REISK MANAGEMENT METHODOLOGY INTO AN AGRI-PRODUCT PRODUCTION SYSTEM

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ABSTRACT

Risk Management is an on-going activity of the management in all organisations. This paper first defines risk in theoretical terms. Risk here is defined as an event whose occurrence is not certain and whose consequences impact negatively. This paper presents two ways in categorizing the risks for managerial purposes. The presented framework takes a holistic approach to risk management allowing risks to be managed in several different means: Contingency planning, Early control, Information acquisition, Cause removal, Backup planning, Risk sharing, Insurances. The proposed risk management framework is then applied to a production system where agriculture products are processed to industrial products.

Keywords: risk, risk management, bio-materials, agricultural production

INTRODUCTION

The basic idea of the risk management is very simple. We want to gain something: either to get better profit or for example to win time and to deliver better solution in a shorter time. In many cases the money is the strongest motivation and by taking risks there are possibilities to make profits. It's always the fact that by taking the bigger risk you might get better returns, but also to loose more. When managing risks - using risk budget - there are better possibilities to handle situation e.g. a delivery of a solution and to have less changes to fail.

There are several definitions of risk available. The risk, by definition has several aspects;

- consequence
- uncertainty
- connection to an event or to an act or to a thing
- addressable

A definition of risk can be formulated in the following ways:

Table 1. Definition of Risk

Risk is an event whose occurrence is not certain and whose consequences impact negatively (on the project, operations etc.)	RiskMan, 1994
Risk is the possibility of suffering harm or loss, or exposure to this	RiskMan, 1994
Risk is an exposure to the possibility of economic or financial loss or gain, physical damage or injury, or delay, as a consequence of the uncertainty associated with pursuing a particular course of action	Cooper & Chapman, 1986
Risk is the possibility of loss or injury	Boehm & Ross, 1989
Risk is the concept that captures the uncertainty, or more precisely, the probability distribution associated with the outcome of resource commitments	Bowman, 1982
Risk is the potential for realization of unwanted, negative consequences of an event	Rowe, 1988

From a management point of view, a risk is an occurrence which may or may not happen, but if it does it will have unpleasant consequences. The realization of a risk is likely to require additional resources, delay completion, have financial costs, or in other ways harm the reputation of the organization and the achievements of its objectives.

In order to manage risks, it is necessary to define it in terms of the following:

- **The risk drivers:** These are the factors that may make risk(s) occur. They are important for the management of the probability of occurrence
- **The probability** is the likelihood that a risk will occur. This will be used in order to evaluate the overall project risk exposure in case of project risk management. The accuracy with which this can be predicted will increase as the project proceeds, and considerable thought has been given to assisting management in defining it at as early stage as possible.
- **Indicators to measure development** is a conscious process to be implemented to ensure the occurrence of the risk(s) identified. In some cases managers can reduce the impact of a risk if he is immediately informed that it has happened.
- **The risk cost** involves both the cost of damage and the cost contingency plan that will be invoked to overcome any problem arising. The cost must be measured both in terms of time and money.
- **Consequential risks –** risks have a nasty habit of occurring in clusters which have a synergistic effect in the harm they cause. When a risk has a down-stream effect on another risk(s), there is sometimes a new risk that the combined effect is greater than the sum of the original risk.
- **A class** is used to categorise risks into different types by their nature.

RISK CLASSIFICATION

It is useful to make a classification of risks because:

- risks need to be managed appropriately - the need for identification, qualification, analysis, reduction techniques as well as follow up procedures requires classification
- risks need to have owners responsible for their management
- risks must not be overlooked - classification leads to an efficient analysis

Here we classify the risks into classes, which classification is based on the following rules:

- the classes reflect the different specialisations involved on the project or business operation
- the classes represent the whole life cycle of the project and the resulting product
- the classes are compatible with the levels of the decision making inside the organisation.

The risk classes are as follows:

Table 2. Risk Classification

Risk Class	Risk Characterisation
Strategic risks	Anything related to the company's strategic belongs to this class: profits and losses, investments, shares of market segment, image, … Naturally all projects and activities do not involve a strategic level, and this type of analysis is requested when the project risk exposure is considerable, even after risk reduction.
Commercial risks	This class includes any problem related to the sale of the project or product, the customer follow up, the pricing and the possible updates
Management risks	These are tied to organization – resources and teams, schedules, subcontractors, estimations
Project risks	This category includes all risks caused by the technical aspects of the project: specification, design, realization, integration, validation
Operational risks	These are risks that are perturbations (failures) during operation which can cause significant damages and eventually can be dangerous for human life
Maintenance risks	Risks that are caused mainly by over-costs in corrective, evolutionary and preventive maintenance

The following example presents the risk drivers of a commercial risk illustrated by a cause-effect diagram. This technique is very useful to evaluate the probability and impact of any risk.

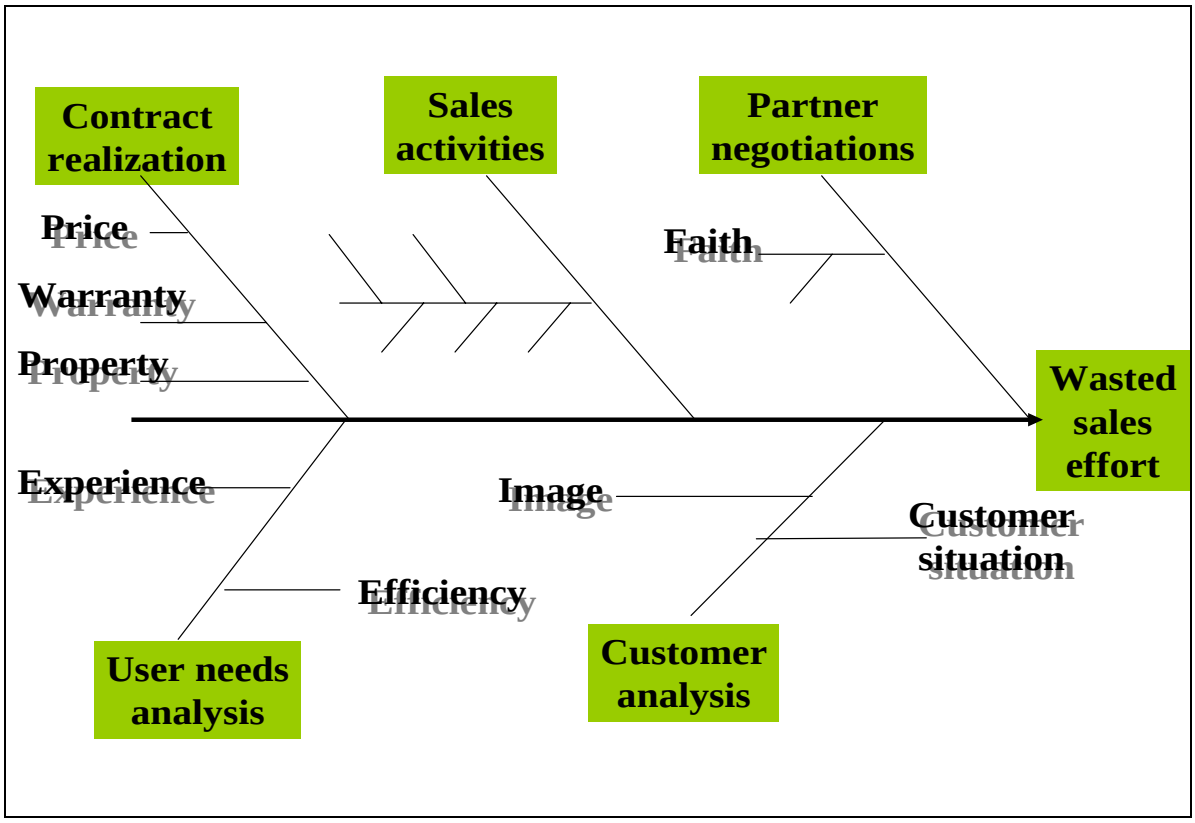

Figure 1. Cause-effect risk analysis

RISK DRIVE MANAGEMENT

For the efficient risk management we define seven risk reduction exes:

1. Contingency
2. Early control
3. Information acquisition
4. Cause removal
5. Backup plans
6. Risk share
7. Insurance

These can be presented graphically as in figure 2.

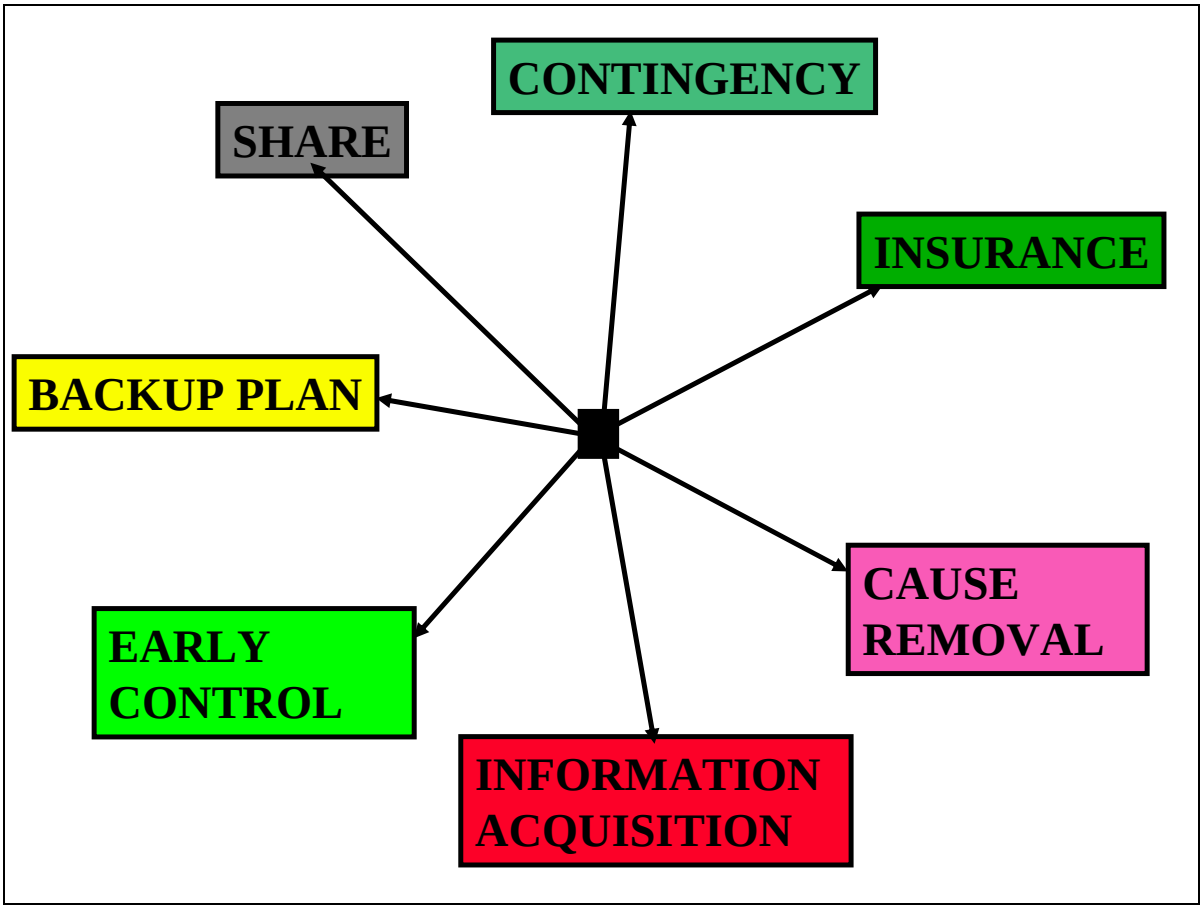

Figure 2. Risk reduction axes

RISK EXPOSURE

The Risk Exposure is a function of the impact value and of the probability of the occurrence:

risk exposure = impact value X probability of occurrence

Based on the evaluation of the risk exposure we can have the following risk categories:

1. **Unacceptable risk**: exposure of risk which can jeopardize the company strategy and/or present dangers for human lives and/or represents an outstanding financial exposure
2. **Critical risk**: exposure of risk which can penalize the company strategy, and/or represent a significant financial exposure
3. **Significant risk:** which can cause operation problems but id budgetable
4. **Minor risk:** which does not cause any significant problem and represents small financial amounts.

APPLICATION OF THE RISK MANAGEMENT METHOD TO AN AGRI-PRODUCT PRODUCTION

In the following table the risk analysis has been made to a production system, where the raw materials come from agricultural production.

Table 3. Risk Analysis

Process Unit	Risk Class	Risk Characterization	Risk Reduction	Owner of the Risk
Raw Material Handling and transportation	Strategic	* subcontractor problems	* back-up plan	
	Commercial	N/A	N/A	N/A
	Contractual	* sub contractor problems	Early control	
	Management	* scheduling problems	* development of a scheduling system	
	Operational	N/A	N/A	
	Maintenance	N/A	N/A	
Process Unit	Risk Class	Risk Characterization	Risk Reduction	Owner of the Risk
Biotechnical processes	Strategic	* entzyme problems	* continuous R&D	
	Commercial	N/A	N/A	N/A
	Contractual	* enzyme acquisition problems	Early control	
	Management	* scheduling problems * costs out of control	* development of a scheduling system	
	Operational	* process stability * quality problems	* process control *R&D * continuous process improvement	
	Maintenance	None	N/A	
Process Unit	Risk Class	Risk Characterization	Risk Reduction	Owner of the Risk
Substrate Production	Strategic	None	N/A	
	Commercial	* no markets * low sales prices	* market research * own mushroom production	
	Contractual	* long term supply controcts fail	Early control	
	Management	* scheduling problems	* development of a scheduling system	
	Operational	* Utilities * Process stability	* back up plan * R&D	
	Maintenance	None	N/A	

Process Unit	Risk Class	Risk Characterization	Risk Reduction	Owner of the Risk
Side Product Production	Strategic	* wrong product families	R&D	
	Commercial	* no markets	• market research • partners from EU/Japan/USA	
	Contractual	* penalties	* good contracts	
	Management	* scheduling problems	* development of a scheduling system	
	Operational	* contamination	* continuous quality improvement towards ISO 9000	
	Maintenance	None	N/A	

Utilizing Riskman Tools

The presented risk management approach can be used for managing the business process improvement and risk management actions. The approach allows for managing "traditional BPI actions" and risk management actions in an integrated manner. In addition, the presented methodology in a complementary way monitors the risks and the risk management actions in defining a top risk list and associated risk reports.

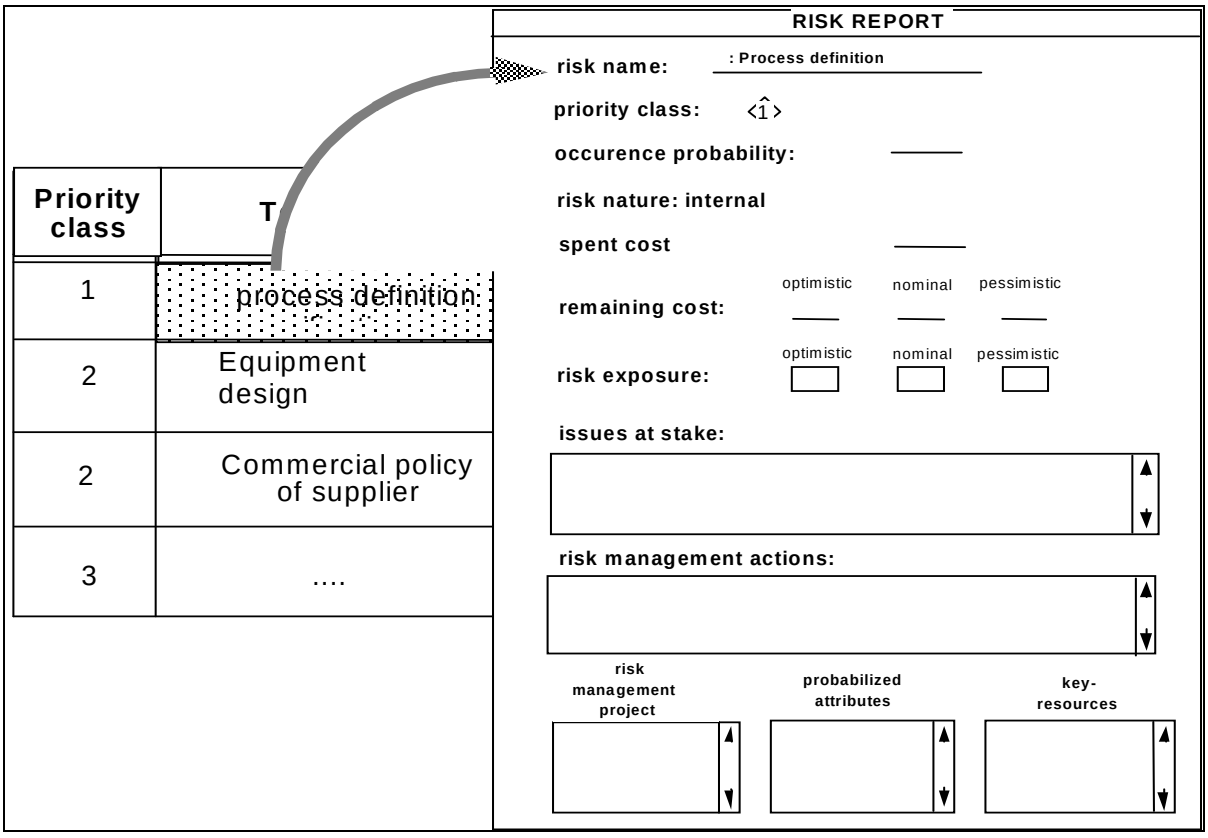

Figure 3. Top 10 risks and their management

Besides, this it is possible in more realistically estimating the cost, benefits and schedule in using its probabilistic estimation and scheduling function that is based on the Monte Carlo simulation.

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ADOPTION OF ISLAMIC BANKING AS AN INNOVATIVE BANKING SERVICE IN THE RURAL REGIONS OF MALAYSIA: A CONCEPTUAL FRAMEWORK

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ABSTRACT

The aim of this study is to identify factors that affect the adoption of Islamic retail banking services among the banking consumers in Malaysia, specifically in the rural regions of Malaysia. Islamic banking has evolved as a new reality in the international financial scene since 1970s. As competition intensifies, Islamic banking is no longer regarded as a business entity striving to fulfill only the religious obligations of the Muslim community, but more significantly as an innovation in the banking industry, that ought to be, as competitive as conventional banking. Specifically, the objectives of this study are to (1) determine factors which affect the Islamic banking adoption in the rural regions of Malaysia (2) analyze the perception and preferences of Muslim consumers in the rural regions of Malaysia in regard to Islamic retail banking services; (3) To analyze the perception and preferences of non-Muslim consumers in the rural regions of Malaysia in regard to Islamic retail banking services; (4) To examine the moderating effect of personal characteristics on intention to use Islamic banking services in the rural regions of Malaysia. A set of survey questionnaire will be developed and distributed to 400 rural bank customers maintaining accounts with the conventional banks. Multiple analytical techniques including factor analysis (SPSS), t-test, Friedman test, multiple regression analysis will be used to analyze the data and develop the model. This study aims to fill the gap in the literature by providing concrete evidence on consumer adoption of Islamic banking in Malaysia, particularly in the rural regions of Malaysia. The findings will be useful for the banking sector in understanding the rural customer's needs and preferences regarding Islamic Banking services.

Keywords: Islamic banking, Adoption, Rural, Malaysia

INTRODUCTION

Research Background

According to a research study conducted by Fazlan et al., (2007), the emergence of interest-free financial institutions has created a new dimension to economic models Widely known as Islamic banks, these interest-free institutions are organized financial intermediaries which operate in accordance with Islamic law (*Shariah Law*) (Iqbal et al., 2007; M.Kabir H and Mervyn KL, 2007). The term "Islamic Banking" is defined as the conduct of banking operations in consonance with Islamic teachings (Mirakhor, 2000; Haque et al., 2007). The main principles of Islamic banking activities comprise of prohibition of interest or usury (*riba)* in all forms of transaction, undertaking business and trade activities on the basis of fair and legitimate profit, giving *zakat* (alms tax), prohibition of monopoly, and cooperation for the benefit of society and development of all *halal* aspects of business that are not prohibited by Islam (Haron, 1997; Mirakhor, 2000). Unlike conventional banking system, the Islamic banking system prohibits usury (*riba*), the collection and payment of interest, instead, it promotes profit-sharing in all conduct of banking businesses (BNM, 2007).

Over the past four decades, Islamic banking has emerged as one of the fastest growing industry, at an estimated growth rate of 15-20 percent per annum (Haque et al., 2007). It has spread to all corners of globe and received wide acceptance by both Muslims and non-Muslims (Aziz ZA, 2006). Great emphasis is given by the Malaysian government to develop a well functioning and efficient Islamic banking system. It is not a coincidence that Islamic banking is making its progress in Malaysia but it is the Malaysian government's vision to develop a progressive and robust Islamic banking industry, rooted in the Islamic core values and principles that best serve the needs of the nation's economy. It is the aspiration of the Malaysian government to have a strong Islamic banking industry capturing 20 percent of the market share of financing and deposits in the Malaysian financial industry by 2010 (Aziz ZA, 2007).

While the opportunities for Islamic banking will continue to grow there is a need to develop products and services that are in line with the changing needs and demands of customers to remain competitive in the business. A feature of the banking industry across the globe has been that it is increasingly becoming turbulent and competitive (Sohail and Shanmugham, 2003). The process of globalization and liberalization together with digitalization has fueled the intensity of business competition today. Islamic banking in Malaysia, as one of the most important players in the service industry is faced with stiff competition, not only with the long established conventional banking system and the international players but also within themselves.

As competition intensifies and as one of the most important players in the service industry today, Islamic banking is no longer regarded as a business entity striving to fulfill only the religious obligations of the Muslim community, but more significantly as an innovation in the banking industry, that ought to be, as competitive as conventional banking. This necessitates Islamic financial institutions to really understand the needs of their customers towards Islamic banking services. In Malaysia, customers' positive perception towards Islamic banking is far more crucial mainly due to the fact that Islamic banks have to compete with the

dominant and long established conventional banks in a dual-banking system, since 1983 (Asyraf, 2007).

Moreover it is nearly three decades now, ever since Islamic banking was launched in Malaysia, way back in 1983, when Bank Islam Malaysia Berhad (BIMB) first commenced its operations. And it is the aspiration of the Malaysian government to turn Malaysia into a regional Islamic banking hub. However, the market share of Islamic deposits and financing as of 2009, stood at only 18.2 and 17.8 percent of the industry's total, despite twenty seven (27) years of operation (Bank Negara Malaysia, 2009).This implies, although the number of Malaysian banking consumers using Islamic banking products and services are growing, a majority still have not adopted the system particularly in the rural regions, whereas the rural population of Malaysia, comprises of about 38 percent, of the total population of 28 million people (Department of Statistics Malaysia, 2009).

Against this backdrop, the present study aims to address the problem: ***What factors affect the consumer adoption of Islamic banking in the rural regions of Malaysia?*** The problem will be addressed from the customers' perspective, within the context of retail banking services, in particular the rural regions of Malaysia.

Specifically, the study sets out to address the following research questions:

i) What are the factors that affect Islamic banking adoption in the rural regions of Malaysia?

ii) Are there any significant differences between the preferences of Muslim banking consumers in the rural regions of Malaysia in regard to Islamic retail banking usage?

iii) Are there any significant differences between the preferences of non-Muslims banking consumers in the rural regions of Malaysia in regard to Islamic retail banking usage?

iv) How do the rural banking consumers of Malaysia perceive Islamic banking?

LITERATURE REVIEW

In early 1990s, the scope of Islamic banking studies was extended to leading issues in Islamic banking system. In the Southeast Asian context, the Malaysian experience in Islamic banking has been very encouraging. Saad Al-Haran in his book, "Leading Issues in Islamic Banking and Finance", highlighted that for a viable Islamic Economic System to operate critical issues on product development and market research have to be addressed first. His line of argument was not only confined to Bank Islam Malaysia Bhd that lacked the marketing research during that point of time but also to most conventional banks which have underestimated the importance of marketing of their product to the customers (Saad Al-Haran, 1995) . While studies on consumer adoption of Islamic banking services in Malaysia remain scarce, almost all of these studies largely focused on the combination of various factors such as religion, relative cost and benefits, service delivery, staff competency and convenience (Saad Al-Haran, 1995).

Further studies related to Islamic banking adoption also affirm that the selection of Islamic banks appears to be predominantly a combination of Islamic and financial reputation and quality service offered by the banks, whilst other factors such as good social responsibility practices, convenience and product pricing are also considered to be important (Abbas et al., 2003; Asyraf and Nurdianawati, 2006). Asyraf and Nurdianawati (2006), also critiqued the earlier studies stating Islamic banking as one of the most important players in service industry today, should no longer be regarded as a business entity striving only to fulfill the religious obligations of the Muslim community, but more significantly as a business that is ineluctably in need for winning over customers. Recent studies conducted by Ahasanul et al (2007), highlighted that demographic factors such as gender and race showed significant relationship with overall perception towards Islamic bank (Ahasanul.H, 2007).

As opined by Fazlan and Mohammad (2007), in practice, much of the decision to adopt is influenced by two major factors. Firstly, the perceived attributes of the innovation and secondly the characteristics of the consumers. Accordingly, Yusof's (1999) study on Islamic banking adoption in Singapore focused mainly on the perceived attributes of innovation and consumer's characteristics (Yusof M.Y.R, 1999). He argued that the initial influence arises from the attributes of an innovation itself and the way in which these present the possibility of improvement and second is the personal characteristics of the consumers, such as attitudes, beliefs and human values. However, less emphasis was given by Yusof in his study to variables such as consumer awareness and knowledge on Islamic banking schemes. Moreover, variables such as the influence of communication channels and the change agent's promotional efforts also were not included in his studies (Rogers E.M, 2003).

Whereas, Gerard in his study has stressed the significance of customer awareness, product knowledge and informative advertising campaigns (Philip and Cunningham, 2003). In addition, although some of the factors like cost, perceived risk, reliability, promotion and competence of bank staff have been tested widely in adoption studies related to Conventional Banking, Internet banking and Self-Service Technologies, adoption studies remain rare with regards to Islamic banking in Malaysia (Sathye, M., 1999; Suganthi et al., 2001; Jamal and Neser, 2002; Sureshchandar et al., 2003). Islamic banking studies in Malaysia indicates religion as the most important reason for customers patronizing Islamic banks contradict those findings by Haron et al. (1994) and Gerard and Cunningham (1997). It was critiqued by Norafifah and Haron (2002) in their study conducted in Malaysia that Islamic banks should not only rely on the religious factor as a strategy in its effort to attract more customers, but emphasized on service level efficiency and situational factors as pertinent factors that would determine its future competitiveness (Norafifah A., and Haron S., 2002).

Apart from the above, in the context of Malaysia, the previous studies related to Islamic banking adoption is limited in scope either due to limited sample size or restrictive in representation (Asyraf and Nurdianawati, 2007). As opined by Asyraf and Nurdianawati (2007), research by Ahmad and Haron (2002), for instance was represented by only 45 respondents. As for Kader (1993, 1995) and Haron et al (1994), their sample was restrictive in the sense that they were collected from one single location or district. For example, in Kader (1993, 1995), the survey was confined to one location, that is, Kuala Lumpur. Similarly for the studies conducted by Haron et al., (1994), the samples were drawn from three towns namely: Alor Setar, Sungai Petani and Kangar. Whilst, Asyraf and Nurdianawati

(2007) in their research have included only the major cities of Malaysia, that is, Kelantan, Penang, Kuala Lumpur and Johore and did not cover any towns from the rural regions and rural regions of Malaysia. These efforts could be inadequate to represent the overall needs and wants of the banking consumers in Malaysia. Therefore, samples to conduct a comparative analysis for this study will be drawn from the major cities and towns classified as minor settlement regions (rural) of Malaysia, in order to cover wider scope of representation.

Furthermore, most of the previous Islamic banking adoption studies were represented by only Muslim consumers (Kader, 1993, 1994; Gerrard and Cunningham, 1997; Saad and Almossawi, 1998; Yusoff, 1999; Naser, 1999; Haron, 2002; Gerard, 2003) and only limited studies have included Non-Muslims as respondents (Hussain 2005; Ravindran and Shanmugam, 2006; Ahasanul et al., 2007; Asyraf and Nurdianawati, 2007). Thus, in this study, the samples will be drawn from both Muslim and non-Muslim banking consumers who reside in the rural regions of Malaysia.

As the government strives to build Malaysia as the regional Islamic banking hub, specific studies are needed to help the government learn more about the voice of Malaysian banking consumers regarding Islamic banking. Such studies will reveal the perceptions of the consumers in Malaysia towards Islamic banking services and provide a framework to approach the prospective consumers. In this context, it is imperative to examine empirically the factors affecting the adoption of Islamic Banking in Malaysia, extending the scope, from the urban regions to the rural regions. Clear understanding on customer needs, wants and preferences will help Islamic financial institutions to craft appropriate marketing strategies to take a larger share of the financial market. After all, the customer is the final arbiter who determines the market share of any industry (Kotler P. and Gary A., 2001).

RESEARCH OBJECTIVES

The proposed research will be conducted based on two categories of objectives that are general and specific objectives. The general objective of the present study is *to understand the nature of consumer adoption of Islamic banking, in particular retail banking, in the rural regions of Malaysia.* The specific objectives are as follows:

- To determine the factors that affect Islamic retail banking adoption in the rural regions of Malaysia.

- To analyze the perception and preferences of Muslim consumers in the rural regions of Malaysia in regard to Islamic retail banking services.

- To analyze the perception and preferences of non-Muslim consumers in the rural regions of Malaysia in regard to Islamic retail banking services
- To examine the moderating effect of personal characteristics on intention to use Islamic banking services in the rural regions of Malaysia.

CONCEPTUAL FRAMEWORK

Theory of Diffusion of Innovation

One of the widely used models in the area of innovation adoption is Rogers' "Diffusion of Innovation" theory (Rogers E.M, 1999, 2003). The scholarly work of Roger (1962) has encouraged research studies in the area of diffusion and adoption extensively (Rogers, 1999, 2003). Approximately 5,200 diffusion studies had been identified by Rogers (2003) while working on the 5th edition of his text. In general, the adoption process has been defined as the process through which individual adopters pass from awareness to full acceptance of a new innovation (Rogers E.M, 1999; 2003). According to Roger there are two levels to adoption. Initially, innovation must be purchased, acquired and adopted by individuals or organizations. Subsequently, it must be either accepted or rejected by the ultimate users in the society or community. The relative newness of these innovations and the associated uncertainty is what differentiates innovation adoption decisions from other types of decision making (Gerard et al., 2003).

However getting a new idea adopted, even it has obvious advantages, is difficult. Many innovations require a lengthy period of many years, from the time when they become available, to the time when they are widely adopted. Furthermore the same innovation may be desirable for one situation but undesirable for another potential adopter, whose situation differs (Erol et al., 1989; Erol et al., 1990; Gerard et al., 2003). Rogers (2003) identified five main characteristics of innovations: Relative advantage, compatibility, complexity, observability and trialability as the most important explanation of the rate of innovation adoption (Yusof, 1999; Sohail et al., 2002; Rogers, 2003). Most of the variance in the rate of adoption of innovations, from 49 to 87 percent is explained by these attributes (Rogers, 2003). Thus, the diffusion literature provides an ideal framework to be applied to the present study which, seeks to extend the research area in a service innovation context, the innovation being Islamic banking. The study would determine which factors according to Rogers' framework (2003), would fare when applied on a service innovation, more particularly retail banking services which conform to Islamic principles.

Therefore the dependent and independent variable of primary interest to this research is derived from the theory of Diffusion of Innovation model (Rogers, 2003).

Research Variables

Islamic banking adoption being the dependent variable, the independent variables include: Consumer Awareness, Relative Advantage, Compatibility, Complexity, Trialability, Observability and Uncertainty.

Consumer Awareness

Adoption is the acceptance and continued use of a product, service or idea. According to Rogers (2003), consumers go through a process of knowledge, persuasion, decision and confirmation before they are ready to adopt a product or service. Knowledge occurs when an individual or other decision-making unit is exposed to an innovation's existence and gains an

understanding of how it functions (Rogers, 2003). He has quoted this as the "Pre-contemplation" stage. Consumer awareness have been tested as one of the key variable in numerous studies specifically in the area of on-line banking, internet-banking and self-services technology adoption (Sathye, 1999; Suganthi et al., 1999; Yusof, 1999; Gerad et al., 2003).

However, limited studies have investigated on consumer awareness in the area of Islamic banking adoption. Haron (1994), in his studies stated that about 100 percent of the Muslim population and 75 percent of non-Muslims are aware of the existence of Islamic banking services in Malaysia and out of this only 63 percent understood the difference between Islamic banks and conventional banks. Whereas, some studies reported, Muslim respondents, though aware of fundamental terms in Islam, were almost exclusively unaware of the meaning of specific Islamic financial terms like Mudaraba, Musharaka and Ijara (Gerard, 1997; Kamal et al., 1999).

Proposition 1: *There is a positive relationship between customer awareness and the usage of Islamic banking.*

Perceived Relative Advantage

Relative advantage is defined as the degree to which an innovation is perceived as being better than the 'idea' it supersedes (Rogers, 1999). Potential adopters want to know the degree to which a new idea is better than an existing one. According to Yusof (1999), diffusion scholars have found relative advantage to be one of the best predictors of an innovation's rate of adoption. Rogers (2003) found that adopters invariably perceived relative advantage in terms of the economic benefits and the costs resulting from the adoption of an innovation and improvements that are afforded to their social status. In addition to these, economic profitability, low initial cost, a decrease in discomfort, social prestige, savings in time and effort and the immediacy of the reward, have been described as the sub-dimensions of relative advantage (Gerard, 2003). Therefore, the present study intend to investigate the economic benefits (profits earnings, service charges and incentives) and service delivery (fast and efficient service, staff competency) of Islamic banking services, within the framework of relative advantage.

Proposition 2: *The adoption of Islamic banking by the Malaysian banking consumers is positively related to the perceived relative advantage of using Islamic banking services.*

Perceived Compatibility

Compatibility is defined as the degree to which an innovation is perceived as being consistent with existing values, past experiences and the needs of potential adopters (Rogers, 2003). Thus, compatibility is a measure of the values or beliefs of consumers, the ideas they have adopted in the past, and the ability of an innovation to meet their needs (Gerard, 2003). As such, in regards to banking experiences and practices, the Malaysian banking consumers have already possess banking habits from the long operating conventional banks and Islamic banking functions and operations are not new to them. Therefore it is crucial to test the

consistency (felt need, previous banking methods) of Islamic banking services as it may have significant impact on the consumers' willingness to adopt.

Proposition 3: *The adoption of Islamic banking services is positively related to the perceived compatibility of using Islamic banking services.*

Perceived Complexity

Complexity is the degree to which an innovation is perceived as difficult to understand and use (Rogers, 2003).As opined by Yusof (1999) any idea could be classified on the complexity-simplicity continuum. Some innovations are clearly understood by potential adopters whereas others are not. Therefore, complexity has been measured in relation to perceptions about the purpose of the respective innovation, its intended use and the ease with which it can be used (Gerard, 2003). It is believed that there is a negative relationship between complexity and adoption rate (Rogers, 2003; Gerard, 2003).

Proposition 4: *The adoption of Islamic banking services is negatively related to the perceived complexity of using Islamic banking services.*

Observability

Observablity is described as the degree to which the results of an innovation are visible to others (Rogers, 2003). Some ideas are easily observed and communicated to other people, whereas other innovations are difficult to observe or describe to others. According to Yusof (1999) and Gerard (2003) this is especially true for a service where the characteristic of intangibility will hinder its visibility. Using this argument in the context of Internet banking Gerard (2003), highlighted that observability does not appear to be a contributor to the adoption of Internet banking since it is most unlikely that Internet banking uses are prepared to show the results of their financial dealings to third parties. However Yusof (1999) in his studies, opined that in the case of Islamic banking adoption, it is possible that Muslim consumers would find it easy to explain and provide evaluative feedback to others regarding the benefits of using Islamic banking services, which would further enhance adoption.

Proposition 5: *The adoption of Islamic banking services is positively related to the perceived observability of using Islamic banking services.*

Uncertainty

Uncertainty is the degree to which a number of alternatives are perceived with respect to the occurrence of an event and the relative probabilities of these alternatives (Rogers, 2003). Uncertainty motivates individuals to seek more information, as it is an "uncomfortable state of mind". According to Roger (2003) a kind of uncertainty is generated by an innovation that is perceived as new by an individual or another unit of adoption. The perceived newness of an innovation, and the uncertainty associated with this newness is a distinctive aspect of innovation decision making process, that is, either to adopt or reject an innovation. Thus perceived risk, trust and reliability of the system are known to be some of the attributes of uncertainty (Philip.K and Armstrong, 2001; Rogers, 2003). It is believed that there is a

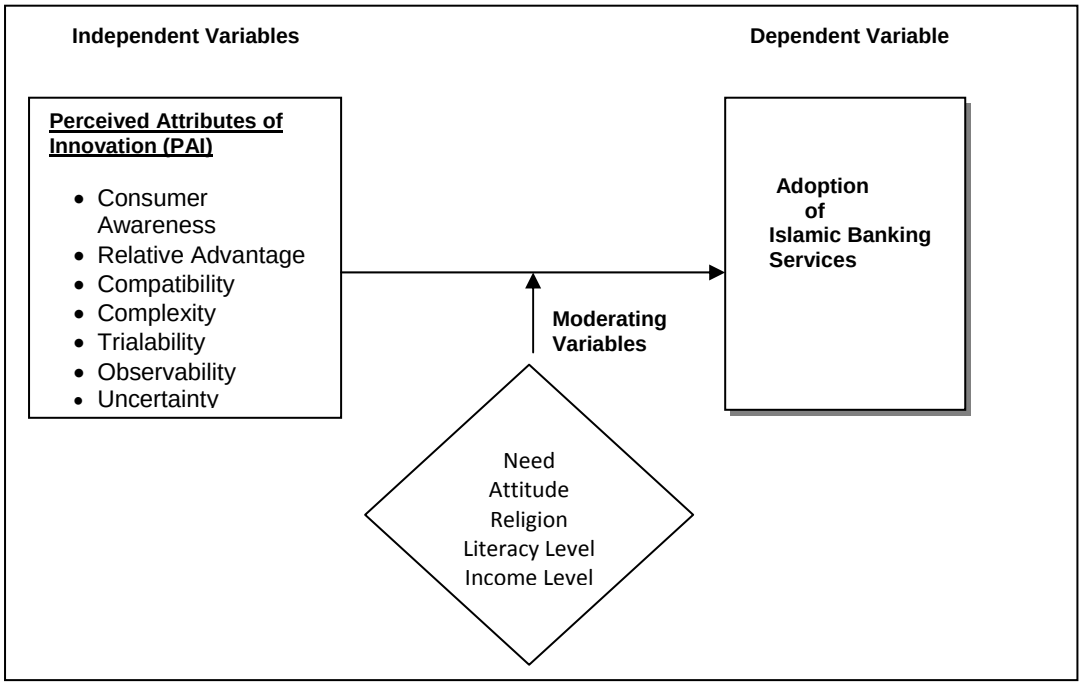
negative relationship between uncertainty and adoption rate (Yusof, 1999). The more consumers feel uncertain about an innovation; the lower would be the rate of adoption (Rogers, 2003).

Proposition 6: *The adoption of Islamic banking services is negatively related to the perceived uncertainty of using Islamic banking services.*

Research Model

The Figure 1 below, shows the proposed model as reference to the explanation made above. The model offers the conceptual foundation of the research to be conducted. The conceptual model of this research aims to explain, how the perceived attributes of innovation determines the adoption of Islamic banking, in particular, retail banking services in Malaysia. In addition it also aims to explain how the relationship of the independent and dependent variables are modified or rather altered by the moderating factors.

Figure 1: Conceptual Framework of Islamic Banking Adoption in Rural Malaysia



CONCLUSION

This concept paper provides a theoretical discussion on Islamic Banking development in the past and the present. Based on the extensive literature review in the areas of Banking and Islamic Banking, together with the evaluation of the suitability of applying Theory of Diffusion of Innovation Model (DOI), this study proposes a conceptual framework, for the study of adoption of Islamic Banking services for the Malaysian rural banking consumers.

The study further recommends a research model with independent and dependent variables to be tested for relationship and to confirm the model fit upon collection of the research data. As such, the model also comprises prepositions.

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DEVELOPING THE SUBSTATION MAINTENANCE PROCESS OF AN ELECTRICITY DISTRIBUTION COMPANY WITH MANAGEMENT SYSTEM RENEWAL

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ABSTRACT

This study brings up keys for developing maintenance process in the electricity distribution substations with new management system, in Tampere, Finland (Takala 2010). Usually a new management system brings the chance to do changes for the whole process and some new functionalities as well. The target was to develop the system so that it could support the operational processes more effectively and improve usability of the system. Another goal was to make the process more suitable for the sub-contractors so that it could also raise the information and knowledge about the maintenance system to a higher level.

This case studies Tampereen Sähköverkko Oy's (TSV, the electrical utility in Tampere) process and its new substation maintenance information system (Maximo). Mostly the research was focused to clearing out the current situation by SWOT analysis (Humphrey), and to finding out the critical factors (Critical Factor Index, CFI) in the use of this system, and analyze these results including their reliability (Ranta and Takala 2007). SWOT was used to find out more candidates for the factors, performance dimensions and actions having effect to the availability and usability. Some of the factors were brought under study from some scientific publications and brainstorming sessions. The goal in this CFI -questionnaire was to make these factors as simple and practical as possible so that the results would be more reliable.

The critical factors for the most relevant and urgent resource allocations for TSV's maintenance processes were as a result from the sub-contractors' and the company's point of view. The extremes (the most critical and the least critical) of the factors were analyzed, and discussed through with the maintenance experts, and a couple of new flow charts of the maintenance processes were determined. By clarifying and by improving and updating the questionnaires for the CFI –method it is possible to develop the maintenance processes. Something new, thanks to the uncertainty evaluation in the informants' answers, was also brought to CFI -method. The case company's staff was used for getting answers for CFI -questionnaire and the staff's expertise and commitment will also be needed in the future to make the development possible. At the end of the study the research and development method created was positively evaluated by the responsible experts by using weak market test of

constructive research approach utilized. In the future, we can measure the capability to use this research and development method for instance by checking quality and amount of the maintenance information collected or by monitoring the availability and usability of the system.

The most critical factor was that the maintenance process should be made even more clear for everyone. Another result was that there should be more electric devices, to be utilized in the same work order. The users own practicing of Maximo was seen as the third critical feature. The criticality will change when development will go on and then an updated CFI -questionnaire will be needed.

Keywords: maintenance, process, electricity distribution, substation, information management, operations management, decision making, resource allocation, Critical Factor Index (CFI)

INTRODUCTION

A new information management software usually forces the organization to some changes in whole the process and brings up some possibly brand new functionalities, too. Therefore there might be a chance to further develop it at the same time. The goals for this study were given by the case company TSV introducing new Maximo maintenance software for its substations. The maintenance process in the case company's substations should be good enough for both the partners (especially in the processes between TSV and VERA (contractor to build and maintain the electricity distribution network)). It was also said that by this case we should find out how to develop this process strategically more effective and operationally more efficient. One goal was to increase Maximo's usage to a higher level and develop this new system so that all the relevant information from substation maintenance would be available to everybody.

There are four different types of maintenance processes in this case for Maximo: preventive maintenance, false alarm/observation, critical fault and special case for any device. In preventive maintenance the devices have maintenance cycles to prevent more extensive faults from occurring. False alarm process is the key to observe a false alarm in any equipment. In critical fault process, when a fault appears in a device, an electrician will immediately begin to repair and will send more detailed information about it later when having more time. This opens also a work order for Maximo at the same time. Special case is basically only a work order.

These processes needed some development efforts, too. The study was began by sending a questionnaire about strengths, weaknesses, opportunities and threats (SWOT) for TSV and VERA. And, as the result of this questionnaire was a description about the current situation to be utilized as the basis for another questionnaire (CFI) focused on how to develop this process.

Critical Factor Index (CFI)- Method

This study is based on Critical factor index (CFI) - method used as the second questionnaire when the results from the SWOT study were analysed . This method brings up the factors which will need more resources, but also those factors that are over resourced beside to those factors that are at this time on right level. The theoretical background is in implementing sense and respond methodology by the CFI method. (Bradley and Nolan 1998, Ranta and Takala 2007)

The time perspective for answering to this questionnaire was no longer than one year so that the company could make an early reaction to improve the processes so soon as possible. Seven experts from TSV and seven ones from VERA answered. The goal was to have the viewpoints from both the groups' interests by comparing these groups with each other by multiplying both the groups' CFIs and by taking separately for them the average values to highlight differences as well. Especially when introducing the new Maximo system the company should know to what factors they should focus.

The factors were tried to be written as multifaceted and clear as possible. They were built mostly from the results of the SWOT-questionnaire, from literature references and from new ideas gathered from the brainstorming processes together with the company experts. 43 Factors were divided on time, quality, costs and flexibility dimensions but there was also a chance for open answers in every main dimension. The CFI -questionnaire included also some special information about factors for the informants to increase the validity of the study (common understanding of the concepts used etc).

The smaller CFI -value the more critical this factor is. One factor will become more critical if its importance is bigger than in other cases. Small standard deviations make the CFI –values more critical, too. If the direction of development is worse or even too much better than before CFI will become more critical as well.

These factors might be unclear for the informants, and therefore in this study we also added a question about certainty of answer given to CFI -pattern to make the results more reliable. If you are sure about your answer (100%), it will not effect to CFI. But if the certainty decreases upto zero (0%) CFI will grow very much requiring a more detailed analysis because this factor will not be critical basing on CFI-method (CFI will grow upto infinite level corresponding yellow factors, see Results).

Ranta and Takala (2007) used originally CFI -pattern described as follows:

$$CFI = \frac{\text{standard deviation of expectation} \cdot \text{standard deviation of experience}}{\text{Importance index} \cdot \text{Gap index} \cdot \text{Direction of development index}}$$

where Direction of development % = (quantity of direction of development answers / quantity of the answers) · 100%,
Gap index = | (avg. of experience. – avg. of expectation) | /10,
Importance index = avg. of expectation / 10,

$$\text{Direction of development index} = \left| \frac{\text{worse\%} - \text{better\%}}{100} - 1 \right|$$

In this case study the mean value of certainty in the answers given was added to the original method.

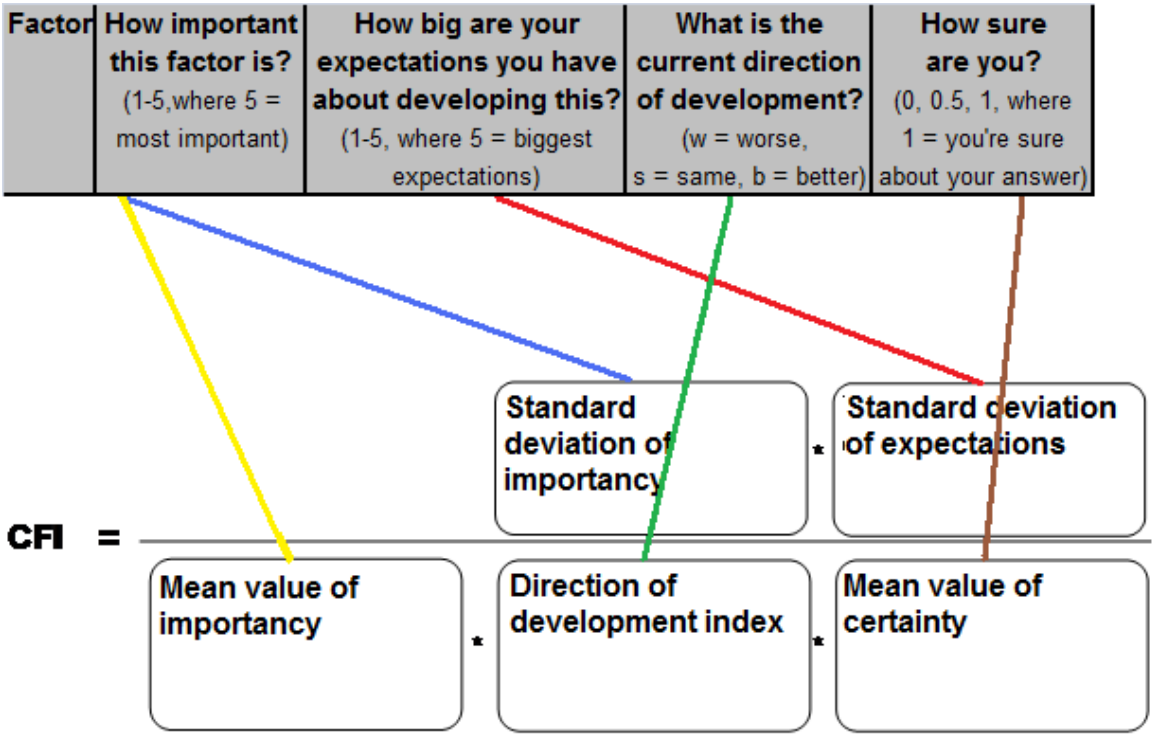

Figure 1. *Four questions in the CFI -questionnaires and CFI –method utilized in this case.*

RESULTS

CFI -values were compared between TSV and VERA. The results were divided into three groups and presented separately and combined together for TSV and VERA); red color represents critical under resourced factors, green normal situation and yellow over resourced. *Figures 2.* , 3., 4, and 5. show these results, and Table 1 shows in more detail how they have been determined

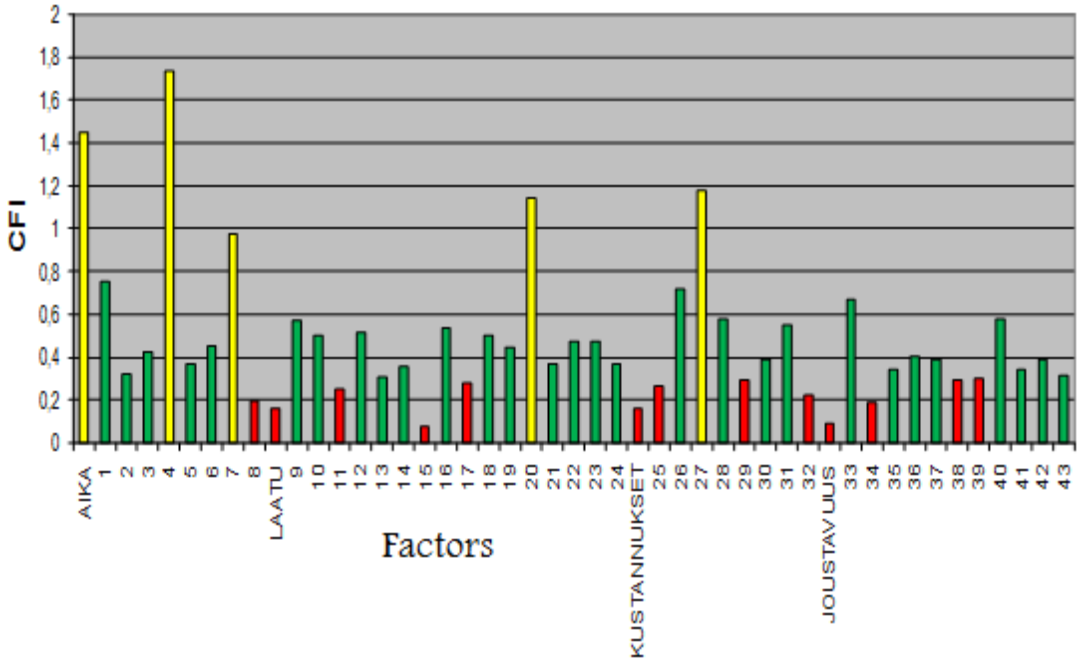

Figure 2. *CFI-results in TSV.*

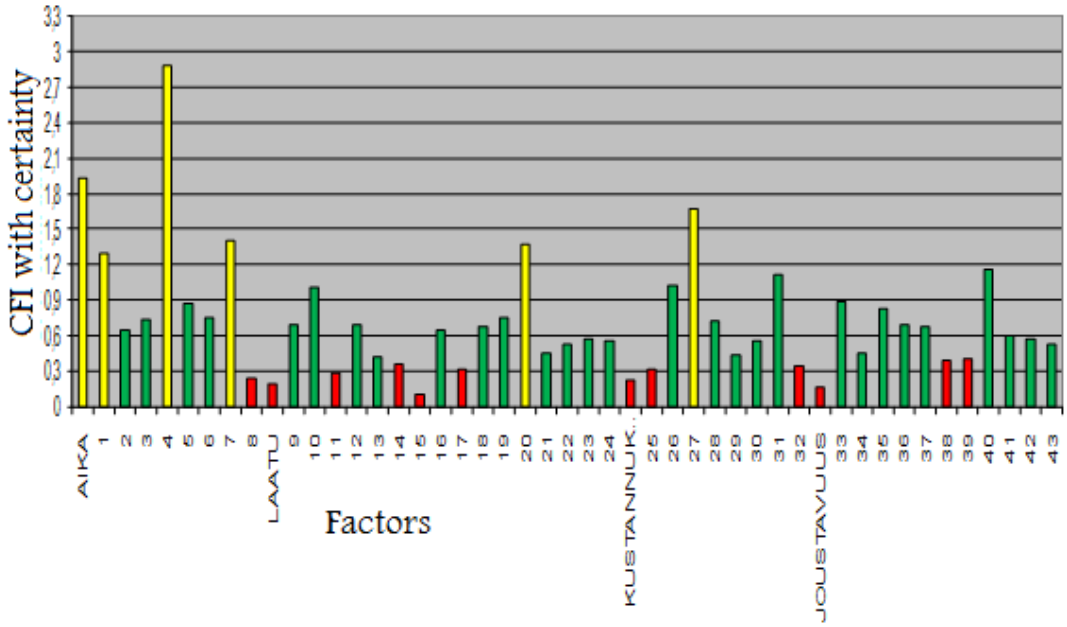

Figure 3. *CFI results with certainty in TSV.*

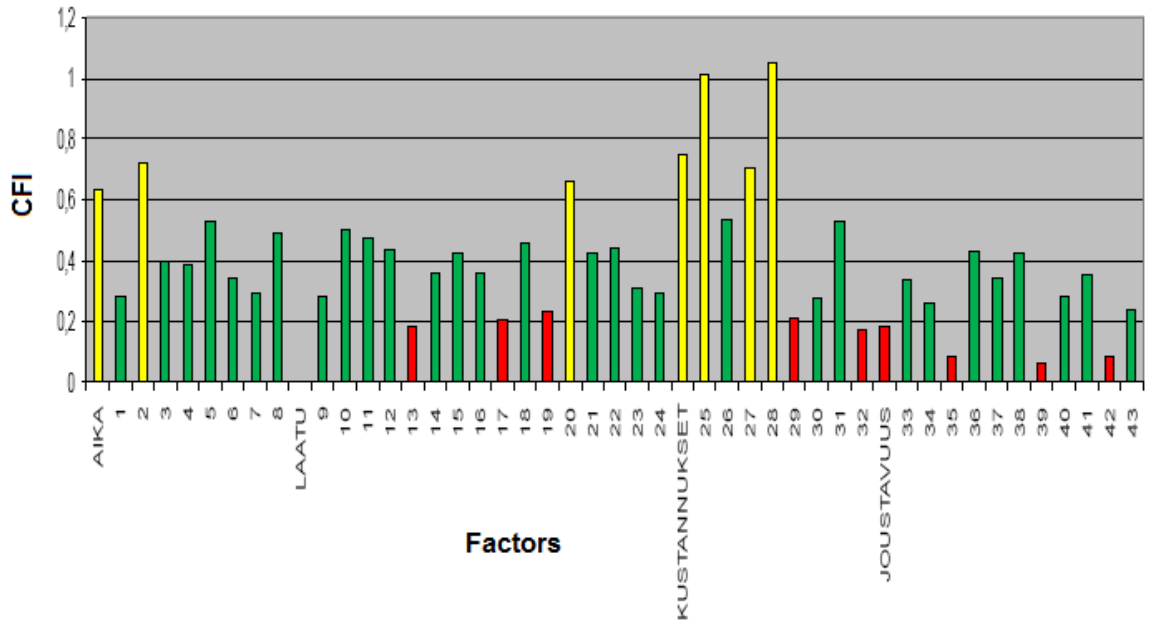

Figure 4. *CFI results in VERA.*

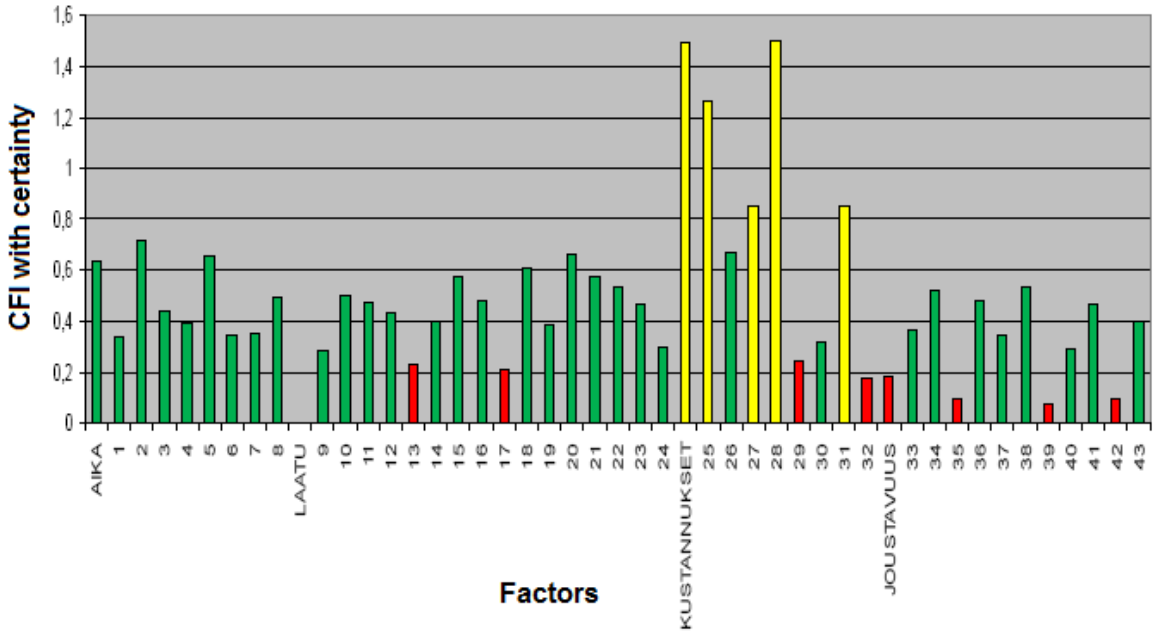

Figure 5. *CFI results with certainty in VERA.*

Table 1. *Calculation of CFIs for TSV and VERA. (MV = Mean value, X = multiplied.)*

FACTOR	TSV	VERA	TSV w /certainty	VERA w/ certainty	MV	MV(w/ certainty)	X	X(w/ certainty)	CRITICAL?
TIME	1,451	0,635	1,934794534	0,634980315	1,043	1,284887424	0,921	1,228556442	
1	0,754	0,282	1,292540063	0,33804962	0,518	0,815294841	0,212	0,436942677	
2	0,324	0,718	0,648180557	0,718207894	0,521	0,683194226	0,233	0,465528393	
3	0,428	0,397	0,73449476	0,441660602	0,413	0,588077681	0,17	0,324397398	
4	1,733	0,388	2,888542675	0,388421895	1,061	1,638482285	0,673	1,121973219	
5	0,37	0,526	0,864197531	0,657530132	0,448	0,760863831	0,195	0,568235917	
6	0,452	0,345	0,752782308	0,344942299	0,398	0,548862304	0,156	0,25966646	
7	0,974	0,292	1,391941392	0,349861601	0,633	0,870901497	0,284	0,486986844	
8	0,195	0,493	0,233572765	0,4930313	0,344	0,363302033	0,096	0,115158684	
QUALITY	0,163	0	0,195230434	0	0,081	0,097615217	0	0	
9	0,568	0,283	0,682005815	0,28341334	0,426	0,482709578	0,161	0,193289546	
10	0,504	0,501	1,00797984	0,500510465	0,502	0,754245153	0,252	0,504504458	
11	0,25	0,474	0,273232615	0,473702719	0,362	0,373467667	0,119	0,129431033	
12	0,516	0,438	0,687583197	0,437521876	0,477	0,562552536	0,226	0,30083269	
13	0,309	0,185	0,411388897	0,231419753	0,247	0,321404325	0,057	0,095203517	CRITICAL
14	0,355	0,362	0,355381902	0,402081591	0,359	0,378731747	0,129	0,142892521	
15	0,078	0,426	0,103860134	0,568404489	0,252	0,336132311	0,033	0,059034566	CRITICAL
16	0,535	0,36	0,641425555	0,48007887	0,447	0,560752213	0,192	0,307934856	
17	0,277	0,209	0,307549652	0,208571391	0,243	0,258060522	0,058	0,064146059	CRITICAL
18	0,502	0,456	0,668824203	0,60778597	0,479	0,638305087	0,229	0,406501967	
19	0,446	0,232	0,743997218	0,386341255	0,339	0,565169236	0,103	0,287436819	
20	1,141	0,661	1,36865082	0,661393735	0,901	1,015022277	0,754	0,905217078	
21	0,367	0,427	0,440685655	0,569303508	0,397	0,504994581	0,157	0,250883889	
22	0,475	0,441	0,528255962	0,529199692	0,458	0,528727827	0,21	0,279552892	
23	0,473	0,308	0,567970713	0,461504018	0,39	0,514737366	0,146	0,262120766	
24	0,367	0,294	0,549935279	0,294265187	0,33	0,422100233	0,108	0,161826807	
COSTS	0,161	0,746	0,214555096	1,491865946	0,453	0,853210521	0,12	0,320087441	
25	0,264	1,012	0,316777502	1,264746819	0,638	0,790762161	0,267	0,400643338	
26	0,719	0,532	1,026833073	0,664478579	0,625	0,845655826	0,382	0,682308581	
27	1,175	0,705	1,67786881	0,845442913	0,94	1,261655861	0,827	1,418542294	
28	0,575	1,05	0,719215892	1,499970001	0,813	1,109592946	0,604	1,078802262	
29	0,291	0,21	0,43636927	0,239781959	0,25	0,338075615	0,061	0,104633479	
30	0,391	0,277	0,558622673	0,31618278	0,334	0,437402727	0,108	0,17662687	
31	0,553	0,529	1,105126214	0,847058824	0,541	0,976092519	0,293	0,936106911	
32	0,226	0,175	0,338752039	0,174555853	0,2	0,256653946	0,039	0,059131151	CRITICAL
FLEXIBILITY	0,089	0,183	0,152135013	0,182951016	0,136	0,167543014	0,016	0,027833255	CRITICAL
33	0,668	0,338	0,89093311	0,369223334	0,503	0,630078222	0,226	0,328953293	
34	0,189	0,259	0,45254834	0,518483953	0,224	0,485516146	0,049	0,234639052	
35	0,342	0,087	0,819739666	0,095452636	0,215	0,457596151	0,03	0,078246312	
36	0,406	0,432	0,695604553	0,480522953	0,419	0,588063753	0,175	0,334253954	
37	0,389	0,344	0,666653334	0,344240371	0,367	0,505446852	0,134	0,229488991	
38	0,293	0,424	0,390068426	0,530330086	0,358	0,460199256	0,124	0,206865022	
39	0,299	0,066	0,398184894	0,075419695	0,182	0,236802295	0,02	0,030030983	CRITICAL
40	0,58	0,286	1,159488536	0,285547286	0,433	0,722517911	0,166	0,331088805	
41	0,345	0,352	0,591484765	0,46973616	0,349	0,530610463	0,122	0,277841782	
42	0,393	0,087	0,561204632	0,096553558	0,24	0,328879095	0,034	0,054186304	CRITICAL
43	0,314	0,238	0,523782801	0,396858056	0,276	0,460320428	0,075	0,207867424	

EVALUATION OF THE RESULTS

Six critical factors were chosen because both the groups' CFI -values were red with and without certainty but also because their multiplied and the average values separately for TSV and VERA were critical with and without certainty. One factor was also chosen to be critical because only one of these CFIs was not red. Five of the most critical factors were factors 39, 42, 32, 17 and 35:

”39 Increasing Maximo-user's own practicing time on Test side of Maximo.": Possibility to save some time where ever Maximo is used. Investing only few hours for the employees time might make a good improvement.

”42 Maximo should work faster.”: Some actions were taken to make it faster and also to simplify functionality in Maximo. Simplified instructions for the main tasks for each user role might help.

”32 Making more maintenance at the same time (more devices to work order).”: Maximo makes it possible to search work orders for substations and preventive maintenance for known time to combine them as more extensive work packages.

”17 Maintenance process should be more clear to both the partners (TSV and VERA).": Introducing the new Maximo and changes in the company's staff might have caused that this factor was critical. Process descriptions and some instructions with personal teaching for the employees are used to improve this situation.

"35 Information transfer should be quicker between processes.": Maximo makes it possible to build workflows by automatic e-mails increasing functionality in all the processes. Meetings with the sub contractors might help, too.

Yellow factors (with extremely high CFIs) that were over resourced must not be forgotten. They need to be carefully investigated together with the process experts to find out reasons for possible over resourcing.

The question about certainty was added to questionnaire to achieve higher reliability of the results (Fig. 6.).

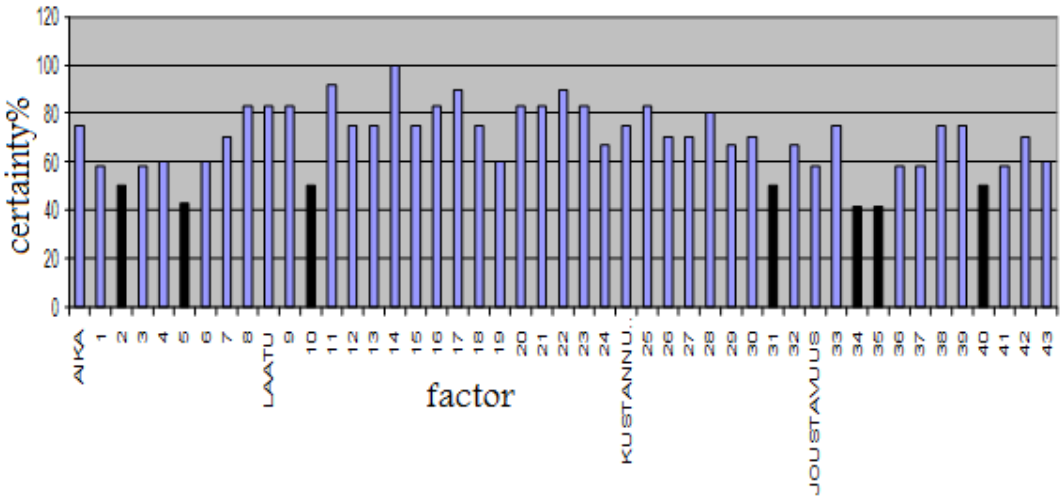

Figure 6. *Certainty for each factor in TSV*

The questionnaire was also tested by three employees before sending it forward to all the informants (the sample was 7 in TSV and 7 in VERA). There was also some controlling factors to search if the answers were all the time in the same line but on the other hand they were not identical in wording.

$$\text{CFI difference} = \frac{\text{(The biggest CFI value - The smallest CFI value)} * 100\%}{\text{The Biggest CFI value - The smallest CFI value}}$$

Let us look at two controlling factors *"6. Making it simple to write feedback about work orders."* and *"9. Making it easier to find information (feedback, history, work order status) from Maximo."*

	Factor	TSV CFI (with certainty)	VERA CFI (with certainty)
	6	0,752783	0,344942
	9	0,6820058	0,283413
Difference:		0,070776	0,061528

Figure 7. *Maximum differences between both groups (factors 6. and 9.).*

TSV's CFI (with certainty) difference to TSV's maximum scale (2,784) that this group answered is ≈ 2,54 %. VERA's CFI (with certainty) difference to VERA's maximum scale (1,424) is ≈ 4,31 %. This shows that with these factors the differences were small compared to the whole scale that groups used in this questionnaire, and this means that these answers were in the same line (consistent).

Those factors with the worst certainty had clear logic that they were only for TSV-company and not for VERA. The biggest differences between both the groups' CFI-results stressed that the questionnaire was a great success. If we compare both the groups' CFI (with certainty) -values and think if their different interests could be seen from the results then we can have

even higher reliability. We can look for example Factor 4. (*"4. Shorter time for writing feedback to work orders.")* and ask how big portion the other group's CFI (with certainty) -value is compared to the other group's one? VERA's value was 86,55 % smaller than TSV's one. This reflects both the groups' different interests: TSV wants to have better feedback and delivery time is not so important for them, and VERA has inverse goals.

Next steps
In this case the development procedure was done as follows:

1. Examine the situation (SWOT-questionnaire and other sources).
2. Make CFI-questionnaire.
3. Analyze the results and make an action plan.
4. Meeting with contractor about changes.
5. Make decisions.
6. Implementation (of course some critical factors were easy to do straight ahead).
7. Follow the situation.
8. Analyze feedback.
9. After this begin from start.

Also when studying the development possibilities next time there is a chance to improve everything a lot. Benchmarking might be useful for having new ideas from the processes and workflows in other companies, e.g. from knowledge intensive maintenance businesses in industries. CFI-questionnaire could be prepared by brainstorming in a group because everybody should know how to make this questionnaire in case of someone cannot do it upto the end. Factors could be made even more clear and simple to have higher validity and reliability. The results might be weak even if one expert would not answer. Making a shorter questionnaire might lead to have answers quicker and not loose employees' motivation for stopping answering too early. And, for example this questionnaire could have been done in two parts and phases. So the key is to learn from the earlier questionnaire, for example the special information about some factors was useful from learning point of view.

Feedback is one key for measuring capability. Maximo makes it also possible to follow differences by looking about quality and amount of feedback from work orders. SWOT- and CFI-method are also useful to have information about where to put resources for having better long term capability, at least to make a good quess about it. It is clear that some changes for Maximo's functionality will save some time and make its phases more userfriendly. Compared to earlier situation, this new process has for higher usability of new maintenance software Maximo. But if for example critical factor "39 Increasing Maximo-user's own practicing time on Test side of Maximo." will not be taken seriously, this potential might just remain as a possibility without any benefit.

CONCLUSION

SWOT-method can be used as a source for critical resource factors for CFI-questionnaire. In this case study some factors were written about management system's new functionality which was not clear for all the informants. Because of new functionality it was noticed as a good way to add some detailed information about the new factors to make them as clear as

possible. And, because of that in this case a new question about certainty of the answer given was added to CFI-questionnaire to improve reliability of the method utilized.

The critical factors were chosen by calculating separate average values and multiplied values from both the groups' (customer's own and maintenance service provider's) answers with and without certainty. And if they all were seen as critical this factor was chosen to be improved by higher resource allocations. Own practicing time and making management system to work faster were seen as critical ones. Especially when introducing a new information system for maintenance it should be clear for all the role players how whole the process should work. Maximo makes it possible to have information available fast enough for all the roles. But still it demands a lot of work from every role and beside to that, in this case, other CFI-questionnaires will be done to make the direction clear and also developing some of the factors further.

The future development will demand motivation for questionnaires and feedback but also work from the main users of the new information management system. It is not clever to develop every new functionality of the system because the most critical ones will be the most important ones to be developed. That is one of the reasons for using CFI-questionnaire in the further development to improve those mostly used functions for different roles. One key for further studies is to learn from the last CFI-questionnaire and make it even more suitable for the company.

Reliability of the questionnaire can be analyzed through certainty-values and controlling factors testing if the results are in the same line or not. The biggest differences between both the groups' results show if the groups different interests will be seen from the questionnaire reflecting also that the results are reliable.

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DEVELOPMENT OF SIMULATION TEMPLATE FOR SUPPLY CHAIN NETWORK ANALYSIS

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ABSTRACT

Supply chain network is considered as a complex system. The design of supply chain needs to consider several trade-offs in financial and non-financial measures, such as inventory level, order lead time, and on-time delivery etc. Therefore, it is important to have a tool to help develop supply chain configuration as design alternatives. Running different alternatives with a group of decision makers may improve managerial implications. One of the supply chain analysis software applications called "Agile Supply Demand Network (ASDN)" was developed by University of Vaasa, Finland and ABB Operations Development Group. ASDN is software for analyzing and developing supply chain networks. Even though, ASDN is rapid modeling tool should help decision-making in network architecture design and performance management but it is developed based on several inventories theories with normality assumption. However, the events related to activities and transactions in supply chain network often stochastically behave in non-normality. Therefore, to extend the ability of ASDN, the discrete event simulation tool is considered as an add-on feature to ASDN. Discrete event simulation is a popular tool for analyzing complex system, such as a factory or its supply chain networks however to develop a simulation model demand significant amount of time in requirement analysis, modeling, verification, and validation. To shorten the time of these activities, the simulation software developer such as Arena (Rockwell Software) developed a tool called template.

The objective of this research is to develop a rapid modeling and analysis tool based on template for supply chain network similar to ASDN with ability to access the performance of supply chain network in stochastic environment. Template development tool helps a modeler to combine command and logic into system object. The system object has a predefine logic with parameter where user can adjust to change the behavior of the system object in this paper calls this system object as entity template such as machine template which combine queue and resource related command all together. So that the user only add a new template when new machine added into the model without creating new but similar commands. The primary purpose of this study is to demonstrate the usefulness of the template development tool. By using supply chain management system as a case model, the entities such as suppliers, manufacturers, distributors, and retailers including their operating, logic are modeled in the form of template for a particular type of supply chain entity. These supply chain entity templates are tested with

regular users who have knowledge of using simulation modeling software but do not frequently using it. The results show that the user can model the supply chain network with is considered as complex system in a short period of time. For example the supply chain that consists of 5 suppliers, 1 manufacturer, 1 distributor, and 5 retailers can be modeled within 30 minutes in order to analyze the behavior of inventory of each entity and the entire supply chain network.

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EXPLORING THE BARRIERS TO KNOWLEDGE FLOW THROUGH FORMAL CONCEPT ANALYSIS

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ABSTRACT

This research aims to use concept mapping to explore the barriers of knowledge flow which may influence the performance of knowledge management, from the perspective of knowledge flow. The major feature of concept mapping is to transform the semi-structured or term-rich contexts to be a structured and systematic map for easy understanding and (or) focusing on; furthermore, it could help to present the visualized contexts with an essential concept, and mine the potential implication behind. Comparison with the nature of knowledge itself and knowledge flow, both of them are involved in sense making and contextual issues, thus here we adopt one of the tools for mapping the concepts - Formal Concept Analysis (FCA) to present the barriers of knowledge flow which could be considered as the influencing factors of knowledge management, to explore and generate the association rule which is general or specific for reasoning the relationship between them. In this study, we not only combined the context and content analysis but also confirm with support of FCA to redeem the deficiencies of qualitative research that are argued by academy and practice.

Furthermore, FCA can be considered as a method for combining with qualitative research to comprehensively observe the situation and propose meaningful propositions systemically and objectively from semi-structured data. Furthermore, we can explore valuable implications from these propositions.

Keyword(s): Formal Concept Analysis (FCA), Knowledge flow, Knowledge Barriers to Knowledge Flow, Knowledge management (KM)

1. INTRODUCTION

Methods for managing knowledge have become one of important issue in the past decades, and the knowledge management community has developed a wide range of technologies and applications for both academic research and practical applications . Recently, the issues regarding knowledge management flow have been mentioned and studied abundantly. The approach for coordinating the knowledge flow process with the workflow process can provide an appropriate way to model the distributed work process . Enhancing the quality of KM by identifying key processes on which important knowledge flows, and managing them formally . Hence, a major management issue of KM is how to change individual knowledge into organizational knowledge . Consequently, discussing the factors affecting knowledge sharing and transfer has become popular recently issues about the performance of knowledge management. In this study, we not only attempt to discover the barriers of knowledge flow, but also try to figure out how those barriers (as well as influencing factors of knowledge management activities) affect each other and the causal relations behind.

However, most of valuable information is not always well structured, and it's usually imprecise. Abernethy et al. argued that the know-how is deeply embedded in the individual and is typically acquired through extensive training and on-the-job experience. Converting tacit knowledge to explicit knowledge is a daunting task since that tacit knowledge is often difficult to communicate, present, transfer, and sharing. Those possessing it find difficulty in explaining the decision rules that guide their performance . Although converting tacit knowledge to explicit knowledge is very difficult, the article of Siau and Wang supports us a method to solve the problem. Siau and Wang advanced cognitive maps visualize knowledge and communicate the visualization to individuals, groups or organizations, thus converting tacit knowledge to explicit knowledge .

To comprehensively understand the factors affecting knowledge management performance, firstly, we survey a lot of articles about knowledge management and knowledge flow to figure out the determinants of knowledge flow. Then we want to transform the unstructured knowledge to structured knowledge. In accordance with Siau and Wang (2007), so we employ formal concept analysis to explore the determinants which may affect knowledge management performance. Thus, in this study, we will visualize the relationships of the factors to make us understand the knowledge management activities easier and clear.

Formal Concept Analysis (FCA) has been introduced by Wille (1982). In lately decade, FCA applied in many quite different realms like psychology, sociology, anthropology, medicine, biology, linguistics, computer sciences, mathematics and industrial engineering . Formal concept analysis (FCA) is a kind of important mathematical tool for conceptual data analysis and knowledge processing . The sketchy idea of FCA is the pair (A,B) of a set of objects and a set of features where B is the maximal set of features common to the objects in A and A is the maximal set of objects that possess all the features in B is called the formal concept . In consequence, we will use FCA to analyze the transcripts and hope to find the relationship in the factors.

Using the framework of FCA, formal concepts are structured in the form of a lattice called the concept lattice (Saquer and Deogun, 2001). Godin and Missaoui argued that the Galois

(or concept) lattice produced from a binary relation has been proved useful for many applications. Building the Galois lattice can be considered as a conceptual clustering method since it results in a concept hierarchy. The concept lattice is a useful tool for knowledge representation, and knowledge discovery . Accordingly, we will structure the concept lattices of knowledge flow then understand the knowledge structure and hierarchy much easily and clearly by through concept lattices. Furthermore, we expect to explore the barriers of knowledge flow by taking a systemic view and further to build up a model combining the viewpoints of cognition oriented and technical oriented.

Thus, the aims of study are that to find these influencing factors of knowledge flow and employ formal concept analysis to analyze the transcripts. Then we will structure the concept lattices for understanding the knowledge structure and hierarchy about knowledge flow more easily and clearly.

The purposes of the research in detail are as follow:

(1) To discover the potential relationship between those knowledge flow barriers for detecting the performance of knowledge flow.

(2) To construct structure and hierarchy of knowledge flow through FCA for observing the overall concept visually

(3) To systemically and comprehensively explore the valuable implications about knowledge flow.

2. THEORETICAL FRAMING

In this study, we first interviewed twelve experts of knowledge flow for conceptual understanding all the possible determinants which may affect knowledge flowing. Second, we explore the key themes about knowledge flow from previous literatures, and gather them and their related transcripts from practical parties. Then, we adapted formal concept analysis as an information retrieval tool to analyze the transcripts that we collected from the enterprises in Taiwan. Lastly, a knowledge structure and knowledge flow hierarchies were built from our analysis results. The knowledge hierarchies were utilized to discover barriers of knowledge flow, the relationship among them, and the association rules which may positively affect the performance of knowledge management.

2.1. Determinants and Barriers of Knowledge Flow

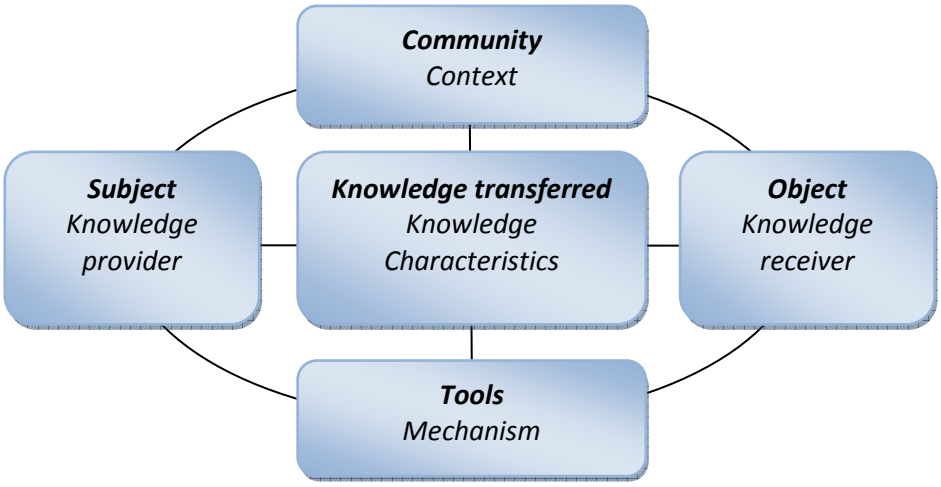
Knowledge flow is most likely influenced by four factors: knowledge transferred, source, receiver, and context in which knowledge flow takes place . Zhuge indicated three crucial attributes of knowledge flow: direction, content and carrier . Bock and Kim found that expected associations between knowledge sharers and expected contribution to the organization are major determinants of individuals' attitude toward knowledge sharing .

Just like a double sword, determinants may become barriers if not being applied appropriately. KPMG's survey suggested that the biggest barrier to organizational knowledge usage is a blocked channel between knowledge provider and knowledge seeker . Blockages arise from causes such as temporal limitations, lack of staff motivation and willingness, as well as lack of incentives. Jain et al. conclude that lack of rewards and recognition, lack of

time, and lack of formal and informal activities to cultivate knowledge sharing have been identified as the strongest barriers . In addition, Husted and Michailova concluded that culture and behaviors might be the key drivers or inhibitors of knowledge sharing .

Dixon believed that lack of absorptive capacity, the assumption behind the question (context), relationship between knowing and identity, confidence in the source of knowledge and the fit of the knowledge for the project are all drivers as well as the inhibitors of knowledge sharing . Ndlela and du Toit indicated that people related issues, including people's unwillingness to share their knowledge and lack of leadership commitment as well as time and resource constraints could be barriers when one is trying to implement a knowledge management program .

According to Lin, et al. , they utilize the revised CHAT model to carve the theoretical landscape into five domains: subject, object, tools, community and knowledge transferred, and those domains may contain most of the factors concerning knowledge flow. "Subject" refers to "knowledge provider"; "object" refers to "knowledge receiver"; "community" refers to "context", "tools" refers to "mechanisms" and "knowledge transferred" refers to "knowledge characteristics" . Figure 1 presents that how the revised CHAT model can be applied to describe knowledge flow determinants.



The Revised CHAT Model of Knowledge Flow
(Source: Lin, Tan, & Chang, 2008)

In practice, the revised cultural historical activity theory (CHAT) model can provide a clear blueprint for determining the barriers. After synthesizing the literature reviewed, we base on the revised CHAT model to classify the barriers for knowledge flow into five dimensions.

The barriers to knowledge flow were discovered through volume literatures reviews are summarized in Table 1.

Table 1 Barriers to Knowledge Flow

Domain	Sub-domain	Barriers of knowledge flow
Knowledge characteristics		o Ambiguity (Szulanski, 1996) o Unprovenness (Szulanski, 1996)
Knowledge provider	Lack of motivation	o Lack of time (Riege, 2005) o Fear to reduce job security (Riege, 2005) o Low awareness and realization of knowledge sharing (Riege, 2005) o Fear losing the ownership of intellectual property (Riege, 2005) o Unwilling (Dixon, 2005) o Not adequately reward (Nonaka, 1994)
	Lack of ability	o Poor community skill (Riege, 2005)
	Lack of trust	o Lack of trust in people (Riege, 2005)
Knowledge receiver	Lack of motivation	o NIH syndrome (Szulanski, 1996)
	Lack of ability	o Lack of absorptive capability (Dixon, 2002) o Lack of retentive capacity (Szulanski, 1996)
	Lack of trust	o Lack of trust in knowledge (Riege, 2005)
Contextual factor	Relationships between knowledge sources and knowledge receivers	o Trustworthiness (Andrew and Delahaye, 2000) o Lack of contact time and interaction (Riege, 2005) o Differences in experience level between them (Individual perceptions of approach ability) (Riege, 2005) o Arduous relationship (Szulanski, 1996) o Unawareness (Szulanski, 1996)
	Organizational context	o Culture, cultural characteristics (Glmseth et al., 2007) o Organizational structure (Weiss, 1999) – Physical work environment – Lack of spaces to share – Size of business units o Time and resource constraint (Weiss, 1999) o Organizational incentives (Riege, 2005) o Lack of leadership (Zhang et al., 2005)
	Other contextual factors	o incoordination between units (Riege, 2005) – Geographical dispersion – Context differentiation – Competitiveness o Different language (Husted and Michailova, 2002) o Overly technical terminology (Koskinen, 2005)
Tool	Lack of tangible/intangible mechanism (Kwok and Gao, 2005)	o Tangible mechanism: telephone, discussion rooms or computer network
		o Intangible mechanism: o unscheduled meetings, informal seminars, or coffee break conversations
	Lack of integration (Riege, 2005)	o Lack of integration of IT systems and processes, o Lack of compatibility between diverse IT systems, o Unrealistic expectation of employees and mismatch with individuals' need,

Domain	Sub-domain	Barriers of knowledge flow
	Lack of training (Riege, 2005)	o Employ lack of familiarity and experience with new IT system, o Lack of training regarding employee familiarization of new IT systems, o Lack of communication the advantages of new system to employ.

2.2. Formal Concept Analysis

Formal Concept Analysis (FCA) has been introduced by Wille (1982) and applied in many quite differnet realms like psychology, Sociology, anthropology, medicine, biology, linguistics, computer science, mathematics and industrial engineering . Farther, in lately decade, more and more researchers utilized FCA in software engineering, artificial intelligence and information retrieval .

The algebraic principle of Galois connection utilizes attributes and objects to cluster and makes the same attributes or objects in the same set called concept. Using the framework of FCA, formal concepts meant the set of some attributes and objects are structured in the form of a lattice called the concept lattice . The concept lattice is a useful toolfor knowledge representation, and knowledge discovery .

The formal concept analysis has also been applied in the area of conceptual modeling that deals with the acquisition, representation, and organization of knowledge . Several concept learning methods have been implemented in using ideas from the formal concept analysis .

Although FCA can be used in lots of areas, it still has some disadvantages we need to consider. This has the advantage that the main ideas are understood quite quickly, but there are two disadvantages. Firstly, that some important connections cannot be explained since the language chosen is too inexact .Secondly, when the formal concepts are too many, a concept lattice can be exponential in the size of the context, so the concept lattice becomes too complicated and it can't express the relationship between concepts clearly . So controlling the concept lattices (key items) is an important determinant affecting the concept lattices performance.

2.3. FCA related Research

In the late years, more and more researchers paid attention to FCA in some areas about psychology, Sociology, anthropology, medicine, biology, linguistics, computer science, mathematics industrial engineering, software engineering, artificial intelligence and information retrieve . Now we introduce some researches related to the application of FCA as following:

Díaz-Agudo and González-Calero used FCA to analyze the cases of travel agencies. Using FCA to execute case-base-reasoning, it could find implications which could help the travel agencies to search the similar cases when they met some problems .

Cimiano, et al. combined ontology with FCA to model the concepts. They argued FCA and ontology cold support each other and work together. The conclusions were following :

(1) FCA could help to structure ontology.
(2) After structuring the ontology, FCA also could analyze ontology.
(3) Ontology could increase the applications of FCA.

Lakhal and Stumme introduced some basic efficient ideas of mining association rules based on formal concept analysis and described a specific algorithm (Titanic algorithm) to mine association rules. They showed how FCA helps in reducing the number of resulting rules without loss of information. In the survey, they gave a general overview over the history and state of the art of applying FCA for mining association rules .

Zhang, et al. utilized the theorem and relational algorithm of FCA to design and automatically produce the hierarchical menu on the web. The way is called formal concept analysis for web navigation (FCAWN). The menu produced by FCAWN was different from the menu produced by traditional tree structure. A subitem attached to only superitem in the menu produced by tree structure, but a subitem attached to lots of superitems in the lattices-based (hierarchical) menu. Since hierarchical menu can discovery more relational webs than the traditional menu and hierarchical menu more satisfy surfers .

Typically, fuzzy ontology is generated from a predefined concept hierarchy. However, to construct a concept hierarchy for a certain domain can be a difficult and tedious task. To tackle this problem, Tho, et al. proposed the FOGA (Fuzzy Ontology Generation framework) for automatic generation of fuzzy ontology on uncertainty information. The FOGA framework comprised the following components: Fuzzy Formal Concept Analysis, Concept Hierarchy Generation, and Fuzzy Ontology Generation. They also discussed approximating reasoning for incremental enrichment of the ontology with new upcoming data. Finally, a fuzzy-based technique for integrating other attributes of database to the ontology is proposed.

Both domain ontology and Formal Concept Analysis (FCA) aim at modeling concepts, although with different purposes. Sometimes, there are some concepts which indicate the same thing, but we don’t know the concepts are similar. So we often spend a lot of time and money to construct the concepts which have existed. Formica argued an ontology-based method for assessing similarity between FCA concepts. Such a method is intended to support the ontology engineer in difficult activities that are becoming fundamental in the development of the Semantic Web. It can increase the performance of constructing the concepts .

After surveying a lot of literature about FCA, we find FCA is an important and useful tools, but most research utilize FCA to analyze structured database or data warehouse. Since, in our research, we combine qualitative research with FCA and expect to make the unstructured data which comes from qualitative research become structured knowledge. Then we discover the implications and association rules form the structured knowledge.

2.4. Knowledge Map

Knowledge maps provide a visual orientation for managers or specialists who wish to locate, evaluate or develop knowledge in an organizational context. They condense information about knowledge sources, assets, structures, applications, or development needs in an accessible way .

A knowledge map is a visual display of captured information and relationships, which enables the efficient communication and learning of knowledge by observers with differing backgrounds at multiple levels of detail . The individual items of knowledge included in such a map can be text, stories, graphics, models, or numbers. Knowledge mapping is defined as the process of associating items of information or knowledge (preferably visually) in such a way that the mapping itself also creates additional knowledge .
Eppler distinguished five types of knowledge maps by knowledge display and knowledge context :

(1) Knowledge source maps: They structure a population of company experts along relevant search criteria, such as their domains of expertise, proximity, seniority, or regional distribution. Knowledge source maps answer questions such as “where can I find somebody who knows how to calculate a company valuation” or “do we have people who have run large e-commerce projects?”

(2) Knowledge asset maps: This type of map visually qualifies the existing stock of knowledge of an individual, a team, a unit, or a whole organization. It provides a simplified, graphic “balance sheet” of a company’s intellectual capital. Knowledge asset maps answer questions such as “how many SAP-consultants do we have, and how many SAP-projects have we completed?” or “how many of our software engineers have been with the company for more than five years?”

(3) Knowledge structure maps: These maps outline the global architecture of a knowledge domain and how its parts relate to one another. This type of knowledge map assists the manager in comprehending and interpreting an expert domain. Typical questions that can be answered by such a map are “which are the skills needed to run a project, how do they relate to one another, and what are the available courses for every such skill?”

(4) Knowledge application maps: These maps show which type of knowledge has to be applied at a certain process stage or in a specific business situation. Usually, these maps also provide pointers to locate that specific knowledge (documents, specialists, databases). Knowledge application maps answer questions of people who are involved in a knowledge-intensive process, such as auditing, consulting, research, or product development. They provide answers to questions such as “who do I talk to if the market tests are inconclusive?” or “what are our experiences in moving from a prototype to mass-production?”

(5) Knowledge development maps: These diagrams can be used to depict the necessary stages to develop a certain competence, either individually, as a team, or as an organizational entity. These maps can serve as visualized learning or development

roadmaps which provide a common corporate vision for organizational learning. They answer questions such as "how do we achieve business excellence for our unit?" or "how can we prepare our unit (intellectually) for the entry into a new market?" We have also used this type of map to visualize the necessary steps to develop e-commerce competence (from mere web designing skills, to community development skills, to secure electronic contracting skills, to inter-business networking skills).

The knowledge structure maps can make users understand and learn the special domain knowledge quickly and clearly. And knowledge structure maps can direct users a way that how does the problem happen. Therefore, in my research, finally I will display the results of research by knowledge structure maps.

3. RESEARCH FRAMEWORK

In this study, we not only attempt to discover the determinants of knowledge flow but also try to figure out how the facts affect the performance of knowledge management. After finding the determinants form the literatures and In-depth interviewing with twelve experts who involve and good at the implementation of knowledge management, we utilize formal concept analysis (FCA) to analyze the transcripts and employ concept lattices to represent the knowledge hierarchy about knowledge flow. And then using the concept lattices to discovery some important association rules which can help managers to handle the barriers of knowledge flow.

In addition, we attempt to visualize the results of qualitative research. The most valuable information and the transcripts are not structured and they are usually imprecise, so we want to use structured graphs to make us understand the knowledge easily and clearly. Since, for improving the performance and accuracy, we combine qualitative research and FCA to semi-automatically accomplish our purpose and visualize the results. Our research framework is as Figure 3-1.

3.1. Generate Casual Relationships Through FCA

According to this arguments Díaz-Agudo and González-Calero mentioned, they utilized FCA to analyze the travel cases. The travel cases are structured, but our transcripts are unstructured . That is why we must to modulate the transcripts before we analyze them. After adjusting the transcripts, every set of question and answer in the transcript describes a case about knowledge flow. Therefore, we suppose every set of question and answer in the questionnaire is a case, and we make the sets as inputs of FCA. This transformation mainly supports two advantages as following:

(1) Transform the unstructured data to structured data, and structured data can make us to construct the formal contexts and make FCA more correctly.

(2) Because both of interviewing the experts and adjusting the transcripts are time-consuming and laborious, the input data for FCA is always not enough. After this transformation, every set of the question and answer in the transcripts is an input data. This can increase the amount of the input data. For example: there are twenty questions

in the questionnaire and it indicates there are twenty input cases for FCA.

3.2. Produce The Formal Context

In this section, we used some barriers to present every set of the question and answer in the questionnaire. This indicates that we use these key words to represent the case. After giving every set some key words, we transfer all of the sets to the formal context .

3.3. Construct The Knowledge Hierarchy

The one of main advantages of concept lattices is that it can represent the relationship - subconcept-superconcept . When we know all of the subconcept-superconcept relationships of the barriers, we can construct the knowledge hierarchy. The knowledge hierarchy is very important and useful graph. It can represent all of the relationships clearly and help us to quickly and easily understand how we can handle the problems when we meet the barriers of knowledge flow.

For screening and filtering the most critical association rules (implications) from volume data we developed a set of thresholds to retrieve the valuable association rules. Witten and Frank explained two criterions (support and confidence) in FCA. The two criterions could determine if the association rule was reliable or not. If the criterions were too critical, the important rules may be missing. If the criterions were too loose, the rules may be meaningless and unreliable . Therefore, how to set the criterions still depends on the need and experience of users.

After retrieving the implications (association rules), we transformed these rules into a knowledge structure map. Through visualizing this knowledge structure map, we comprehended the relationships of the barriers objectively and easily.

4. RESEARCH RESULTS AND VALIDATION

4.1. Results

In this study, we employed the software (ConExp) to construct knowledge hierarchy and generate association rules through transcripts and FCA, since it is a useful and suitable tool for formal concept analysis. From the results of data analysis, we built up a hierarch to display the barriers to knowledge flow and generated association rules among those barriers, and then evaluated and confirmed our findings through volume questionnaires testing and validation.

4.2. Knowledge hierarchy

We divide overall part of knowledge hierarchy to five dimensions, because the overall part of knowledge hierarchy is too large to be read clearly. And further we can compare the results through FCA with these results through literature review. Therefore, we present the knowledge hierarchy by the five dimensions.

(1) Dimension of Knowledge Hierarchy (Knowledge Characteristics)
(2) Dimension of Knowledge Hierarchy (Knowledge Provider)
(3) Dimension of Knowledge Hierarchy (Knowledge Receiver)
(4) Dimension of Knowledge Hierarchy (Contextual Factor)
(5) Dimension of Knowledge Hierarchy (Mechanism)
(6) Implications And Knowledge Structure Map

After formal concept analysis, we can employee ConExp to transform formal concepts to concept lattices. And we developed a set of thresholds (the minimum support of association rule = 9, and the minimum confidence of association rule = 85%) to reduce this volume implications of our analysis data. It expresses that if the occurrence time of the association rule is less than nine, the rule is a special case, not a general rule for our study. The considerations of the experts are much different and we want to retrieve the rules that most of the experts identify, so we set a critical level in confidence.

There are thirty one association rules in total were generated based on the thresholds, and then transformed them into a knowledge structure map as Figure 2. It provides a comprehend presentation about the relationships among the barriers to knowledge flow visually

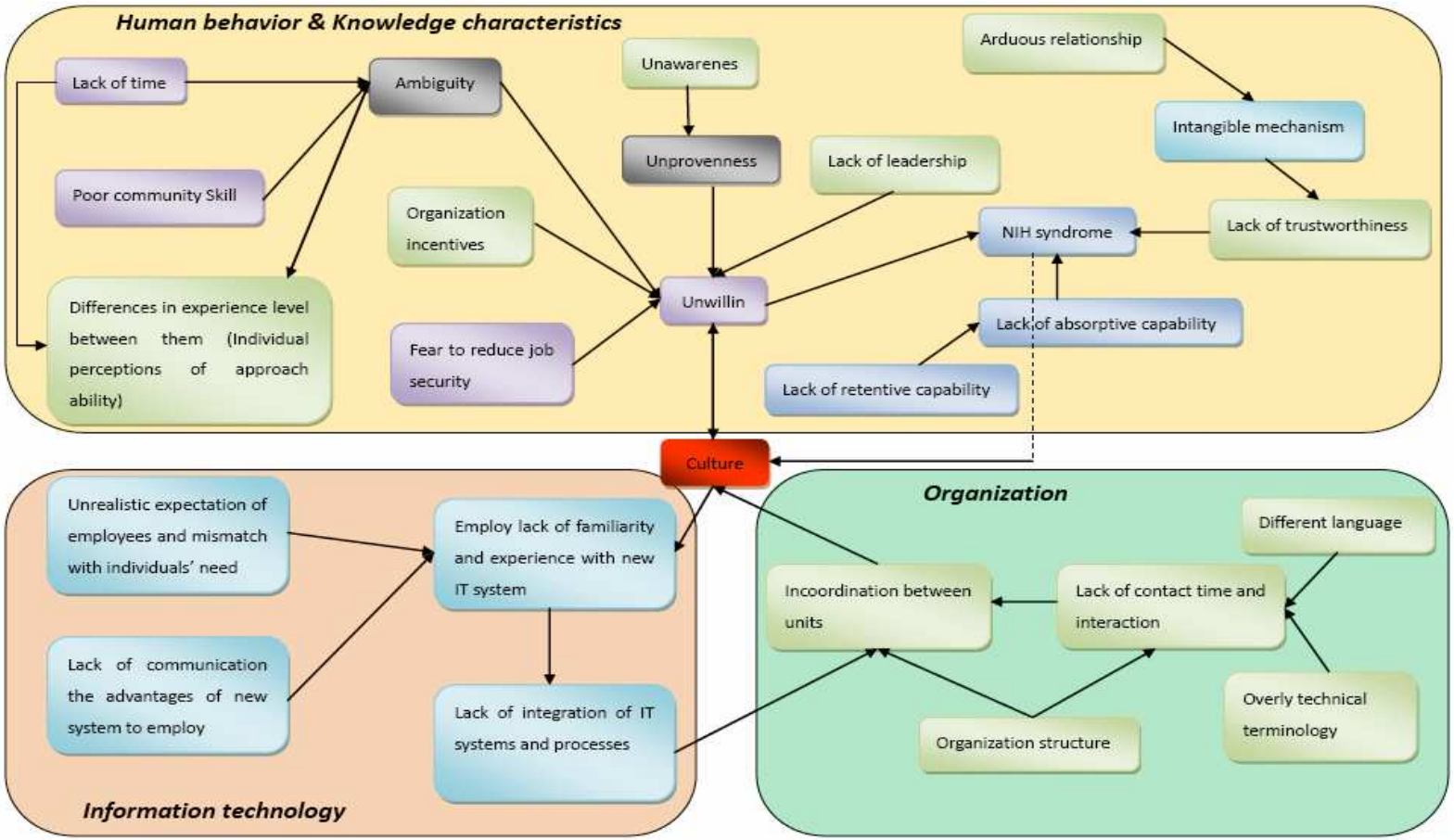


Figure 2 Knowledge Structure Map

4.3. Data Validation

In order to further confirm our finding from Formal Concept Analysis, a questionnaire was designed to test according to the association rules that we finally got. And used construct validity to measure whether this questionnaire can express some concepts or information well or not. Construct Validity can measure the inference capability of this questionnaire. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's sphericity test were used to estimate this questionnaire. According to Kaiser, all KMO values of these three dimensions in this questionnaire are over six and the results of Bartlett's sphericity test are significant (Sig = 0.00). That means that results of every dimension in this questionnaire can express some concepts definitely. The KMO values and results of Bartlett's sphericity test are as Table 2.

Table 2 KMO Values And Results of Bartlett's Sphericity Test

Dimension		Human Behavior & Knowledge Characteristics	Organization	Information Technology
KMO Value		**0.821**	**0.757**	**0.848**
Bartlett's sphericity test	Apporx. Chi Square	2050.255	211.417	218.390
	df	595	15	15
	Sig.	**0.00**	**0.00**	**0.00**

5. CONCLUSION

In the beginning of our research, we extended the outcomes of O'Dell's empirical research and summarized the possible barriers of KM implementation from abundant literature review. Further, we discover these potential relationships between barriers which help us to understand holistic perspective and handle the possible barriers of knowledge flow. To deeply conduct the analysis, we use formal concept analysis (FCA) to construct overall concept of these transcripts. We systematically visualize the concepts of these transcripts by knowledge hierarchy and knowledge structure map through FCA. Knowledge hierarchy and knowledge structure map can help us to understand the causal relationship between these barriers. Finally, we can acquire some valuable managerial implications from these association rules which will facilitate us to retrieve these managerial implications in next section.

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SCORE-BASED ASSESSMENT OF THE INNOVATION CAPABILITY – AT COMPANY LEVEL

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ABSTRACT

The innovation capability, intimately linked with entrepreneurial capabilities (Alvarez and Barney, 2000), is assessed in order to provide strategic tools for companies' managers. The process of innovation assessment is known as innovation audit as well, mainly in the German school (Eckelmann, 2002; Herstatt et al., 2007).

This paper aims at investigating the existing methods for assessing the firm's innovation capability (as Arthur D. Little, 2002), pointing out their strengths as well as weaknesses. Any company has a potential to be creative and innovate. In the process of designing the company strategy, it is critically important that top management becomes familiar with the competitive advantage of their company in the area of innovativeness – as the innovation capability has a leverage effect: if applied, the competitive advantage is considerably amplified. Such companies are well-known for their excellence in innovation (Warschat, 2005).

Based on the results of this preliminary investigation (identified and analyzed advantages and disadvantages of the existing methods), the authors are proposing a score-based method: Score-Based Innovation Capability Assessment (SBICA). The score-based methods are useful tools for analyzing, benchmarking, and communication – all to improve the firm's innovation management. The implications are of high importance for practitioners (entrepreneurs and managers) as well as for the researchers and academics interested in developing tools to assess the firm's innovation capability.
The SBICA method is currently tested in a larger research project – subject of the Ph.D. work of one of the authors.

Keywords: innovation, innovation capability, innovation assessment, score-based innovation capability assessment (SBICA)

INTRODUCTION

Innovations are a fundamental measure to guarantee a competitive advantage. Hence, the assessment of the firm's innovation capability is an important step to derive options for actions in order to remain competitive [6]. In general, small and medium-sized enterprises (SMEs) show the greatest development potential.

However, much of the innovation potential remains unrealized within many SMEs. To a large extent, this is due to a lack of innovation strategy and an inefficient innovation process, which prevents a rapid and consequent transformation of innovative ideas into marketable products and services. Not being aware of one's own innovation capability is a reason why market opportunities remain unrealized [17].

A promising way for enterprises, which are oriented towards innovation, is to install a process of continuous measuring and evaluating of the company innovation capabilities and innovation management performance [9].

Definition of the innovation capability

A series of definitions about the organization's innovation capability are met in the literature:

- The significant set of the features of an organization that facilitates and supports the innovation strategies [7];
- Ability of an organization to innovate successfully on a sustainable base. It refers to generation, adaptation and commercialization of the innovations [3];
- A sustainable competitive advantage which is at the base of the firm's performance [2],

as well as shorter or longer accepted definitions:

- Ability of an organization to adapt and implement successfully new ideas, processes and products;
- Ability to mobilize knowledge through the employees, to combine them in order to create new knowledge resulted in the innovation of a product and/or of a process. It has a dynamic character in which it reveals the interaction between the internal knowledge of a firm and the demands from the external market.

As a synthesis of these definitions, the following statement should be kept in mind: the innovation capability of a firm is its ability of a firm to provide continuously and successfully products at the right time, at convenient costs, and at the required quality. In figure 1, the requirements of the innovation capability are emphasized.

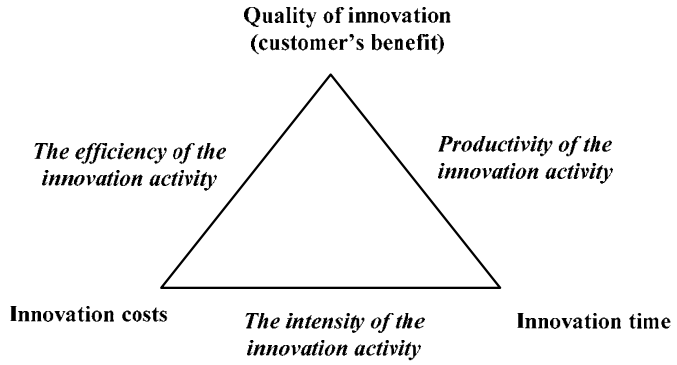

Figure 1 The requirements of the innovation capability [8]

The innovation capability of a firm is a result of the stimulation of the existing innovation potential within the firm. Innovation management is responsible for this stimulation.
Potential of innovation is in touch with other capacities of the firm: the technological potential, the financial potential, the human potential, the managerial potential, the knowledge potential, the relationship potential etc.

The importance of the analysis of the innovation capability in achieving the excellence in innovation

Any firm has a potential of creativity and innovation. Generally, people have many ideas which can be at least useful and can lead to the emergence of some really valuable solutions in the effort of a firm to get a certain competitive advantage. The creativity rate of an organization represents a kind of average of the creativity level of the individuals who make up that organization. Of course, even if the creativity potential is significant, it does not mean that the innovation potential of the respective firm is high. Creativity is the starting point in innovation, but the existence of innovation implies also the presence of other factors.
A question is rising: how innovative is the firm and where is it situated, as performances, against the competition? Therefore, the analysis of the innovation capability represents the starting point in the achievement of excellence in innovation (figure 2).

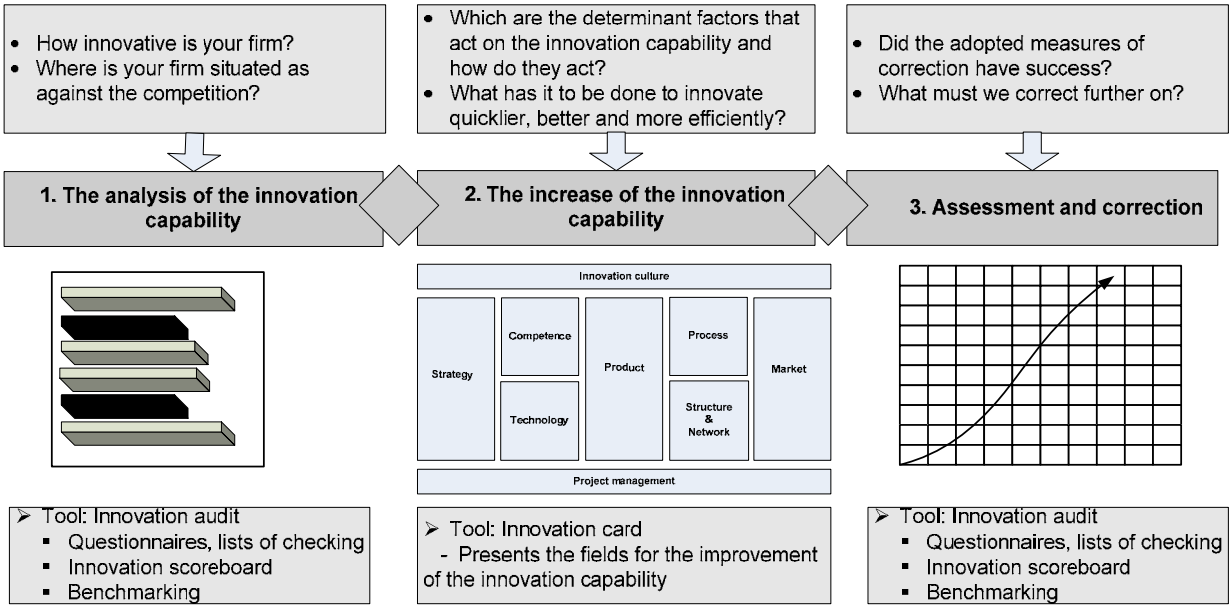

Figure 2 Stages for the achievement of excellence in innovation (by [18])

For the organization, as a whole, an adequate framework of development and valorization has to be offered in order to be capable to innovate, and be able of creative initiatives. The innovation capability of a firm depends on the management capacity to identify the critical factors that impact the innovation capability and determine the way they act.

The question which is rising now is: What has it to be done to innovate more quickly, better and more efficiently?

The adopted measures of correction have to be continuously analyzed and improved.

THE CONCEPT OF INNOVATION AUDIT

The concept of ”innovation audit” is relatively new, although, in the early ‘80’s, there was a “creativity audit” concept. In 1991, Pavitt [14] studied characteristics of the big firms with an important activity in the technological innovation field. A series of authors who followed centered their efforts on studying the innovation capability, not necessarily just technological aspects.

The importance of innovation audit has increased over the last years as the European Union played a more and more significant role; it granted a substantial financial support to over 760 firms from 18 countries in order to benefit from the innovation audits led by consultants. At present, there are over 20 institutes and firms certified in the field of innovation audit, only in Germany.

Audit, generally, means professional examination whereby competent and independent persons collect and assess evidences in order to have an opinion on the degree of correspondence between certain pre-established and observed criteria.

Innovation Audit means a broad and systematic analysis of the innovation capability of a firm, with the main purpose to improve this capability.

The concept of the innovation audit is very little known in Romania. Just to have an idea, the Internet search in Romanian language leads to 1 item, while over 14,500 results have been identified in English and German.

The importance of the innovation audit is:

- Correction - Increase the capacity to compete through corrections on the innovation management
- Certification – Attracting customers, funds and investors; increase the visibility
- Stimulation for development projects.

The innovation audit is different from the financial audit, which is based on the quantitative measurements of the financial results. The innovation audits follow not only the results, but also the way this result was achieved.

An innovation audit is a diagnosis tool used to help an organization to identify its innovation capability, to assess how it performs, to provide a strong indication of what the company really needs. It can be implemented by all kind of firms regardless the size or industry [13].
The innovation audit is an opportunity for managers to determine whether the organization has the resources, infrastructure, culture, and processes to seriously consider either focusing on or improving the current state of innovation [13].

Among others, some of the more specific innovation audit's objectives are to:

- Understand current innovation performance in the main areas of strategy, process and the organization;
- Benchmark this performance against best practice, both within sector and overall at a cross sector level;
- Assess your current capabilities before making expensive changes;
- Learn how to improve the use of all resources involved in the innovation process;
- Develop an action plan or roadmap for future development [13].

Outlooks and fields analyzed through innovation audit

Generally, the audit areas are:

1. Objectives/Strategy - Questions concerning the strategic orientation of a firm, innovation objectives, innovation strategy.
2. Innovation culture - Questions referring to the organizational culture - if it supports the novelty.
3. Technologies/Systems/Processes - Questions related to the technologies, systems and processes.
4. Organization/Structure - Questions with regard to the organizational framework and to the forms of internal collaboration.
5. Resources/Tools - Questions related to the endowment with resources, to the existence of helping tools (tools for creativity stimulation, assessment etc).
6. Management - Questions concerning the innovative activities carried on by the firm's management.

7. Employees - Questions referring to the employees' qualification and motivation as well as their attitude as against the novelty.
8. Learning/Knowledge/Relationships - In what form and by what means the employees' knowledge and competences are activated and promoted.
9. Innovation process - Questions with regard to the means and systems for innovation organizing and leading.
10. Information system/Communication – Issues related to the information flow within the firm.
11. Innovation marketing - Questions referring to the environment, competition, customers, marketing mix.
12. Innovation results - Questions with regard to the innovation purpose.

Both stages and phases of the innovation audit are shown in figure 3.

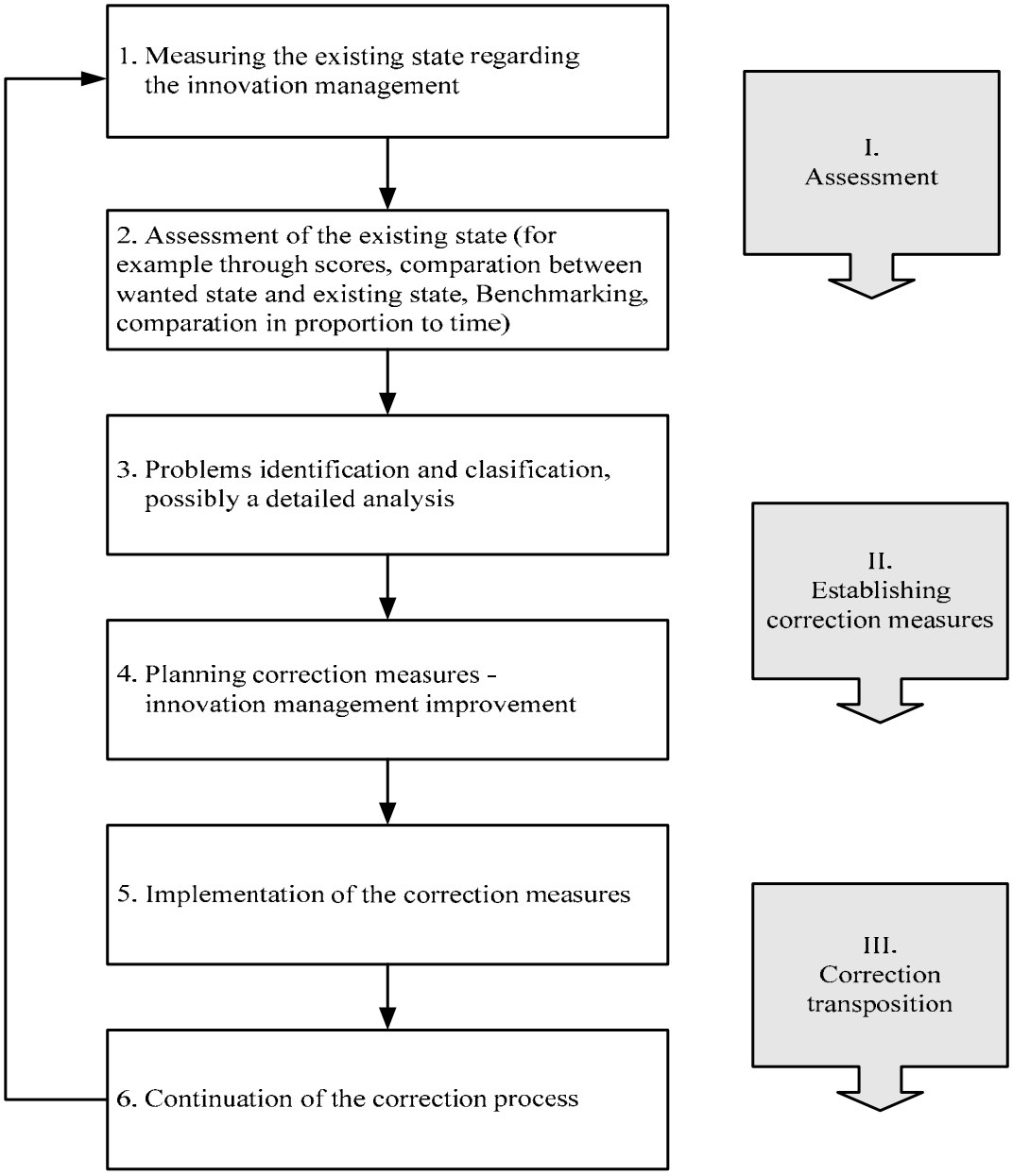

Figure 3 Stages and phases of the innovation audit process [18]

SCORE-BASED MODELS USED TO ANALYZE THE INNOVATION CAPABILITY

The first score-based model in the field of innovation was developed in its first phase (1998) by Arthur D. Little in co-operation with European Business School [5]. Afterwards, the Eckelmann's model (2002) significantly improved it [9] (table 1).
This model is a very good analysis, benchmarking and external communication, which contributes to the improvement of the firm's innovation management.

Table 1

Analyzed aspect	Arthur D. Little's model	Eckelmann's model
Analyzed dimensions	Both models analyse innovation from five perspectives: ➢ innovation strategy, ➢ innovation process, ➢ innovation culture, ➢ resources deployment, ➢ innovation organization	
Criteria of analysis for dimensions	There are eight different sets of criteria of analysis for each perspective (dimension)	
Type of scale	Scale with three positions	Scale with five positions
Scale explanation	There are instructions at the minimal level to mark scores on criteria.	There are explicit instructions to mark scores on criteria (each combination between criteria and position on the scale is explained)
Deciding on the weight of dimensions	In order to analyze innovation performances achieved by various firms from different branches, each analyzed dimension gets a weight of importance. Ascertain weights of importance are difficult and entails the work of many specialists. The amount of the weights of the five dimensions is one. If firms from the same branch are compared, these weights become unnecessarily.	
Establishing the weight of criteria	In order to analyze innovation performances achieved by various firms from different branches, each analyzed criterion gets a weight of importance. Ascertain weights of importance are difficult and entails the work of many specialists. The amount of the weights of the eight criteria for each analyzed dimension is one. If firms from the same branch are compared, these weights become unnecessarily.	
Determining the score of innovation	The score of innovation is established by summing up the scores balanced for each dimension (figure 4)	

Proposed model to determine the score of innovation

The aim to create an original model ([1], [15], [16]) in order to determine the score of innovation is based, first of all, on the wish to achieve a more detailed analysis of the innovation capability. The starting point of building up the model was the analysis of Arthur D. Little's and Eckelmann's models, which are limited to analyze capability of innovation from five perspectives: innovation strategy, innovation process, innovation culture, resources deployment, innovation organization. The proposed model (score-based innovation capability assessment SBICA) aims at clearly deciding among the factors which influence innovation capability, suggesting a number of nine factors and a major extension of the analysis criteria (table 2).

The advantages of the proposed model are:

- ✓ Seven factors to calculate the score of innovation as against five at the Eckelmann's and Arthur D. Little's models ([4], [5]);
- ✓ Ninety-six analysis criteria as against forty at the Eckelmann's and Arthur D. Little's models;
- ✓ The mode of marking scores is based on a clear methodology unlike the Arthur D. Little's model.

The disadvantages of the proposed model are:

- ✓ It does not allow comparing the results of innovation for firms that operate in different industries. Only firms from the same industry and of the same size can be compared.
- ✓ The Eckelmann's model assumes as a basis the experience in the field of innovation gathered at the country level (Germany), which allows comparison of the results of innovation even for different industries. Only in Germany, there are over 20 firms and institutes joined in the field of innovation audit ([11], [12], [18]).
- ✓ In Romania, there are not firms or institutes that provide reliable information that allow comparison among the performances in the field of innovation for the same industry.
- ✓ The mode of marking scores on criteria is not as explicit as in the case of the Eckelmann's model.

Table 2

Analyzed criteria / Analyzed model	**Number of the analyzed factors**	**Total number of the analyzed criteria**	**The mode of marking scores on criteria**	**Number of positions on the assessment scale**	**Means of comparing firms from different industries**
Arthur D. Little's model	5	40	Poorly explained	5	YES
Eckelmann's model	5	40	Very well explained	5	YES
The proposed model	7	96	Well explained	5	NO

A series of important innovation criteria were identified for each factor.

1. Conceptual factor – analysis criteria:
   - ✓ Achievement of the environment analysis
   - ✓ Existence of the forecasts
   - ✓ Clearness of the expression of the business vision
   - ✓ Presence of creativity/innovation concept in the mission statement
   - ✓ Existence of distinctive competences
   - ✓ Perception of the importance of innovation
   - ✓ Correctness of the objectives formulation
   - ✓ Existence of innovation as an objective
   - ✓ Communication of the innovation objectives

- ✓ Existence of an innovation strategy
- ✓ Top management's support for innovation
- ✓ Existence of required innovation resources
- ✓ Relationship between innovation projects and global strategy
- ✓ Top management's involvement in the process of idea generation
- ✓ Existence of a distinct marketing strategy about the new products

2. Cultural factor – analysis criteria:
   - ✓ Promotion of an innovation culture
   - ✓ Opening proportional to external influences
   - ✓ Opening as against taking risk
   - ✓ Attitude towards mistakes
   - ✓ Employees' involvement at the work place
   - ✓ Word and work relationship
   - ✓ Honor successes
   - ✓ Quality of the relationships among compartments/employees
   - ✓ Current leadership style
   - ✓ Solving conflicts
   - ✓ Managers' flexibility proportional to the use of working time
   - ✓ Encouraging communication and ideas dissemination

3. Organizational factor – analysis criteria:
   - ✓ Structure hierarchy
   - ✓ Structure flexibility
   - ✓ Structure stability
   - ✓ Freedom of making decisions
   - ✓ Information flow
   - ✓ Communication efficiency
   - ✓ Making decisions
   - ✓ Authority delegation
   - ✓ Tasks coordination
   - ✓ Jobs enrichment and rotation
   - ✓ Existence of a person or a compartment responsible for research & development
   - ✓ Existence of spaces fitted out and endowed for ideas generation
   - ✓ Existence of project teams
   - ✓ Structure of project teams
   - ✓ Project – structure relationship

4. Personnel factor – analysis criteria:
   - ✓ Existence of the personnel turnover
   - ✓ Giving attention to training and development
   - ✓ Existence of creative employees
   - ✓ Average age
   - ✓ Employees' specialization
   - ✓ Wish of change
   - ✓ Existence of conflicts
   - ✓ Ambition

- ✓ Financial motivation
- ✓ Non-financial motivation
- ✓ Merits recognition
- ✓ Chances of promotion
- ✓ Existence of procedures for recruitment, development, assessment and reward of the persons involved in innovation
- ✓ Development of creative skills
- ✓ Giving attention to creative persons

5. Technological and process factor – analysis criteria:
- ✓ Monitor technical capacities of the competitors
- ✓ Existence of a systematic benchmarking
- ✓ Presence of technological know-how
- ✓ Giving attention to latest technological changes
- ✓ Technological know-how promotion through training
- ✓ Existence of methods for analysis and improvement of innovation process quality
- ✓ Testing new products
- ✓ Existence of well defined procedures for selection of new projects, risk analysis and resources allocation
- ✓ Using computer programs for deployed processes
- ✓ Frequently use of the methods for creativity stimulation
- ✓ Often use of methods for ideas assessment
- ✓ Property of letters patents

6. Learning factor – analysis criteria:
- ✓ Management's attitude compared to learning process
- ✓ Learning stimulation
- ✓ Existence of a group for continuous learning process for developing the core competencies of the organization
- ✓ Causes of the learning processes
- ✓ Involving customers in the learning process
- ✓ Involving suppliers in the learning process
- ✓ Dissemination of knowledge among employees
- ✓ Documentation and availability of the acquired and developed knowledge
- ✓ Implementation of the acquired knowledge into new products and processes
- ✓ Turning to account of the best internal and external practices
- ✓ Spreading and access to knowledge by different means
- ✓ Keeping knowledge of the employees who leave
- ✓ Learning from mistakes
- ✓ Sharing knowledge with other firms
- ✓ Existence of the relationships with well-known consulting firms
- ✓ Existence of the relationships with research and education institutes

7. Economic factor – analysis criteria:
- ✓ Measuring innovation activity
- ✓ Existence of a record of potentially useful ideas generated by persons/compartments

- ✓ Existence of a well defined system of indicators, which measures the performance of innovation
- ✓ Assessment of research & development & innovation expenditures
- ✓ Existence of a well defined budget for research & development & innovation
- ✓ Existence of a flexible budget for research and innovation
- ✓ Source of the resources involved in innovation
- ✓ Relationship between innovation and competitiveness
- ✓ Performances referred to competition

General view over the model

The decision to improve the analyzed factor is made based on the assessment results. The use of Benchmarking is another suggestion for a better understanding of the assessment result.

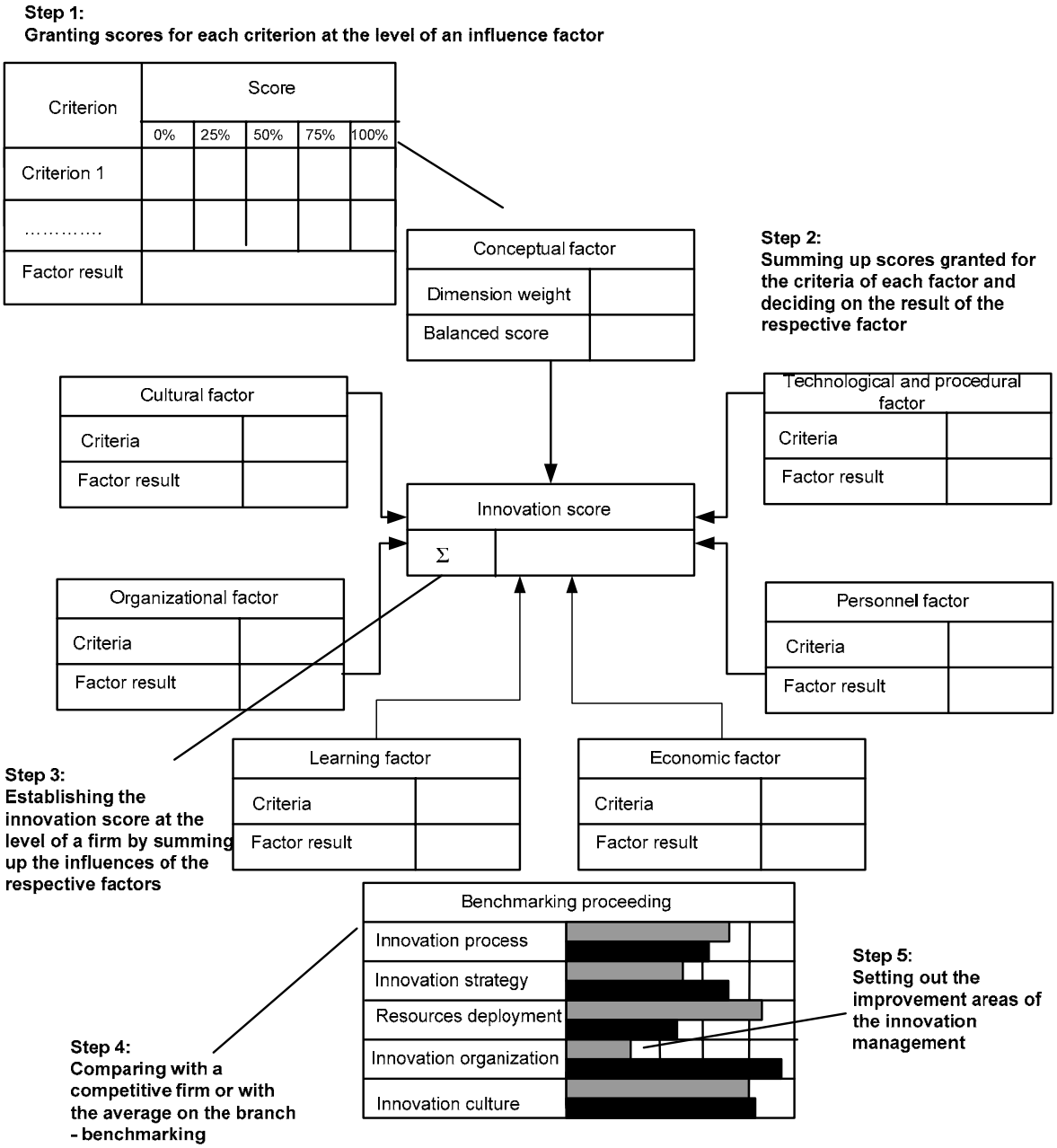

Figure 4 The model overview

The mode of criteria marking

The mode of marking each factor and criterion is based on the EFQM methodology (European Foundation for Quality Management) (table 3).
Each employee involved in the assessment process will fill in a record sheet for each analyzed factor; the score will be calculated at the personal level; and, finally, the average will be considered, according to the number of participants.

The record is filled in individually and anonymously. The necessary time to fill in all the seven records is about 30 minutes.

Table 3

CONCEPTUAL FACTOR						
No.	**ANALYZED ASPECTS**	**MARKING SCALE (a tick will be put to the columns)**				
		0% No proof (It never happens)	**25% Some proofs (It seldom happens)**	**50% Proofs (It happens sometimes)**	**75% Clear proofs (It usually happens)**	**100% Complete proofs (It always happens)**
1.	Criterion statement					
2.	Criterion statement					
...						
...	.....					
N	.....					
	Number of answers (A)					
	Percentage scale (V)	**0%**	**25%**	**50%**	**75%**	**100%**
	Percentage value (A x V)	**%**	**%**	**%**	**%**	**%**
	Σ (A x V)	**%**				
	Factor result Σ (A x V) / N	**%**				

Results assessment

Finally, for each factor, a result will be calculated and explained according to the data from table 4. Thus, the weaknesses of the innovation management will be identified so that the management could intervene.

Table 4

Analysed factor	
Result value (average of the individual results)	**Assessment (weaknesses and strengths identification)**
100-67%	Strength
66-34%	Uncertainty (potential weakness or strength)
33-0%	Weakness

CONCLUSIONS

Today many companies are seeking to improve their innovation performance by having a clear view of both their current and potential innovation capability. It has been a common desire in the business world that companies must be able to be constantly innovative to maintain or improve their position in the market [9].
However, innovation is a highly complex topic and not easily measured and managed particularly with the traditional methods. The point is that innovation measurement or assessment is not simply to collect data but to use some measures to drive improvement of the innovation process. The capacity for continuous innovation requires the integration of management processes [9].

The proposed scorecard helps assessing and optimizing how well an enterprise understands, nurtures and extracts value from its innovations being a simple mechanism for identifying and remedying weak links in the enterprise's innovation system to improve overall performance.

Benefits for SMEs applying the assessment of the innovation capability:

1. Innovation capability is shown as aggregated numeric scores.
2. Predefined set of the most important success factors and indicators that have major impact on the innovation capability.
3. Comparability of the innovation capability by a specified calculation scheme and a predefined set of indicators – the calculated score for one enterprise can be compared to the scores of other enterprises.
4. Transparency on strengths and weaknesses of the innovation capability based on a hierarchical model of indicators, success factors and the seven Fields of Design – the changes of several scores over a period of time give information about an overall development of the innovation capabilities, both for the entire company and its particular divisions.
5. Improved internal communication and the possibility to use the results when communicating with third parties like customers, partners, investors or media.
6. Benchmarking against internal reference points or against reference points from other companies (in case of data availability) [9].

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EMOTIONAL INTELLIGENCE AND ORGANISATIONAL CITIZENSHIP BEHAVIOUR OF MIDDLE MANAGEMENT EMPLOYEES IN THE MANUFACTURING SECTOR: AN EMPIRICAL ANALYSIS

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ABSTRACT

The use of emotional intelligence measures in organisational settings has received much debate. Due to globalisation, workplaces have a diversity of employees. As with diversity, collaboration, co-operation and teamwork have become increasingly important issues for management to handle. The new economic model requires the best of human capital ***(The Star 2008)****. Based on a model developed by* ***Stock (2002)****, emotional intelligence enhances the skills of the executives which will result in organizational success. The model has five components; Emotional intelligence competencies, Critical actions, Executive job results, Department area goals and Organizational goals. Executives represents the middle management of the organization, they can be likened to the link between the top management and the lower management. Based on* ***Watson Wyatt Malaysia (2009)****, employee engagement is important as part of the employee retention programme. Engaged employees will be better performers and will contribute positively to the company's financial performance. Employee engagement can be linked to organizational citizenship behaviour. Organisational citizenship behaviour includes all the extra-role, discretionary behaviour that helps other members in the organisation to perform their jobs. Based on a study conducted by the University of Montreal* ***(Financial Post 2007)****, it was found that the manufacturing sector seems to be generating a new breed of troubled employees. The purpose of this study is to analyse the level of Emotional Intelligence and Organisational Citizenship Behaviour among middle management employees in the manufacturing sector. The GENOS Emotional Intelligence framework developed by* ***Palmer*** *and* ***Stough (2001)*** *will be used to measure the level of emotional intelligence. The framework developed by* ***Podsakoff et al(1990)*** *will be used to measure the level of Organisational Citizenship Behaviour. A total of 536 employees from different organisations and industries took part in this survey. The initial findings suggest that emotional intelligence is positively related to organisational citizenship behaviour. However, in terms of relationship between the dimensions of emotional intelligence and organisational citizenship behaviour, the findings revealed there is a negative relationship between Emotional Recognition and Expression and Conscientiousness. A negative relationship also exists between Emotions Direct Cognition and Sportsmanship. These findings tend to suggest that there are some other matters that exist in the organisational*

workplace. Based on the descriptive analysis, some industries tended to have a lower level of emotional intelligence and organisational citizenship behaviour. The results of this study gave an insight to the manufacturing industry and provided avenues for the management and also the government to rectify the situations at the workplaces especially the industries where the employees are troubled.

Keywords : Emotional Intelligence, Organisational Citizenship Behaviour, human capital

INTRODUCTION

Based on Watson Wyatt Malaysia (2009), employee engagement is important to employee retention. Engaged employees will be better performers and will contribute positively to the company's financial performance. In this respect, employee engagement can be related to contextual performance. According to an article reported in The Star (2009), results have showed that there is a strong link between employee engagement and rate of productivity. According to Abdul Hamid, Baharun and Hashim (2008), among the most common problems faced by organisations especially the small and medium enterprises, includes recruiting and selecting good and dedicated employee. These account for 49.5% and 36.9% respectively. As depicted in Table 1, almost half of the organisations suffer from "Not many dedicated worker" problem. This is a serious issue especially if the organisation requires a lot of manpower such as the traditional wood based furniture factories where they are more labour intensive rather than capital intensive.

Table 1 : Human Resource Problems among SMEs

Problems	Percentage
Not many dedicated worker	49.5
Difficult to find good workers	36.9
Poor employee motivation	34.0
High turnover	26.2
High absenteeism	24.3
Dissatisfaction with pay	17.5
Lack of concern	16.5
Conflict	15.5
Family problem	14.6

Source : Abdul Hamid, Baharun and Hashim (2008)

The services and manufacturing sector are expected to take in substantial amounts of people by the year 2010 (JobStreet 2009). The manufacturing sector will remain as the vital engine to spur growth for the Malaysian economy. They need to enhance the competencies and the innovativeness of the workforce so that they will be able to compete in the global market. This will be a challenge if the sector suffers from employee related issues like "Not many dedicated worker" as depicted in Table 1.

Emotional intelligence, being a relatively new concept (Giesecke 2007) indicating the need to more research on organisational settings. Despite the links between emotional intelligence and performance, there has been relatively little empirical research done to examine the

relationship between emotional intelligence and performance in the workplace. Many researches have been conducted on the top and lower management but there is a lack of studies conducted on the middle management (Accenture 2007). The middle managers play an important role in the pursuit of competitive advantage. In a study conducted by Accenture (2007), 61 percent of the respondents are not satisfied with their current organisation. Some of the British directors believed that their organisation has been paralysed by ineffective or underperforming middle managers, this cost the United Kingdom economy a massive £220 billion a year (Management Issues 2007). It was also found that the middle managers were affected the level of productivity of the organisation. It was found that there was a performance gap in the middle management level. The purpose of this study is to analyse the level of emotional intelligence and organisational citizenship behaviour among middle management employees in the manufacturing sector.

Emotional Intelligence: An Overview

Emotional Intelligence may be defined as the ability to perceive, understand, integrate and manage one's own and other people's feelings and emotions, and to act upon them in a reflective and rational manner (Chartered Management Institute 2004). When applied to the workplace, emotional intelligence involves the capacity to effectively perceive, express, understand and manage emotions in a professional and effective manner at work (Palmer and Stough 2001). There are four approaches to emotional intelligence, as seen in Table 2. From the ability approach, it is assumed that the level of emotional intelligence in a person depends on his or her cognitive ability. These include the level of education, age and also the type of experiences undergone by the individual. Mayer and Salovey (1997) have conceptualised emotional intelligence as a set of mental abilities concerned with emotions and the processing of emotional information. Mayer and Salovey's ability model of emotional intelligence comprises of four conceptually related abilities arranged hierarchically from the more basic psychologically complex, including

(1) The ability to perceive emotions;
(2) The ability to utilise emotion to facilitate reasoning;
(3) The capacity to understand the meaning of emotions and the information they convey; and
(4) The ability to effectively regulate and manage emotion

It is assumed that as a person ages, his or her level of emotional intelligence increases as well. According to Sullivan and Ruffman (2004), older adults and younger adults identify emotions and cognitive stance in a different way. Older adults have difficulty in recognising negative emotions (Phillips, MacLean and Allen 2002). They need more time to process the stimuli due to age-related decline in processing speed (Salthouse 1992). Aging improves the emotional control (Nauert 2009).

Table 2 : Approaches to Emotional Intelligence

Approach	Description
Ability	Models that propose a pure ability definition of emotional intelligence are considered ability models.
Mixed	Models that incorporate aspects of both the original definition of emotional intelligence and aspects of personality are classified as mixed models of emotional intelligence.
Traits	Trait models of emotional intelligence focus on behavioural consistency across situations assessing typical behaviour.
Information Processing	Information processing models of emotional intelligence are more explicit in the relationships between emotional intelligence and cognitive ability.

Source : Mayer, Salovey and Caruso (2000) and Petrides and Furnham (2000)

Based on the mixed model approach, emotional intelligence combines not only the cognitive ability but also the personality of the person and also other demographic characteristics.

Emotional Intelligence and Organisational Citizenship Behaviour

Globalization has increased the level of interdependence among people in the organisations. It emphasizes the need for greater co-operation and pro-social interactions among employees in the organisation. In terms of evaluating employee's job performance, three elements can be used (Katz and Kahn 1978). The three elements that can be used are as follows:

- Joining and staying with the organisation.
- Dependably meeting or exceeding standards of performance prescribed by organisational roles (in-role performance).
- Innovatively and spontaneously going beyond prescribed roles to perform such actions as co-operating with others, protecting the organisation from harm, offering suggestions for improvement and representing the organisation favourably to outsiders (extra-role performance).

Organisational Citizenship Behaviour (OCB) has been defined as the extra-role, discretionary behaviour that helps other members in the organisation to perform their jobs. OCB also includes showing support and conscientiousness towards the organisation (Smith et al, 1983; Bateman and Organ 1983; Borman and Motowidlo 1993). According to Podsakoff et al (1990) OCB has five elements that measures conscientiousness, sportsmanship, civic virtue, courtesy and altruism. According to Abraham (1999), emotional intelligence enhances the altruistic behaviour of an individual. It enables employees to comprehend their fellow colleagues and to respond better than those with lower level of emotional intelligence. Staw et. al. (1994) suggested three explanations for this behaviour. Firstly, being in a positive mood is good in reinforcing and displaying altruism is rewarding in the sense that it enables employees to maintain this state of mind. Secondly, individuals in positive moods are likely to be more socially interactive. Thirdly, when individuals are more satisfied with their work, they would be more likely to engage in a helpful behaviour. Pasanen (2000) found that emotionally intelligent individuals are more likely to engage in pro social behaviour.

Douglas, Frink and Ferris (2004) noted that highly conscientious people with higher emotional intelligence had higher level of performance than those with lower level of emotional intelligence. Those with lower level of conscientiousness and emotional intelligence did not perform well. The findings were based on 205 undergraduates. In a study conducted by Busso (2003), individuals with higher levels of emotional intelligence showed a higher level of contextual performance. This study was conducted based on a sample size of 84 people from different organisations in Mexico. In a study conducted by Sitter (2004), emotion has a positive but low significant factor in OCB. The study was conducted in a manufacturing area with a sample size of 376.

Based on the framework of emotional intelligence by Palmer and Stough (2001), there are five elements. They are Emotional Recognition and Expression, Understanding Others Emotions, Emotions Direct Cognition, Emotional Control and Emotional Management. These five elements refer to interactive skills that an individual needs to display when they interact with one another in the organisation. Recent findings of the multidimensionality of the OCB concept have cast certain doubts (LePine et.al 2002, Desivilya, Sabag and Ashton 2006). The purpose of this study is to examine the pro-social effects of emotionally intelligent employees to organisational citizenship behaviour. Pro-social behaviours have been identified as one of the vital key player in enhancing the effectiveness and sustainability of the organisation. The research objectives of this study would be:

(a) To determine the level of emotional intelligence and organisational citizenship behaviour of the middle management employees across industries
(b) To examine the relationship between the dimensions of emotional intelligence and organisational citizenship behaviour of middle management employees

Method

Measures

Emotional Intelligence

The questionnaire used to measure the level of emotional intelligence among the middle management employees has been developed by Palmer and Stough (2001). According to the GENOS EI, there are five key emotional competencies which are applicable to the workplace situation:-

- Emotional Recognition and Expression – refers to the ability to identify one's own feelings and emotional states and the ability to express those inner feelings to others.
- Understanding Others Emotions – refers to the ability to identify and understand the emotions of others and those that manifest in response to workplace environments and staff meetings.
- Emotions Direct Cognition – refers to the extent to which emotions and emotional knowledge are incorporated in decision-making and or problem solving situations
- Emotional Management – refers to the ability to manage positive and negative emotions both within oneself and others
- Emotional Control – refers to the ability to effectively control strong emotional states experienced at work such as anger, stress, anxiety and frustration.

The questionnaire uses the five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). The GENOS EI is reliable with α = 0.88 (Emotional Recognition and Expression : α = 0.73, Understanding of Emotions : α = 0.83, Emotions Direct Cognition : α = 0.63, Emotional Management : α = 0.72, Emotional Control : α = 0.72) It has also shown to have good internal consistency and test re-test reliability. This test re-test reliability is an important aspect of the psychometric property of the emotional intelligence measurement. The test consisted of 64 questions and takes about 12-15 minutes to complete. There are a balanced number of positively and negatively phrased items that will help to determine inconsistent patterns and also illogical responses by the respondents. There are 11 statements for Emotional Recognition and Expressions, 20 statements for Understanding Others Emotions, 12 statements for Emotions Direct Cognition, 12 statements for Emotional Management and 9 statements for Emotional Control.

Organisational Citizenship Behaviour

Organisational Citizenship Behaviour Scale developed by Podsakoff et al in 1990 was used to measure contextual performance. The scale has five elements that measures conscientiousness, sportsmanship, civic virtue, courtesy and altruism.

- Conscientiousness – punctuality in attendance, use of work time and adherence to rules. It also refers to the trait of being painstaking and careful, or the quality of acting according to the dictates of one's conscience. It includes such elements as self-discipline, carefulness, thoroughness, organization, deliberation (the tendency to think carefully before acting), and need for achievement. It is an aspect of what was traditionally called character. Conscientiousness is related to emotional intelligence and impulse control.
- Altruism – helping others who have been absent or are behind in their work (any voluntary action that helps another person out at work) It is often referred to as the wilful sacrifice of one's own interests or well-being for the sake of something that is non-self. It is also often defined as being the selfless concern for the welfare of others.
- Sportsmanship – putting up with minor inconveniences, or not always finding fault with the organisation
- Courtesy – consulting people who may be affected by a decision or at the very least informing other people in advance of such actions
- Civic virtue – keeping up with developments happening in the organisation (being constructively involved in the political process of the organisation).

Like the GENOS EI, this questionnaire also uses the five-point Likert scale. The reliability properties are as follows:

Scale	Items No.	α
Altruism	39,48,51,53,61	0.85
Conscientiousness	41,56,59,60,62	0.82
Courtesy	43,46,52,55,58	0.85
Sportsmanship	40,42,45,54,57	0.85
Civic Virtue	44,47,49,50	0.70

Procedure

A total of 536 respondents took part in this survey. They were from 16 different organisations throughout the state of Melaka. The organisations were randomly identified from different manufacturing industries. The Human Resource Manager of each organisation was entrusted to distribute and collect the questionnaires from the employees. As such, their identity is not known to the present research. The present researcher also ensures the privacy and confidentiality of their data and subsequently the presentation of the analysis. Upon completion, the Human Resource Manager will insert the questionnaires into a sealed envelope to be handed personally to the present researcher.

Results

Based on the 536 respondents, it was found that a majority of the middle management employees are males. This shows that the manufacturing industry is largely male-dominated. The education level of the respondents is mainly the first degree. A majority of them are aged between 25 to 30 years of age. Almost fifty percent of them are working between 2 to 5 years in the present organisation.

Table 3 : Demographic Analysis of the Respondents

Gender	Frequency	Percentage
Male	383	71.5
Female	153	28.5
Total	*536*	*100.0*
Education Level		
Diploma Level or lower	106	19.8
Bachelors Degree or the equivalent	401	74.8
Masters or higher	29	5.4
Total	*536*	*100.0*
Age Group		
Less than 25 years old	75	14.0
More than 25 but less than 30 years old	184	34.3
More than 30 but less than 35 years old	134	25.0
More than 35 but less than 40 years old	87	16.2
More than 40 but less than 45 years old	18	3.4
More than 45 and above	38	7.1

Total	*536*	*100.0*
Employment Length		
Less than 2 years	116	21.6
More than 2 but less than 5 years	246	45.9
More than 5 but less than 10 years	92	17.2
More than 10 years	82	15.3
Total	*536*	*100.0*

For the first research objective, the descriptive and correlation analysis were used. It was found that emotional intelligence is positively related to organisational citizenship behaviour. The findings concurs with Pasanen (2000) and Busso (2003) and somewhat agreed with Sitter (2004). Since the p value is less than 0.05, it indicates that the relationship is significant. This is seen in Table 4.

Table 4 : Correlation Analysis between Emotional Intelligence and Organisational Citizenship Behaviour

		Organisational Citizenship Behaviour
Level of Emotional Intelligence	Pearson Correlation	.370(**)
	Sig. (1-tailed)	.000
	N	536

** *Correlation is significant at the 0.01 level (1-tailed).*

In Table 5, it was found that it was not necessarily so that industries having the highest level of emotional intelligence would have the highest level of organisational citizenship behaviour. Middle management employees from the Petrochemical industries had the highest level of emotional intelligence but their level of Organisational Citizenship Behaviour was not the highest. Middle management employees from the Engineering and Support had the highest level of Organisational Citizenship Behaviour. There are 3 industries that obtained a low level of emotional intelligence, ie Textiles and Apparels; Paper, carton box and printing together with Pharmaceuticals. For the middle management employees in the Paper, Carton Box and Printing, they have obtained the lowest level of Organisational Citizenship Behaviour. However, in terms of the middle management employees in the Pharmaceutical industry, they tended to have a higher level of Organisational Citizenship Behaviour in comparison with the other industries.

Based on a study conducted by the University of Montreal (Financial Post 2007), it was found that the manufacturing sector seems to be generating a new breed of troubled employees. Industries where the risk seemed higher than normal included fabric, fur and leather products workers, who were almost 2½ times more likely than the average to report

poor mental health. Manufacturing jobs are stressful because of the noise and physical strain. Needle-trade employees may face particular anxiety because their industry shrank by 28% between 2002 and 2006 in the face of overseas competition. In Malaysia, the Textile industry including the batik industry is known for the chemical hazards due to dye (MTUC 2006). There are also cases of exposure to cotton dust and excessive noise from the weaving and ring spinning sections. These would seriously affect the employees' health conditions. This could mean that middle management employees from these 3 industries could be affected by these hazards and this has affected their attitudes.

Table 5 : Mean for Emotional Intelligence and Organisational Citizenship Behaviour across industries

	N	Mean for Emotional Intelligence	Mean for Organisational Citizenship Behaviour
Electric & Electronics	200	204.9450	84.2650
Engineering & Support	15	215.7333	86.4667
Confectionary	27	217.5185	85.1481
Petrochemical & Poly	30	220.6333	86.0000
Textiles & Apparels	27	193.0370	81.5185
Paper, carton box & Printing	70	196.6571	79.8857
Pharmaceutical	17	195.6471	85.2941
Computers	50	206.6600	83.1200
Furniture	50	205.7200	85.8800
Automobiles	50	207.0200	84.7600
Total	536	205.2071	83.8806

The second research objective was to investigate the relationship between the dimensions of emotional intelligence and organizational citizenship behaviour. It was found that all the dimensions of emotional intelligence correlated positively to Altruism (Emotional Recognition and Expression: $r = 0.103$, $p = 0.008$; Understanding Others Emotions: $r = 0.195$, $p = 0.000$; Emotions Direct Cognition : $r = 0.309$, $p = 0.000$; Emotional Management: $r = 0.149$, $p = 0.000$; Emotional Control: $r = 0.191$, $p = 0.000$). This is depicted in Table 5. The findings agrees with Abraham (1999) and Staw et. al. (1994). Executives with a high level of emotional intelligence would be more than willing to cooperate with their fellow colleagues especially those that are behind in their work schedule. The organisation will benefit from this positive attitude. Work runs smoothly without any interruptions. Emotional Recognition and Expression (ERE), Understanding Others Emotions (UOE), Emotional Management (EC) and Emotional Control (EC) are important to improve the working environment. It was found that among all the five dimensions, only Emotions Direct Cognition has a high correlation with Altruism. Since Emotions Direct Cognition refers to the extent the executives incorporate information happening in and out of the workplace, it improves their daily reasoning and this helps them in Altruistic.

In terms of the relationship between the dimensions of emotional intelligence to Conscientiousness, all the dimensions correlated positively with the exception of Emotional Recognition and Expression (Emotional Recognition and Expression : r = -0.008, p – 0.426; Understanding Others Emotions : r = 0.186, p = 0.000; Emotions Direct Cognition : r = 0.416, p = 0.000; Emotional Management : r = 0.127, p = 0.002; Emotional Control : r = 0.191, p = 0.000). Emotional Recognition and Expression has a negative and insignificant relationship with Conscientiousness. Emotional Recognition and Expression refers to how effectively the executive perceives and expresses the emotions and responds to their own emotions. It also refers to the effectiveness of the executive in communicating and displaying their emotions at the workplace. In terms of Conscientiousness, it refers to how the executive manage their time and also the adherence to the organisation's rules and regulations. It includes elements such as self-discipline, carefulness, thoroughness, organisation, deliberation (the tendency to think carefully before acting), and need for achievement. The negative relationship between Emotional Recognition and Expression and Conscientiousness could indicate some kind of resentment towards the organisation in terms of their rules and regulations. They could be unhappy towards the policies implemented by the management.

In terms of Sportsmanship, all the dimensions of emotional intelligence are positively related with the exception of Emotions Direct Cognition (Emotional Recognition and Expression : r = 0.329, p = 0.000, Understanding Others Emotions : r = 0.111, p = 0.005, Emotions Direct Cognition : r = -0.136, p = 0.001; Emotional Management : r = 0.228, p = 0.000; Emotional Control : r = 0.073, p = 0.045). Their relationships are significant. Sportsmanship refers to how well the executive puts up with minor inconveniences in the organisation. Emotions Direct Cognition refers to the extent the executives incorporate information happening in and out of the workplace. The negative relationship between Emotions Direct Cognition and Sportsmanship suggests that executives are aware of the happenings in and around the workplace and this has affected their level of Sportsmanship in the organisation. The executives could be experiencing unhappy events or decisions made by the top management and this has affected their moods and attitudes. Traumatic and significant events influence behaviours (Weiss and Cropanzo 1996) and their attitude towards work (Mignonac and Herrbach 2004).

In terms of the relationship between the dimensions of emotional intelligence to Courtesy, all the correlations are positive and significant (Emotional Recognition and Expression : r = 0.125, p = 0.002; Understanding Others Emotions : r = 0.269, p = 0.000; Emotions Direct Cognition : r = 0.440, p = 0.000; Emotional Management : r = 0.222, p = 0.000; Emotional Control : r = 0.304, p = 0.000). Courtesy refers to the act of consulting or informing others at the workplace when they will be affected by the decisions being made. All the dimensions of emotional intelligence are positively related indicating they enhance the level of Courtesy in the organisation. Among the dimensions, Emotions Direct Cognition has a higher correlation with Courtesy. Since Emotions Direct Cognition describes how well the executive incorporates all information, they in turn inform all other members in the organisation who are affected by the decision.

All the dimensions of emotional intelligence are positively related to Civic Virtue (Emotional Recognition and Expression : r = 0.075, p = 0.41; Understanding Others Emotions : r = 0.144, p = 0.000; Emotions Direct Cognition : r = 0.239, p = 0.000; Emotional Management : r =

0.136, p = 0.001; Emotional Control : r = 0.242, p = 0.000). Civic Virtue describes how well the executive keeps with the latest developments in the organisation and being constructively involved in the political process of the organisation. The higher the level of emotional intelligence, the better would be the level of Civic Virtue in the organisation. Among the five dimensions of emotional intelligence, Emotional Control has the highest correlation level in terms of the others. Emotional Control refers to how well the executive is able to control strong emotions at the workplace. High scores reflect their ability to control these emotions from affecting their thoughts. As such, high Emotional Control levels helps in the level of Civic Virtue in the organisation.

Table 6: Relationship between the dimensions of Emotional Intelligence and the dimensions of Organisational Citizenship Behaviour

		Altruism	Conscientious	Sportsmanship	Courtesy	Civic Virtue
Emotional Recognition and Expression	Pearson Correlation	.103(**)	-.008	.329(**)	.125(**)	.075(*)
	Sig. (1-tailed)	.008	.426	.000	.002	.041
Understanding Others Emotions	Pearson Correlation	.195(**)	.186(**)	.111(**)	.269(**)	.144(**)
	Sig. (1-tailed)	.000	.000	.005	.000	.000
Emotions Direct Cognition	Pearson Correlation	.309(**)	.416(**)	-.136(**)	.440(**)	.239(**)
	Sig. (1-tailed)	.000	.000	.001	.000	.000
Emotional Management	Pearson Correlation	.149(**)	.127(**)	.228(**)	.222(**)	.136(**)
	Sig. (1-tailed)	.000	.002	.000	.000	.001
Emotional Control	Pearson Correlation	.191(**)	.191(**)	.073(*)	.304(**)	.242(**)
	Sig. (1-tailed)	.000	.000	.045	.000	.000

CONCLUSION

Discussion

Different industries have different characteristics and this is beyond the control of the management. With globalisation, the level of competitiveness is further heightened. Industries especially the manufacturing sector was being forced to innovate or vanish. With need to innovate and be cost effective, many organisations especially the manufacturing sector has sought to reduce their workforce. This has resulted in a low level of morale among the employees. Hence, the need for a study in the manufacturing sector particularly focusing on the level of emotional intelligence and organisational citizenship behaviour. The purpose of this current study is to focus on these issues. In the first research objective, it was found that some industries tended to have a lower level of emotional intelligence. It was noted that for some industries it does not necessarily mean that a high level of emotional intelligence

would entail a high level of organisational citizenship behaviour. Different industries have their own unique characteristics. As such, to compare them against one another may not be advisable. According to Porter (1998), each industry is unique. They have their own forces that affect them. Some of the industries are more towards capital-intensive while others are more labour-intensive. Each organisation has their culture. Culture will have an influence. Further to that, in some of the industries particularly the furniture industry, there is a mix between traditional and modern approach. The traditional approach uses more of labour and this is probably one of the reasons why the level of emotional intelligence and organisational citizenship behaviour is rather high for them. Most of the employees have worked there for more than 10 years, their sense of commitment have been built in. The employees have already grown accustomed to each other. It was also observed that for some of the employees, their whole family is being employed in the organisation in different departments. This suggests that there are moderating effects that needs to be analysed.

For the second research objective, it was found that most of the dimensions of emotional intelligence had a positive and significant relationship with the dimensions of organisational citizenship behaviour, with the exception of Emotional Recognition and Expression and Conscientiousness and Emotions Direct Cognition and Sportsmanship. The relationship between Emotional Recognition and Expression and Conscientiousness is not significant while the relationship between Emotions Direct Cognition and Sportsmanship is significant. Sportsmanship refers to how well the executive puts up with minor inconveniences in the organisation and Emotions Direct Cognition refers to the extent the executives incorporate information happening in and out of the workplace. The negative relationship between Emotions Direct Cognition and Sportsmanship suggests that the middle management employees are aware of the happenings in and around the workplace and this has affected their level of Sportsmanship in the organisation. These happenings have caused a negative perception in the minds of the employees and have affected their level of Sportsmanship and also Emotions Direct Cognition. Since many organisations in the manufacturing sector conducted retrenchment exercise and "forced leave", the employees feel negative about it. People are worried about their future especially when they need their financial stability is at stake. As suggested by Hoge (2009), an individual is influenced by many factors such as working hours, number of children, age of children and status of partner. Based on the demographic analysis, it was found that more than fifty percent of the respondents are aged between 25 to 35 years old. Assuming the average marriage age is around 30 years old, the age range suggests the settling down period of new families. Furthermore, in most families, it has been their culture that the males must take care of their families and also the extended families. If their partner is not working, solely relying on the male as the bread winner puts a heavy burden on his shoulders. The studies suggest that an individual is affected by many situations in and out of the workplace.

Strengths and Limitations of Study

Past studies on emotional intelligence and organisational citizenship behaviour were conducted in a limited number of organisations and industries. Others were focused on university students. This study was conducted in 16 organisations across a number of industries. By having a wide area, the results will provide a better insight to the studies and analysis. Studies conducted on middle management employees were rather limited. Most

studies focused on top management leadership. Further to that, the present study was based upon 536 respondents. Their responses will be able to shed more light to the studies.

The present study used a self-report questionnaire. There could be instances of biasness for some cases. The selection of the respondents was solely at the hands of the Human Resource Manager or the Head of the Organisation. Their selection could be a little bias as they do want to have a good presentation.

Directions for Future Research

For future research, it is suggested that other variables could be included as suggested by Hoge (2009), the family factors. In the second research objective, it was shown that there was a problem in the relationship between Emotions Direct Cognition and Sportsmanship. There could be some possibility that the individual could be experiencing some form of emotional problem either at home or at work. The emotional issues at work could be tested using the work support analysis by the superior and fellow colleagues. As suggested by Hoge (2009) issues at work do have an effect on an individual's emotional well being. The present studies was conducted more of a cross-sectional studies. It would shed more light if the same can be done comparing the performance of the individuals in time periods ie, longitudinal studies.

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MAKING THE KNOWLEDGE WORKER AS A LIFESTYLE LEARNER

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ABSTRACT

For organizations to prosper and survive learning should be devised in a method that enables the workers to expand their capacity to perform. Knowledge managers must have a concept that will make workers go beyond their functional role and be highly motivated to execute the task. A historical perspective on knowledge audits the fact that it was mainly about enhanced learning for self-development. The metaphor of North American football is utilized as a philosophical and conceptual learning tool for building employees' analytical thinking skills. The study provides an application script for management to articulate the methodological ideas of the sports into the business core operation.

Keywords: Knowledge Management, Knowledge Workers, Socrates, Taoism, Learning, Lifestyle, Football Philosophy, Coaching, Problem-Solving, Positive Attitude, Teamwork.

INTRODUCTION

Managing people who have the in-depth skills, abilities, or special talent in planning, acquiring, searching, analyzing, organizing, storing, programming, distributing, marketing, and contributing to the transformation and commerce of information into new knowledge can no longer be considered as a functional role. In order to have these unique groups of people perform with positive results on a weekly basis the demand now falls on the individuals, who are considered knowledge managers, to become more effective in their stratagem to equip their employees so that they will be highly motivated to perform. But in order to do so, these managers have to focus on the essence of knowledge. They have to heed to Wilson (2002) who stated *that 'knowledge management' is an umbrella term for a variety of organizational activities, none of which are concerned with the management of knowledge.* He also points out from Miller that *knowledge is what we know… what we know cannot be modified…It must never be thought of as a commodity to be captured, processed, stored, transmitted, nor managed.* Most importantly, Sveiby (2001) firmly addresses that knowledge management is about people.

According to Awad and Ghaziri (2004) the challenge in managing is to get the department or the organization moving in the direction of the goal(s) in line with the rate of change. The focus is on the future, developing strategies and sharing vision through effective communication with knowledge workers. In order for the organization to survive and prosper learning has become the key focus. Methods and application for learning have to be strongly committed to and carefully implemented in order to expand these workers' capacity to perform. Overall, the authors proclaiming that "*learning should promote a new way of thinking, not just facts"* opens the channel for managers to make their knowledge workers convert into becoming a lifestyle learner. This is the pragmatic concept of this paper.

This study is aimed at innovating and improving the managerial technique for developing their staff who deals with knowledge-based task by using a historical method on knowledge. The purpose of this method is to describe how knowledge was utilized in the ancient era so that the practitioners of knowledge management can really see and appreciate how knowledge is genuine in itself. By getting a better understanding of knowledge used from the past knowledge managers will be able to develop their employees with other external resources around them for learning. The idea is to make their workers' lifestyle as a part of their educational curriculum. Managers can plant an inspirational seed within the workers to convert their leisure activities into a learning ground for not just problem solving but for also thinking, analyzing, building relationship and collaboration or any positive action that will moderate the knowledge that they already have and to apply it at work.

LITERATURE REVIEW WITH A HISTORICAL PERSPECTIVE ON KNOWLEDGE

In tracing the history of how knowledge has developed one has to look at ancient Greece as a good place to start. Socrates believed that knowledge virtue and that people behaved badly due to ignorance. Socrates deeply felt that humans had a desire to increase their knowledge. (Roger Osborne, 2006. pg. 75) During his time, Socrates played a big influence with his fellow Greek nationals. The last decades of the fifth century was a time of changes for scholars in Athens and elsewhere who became sick and tired of complying with the restrictions of the old myths. At one point the theatres were the place to discover answers to life. Suddenly, new areas of thinking were needed to cope with the questions that the changing society was provoking. The Sophists began posing some challenging questions. They were educated men who saw that success in Athenian society required skills for arguing and speech-making. They arranged themselves as teachers of debate and rhetoric to the sons of the upper classes. The development of debating skills was not just a matter of effect; in order to win arguments, a speaker must be able to show logical inconsistencies in his opponents' approaches, to think through and clarify his own reasoning in order to avoid being ensnared by others, to look for fault and rectitude in particular statements and arguments and to seek out evidence to support any assertions he might make. All of these were the tools of the sophist's trade that Socrates avidly applied (Roger Osborne, 2006. pg. 76). Ideas such as "truth" and "justice" had been used by Athenians like Solon and Aeschylus and were employed by sophists in their arguments in the jury courts and assembly. Socrates subjected these concepts to rational analysis that went beyond the casually assumed knowledge of other philosophers. Rather than using them as weapons in argument, he saw truth, justice and goodness as the highest goals of human endeavor. Goodness, in Socrates' mind, was something beyond, and superior to, pleasure or companionship or beauty, or even life itself. This was the birth of human morality – the idea that there is some essential goodness to which we can all aspire. Socrates believed we could reach goodness through rational debate and the acquisition of knowledge. Some felt that to reach it one would have to be engaged with the spiritual contemplation, or political action, or the forces of history, or through scientific progress. No matter the method, Socrates' concept of human morality is a blessing to the world. What is unique about his gift is that it was an invention born of a particular time and place rather than from a natural phenomenon. It's one of the single concepts that marks out western society from all others that have ever existed (Roger Osborne, 2006. pg. 77)

Knowledge in ancient India had its origin with a group of mystics known as the Upanishads who were embarking on a peaceful conquest of inner space. The vision of the Upanishads was focused on the interior significance; the practitioner of this group had to know what he is doing, and this knowledge would take him to the Brahman, the ground of being. The worshiper turned within to see that in reality the gods are of his own creation and that he is all of these gods. If the thinker could discover the inner heart of his own being, he would automatically enter into the ultimate reality and liberate himself from the terror of mortality. A teacher of the Upanishads named Yajnavalkya became a leading exponent of the new spirituality. Yajnavalkya was convinced that there was an immortal spark at the core of the human person, which participated in the immortal Brahman that sustained and gave life to the entire cosmos. Yajnavalkya and other Upanishadic sages developed a concept where the person was indeed the agent who created all of the senses that gives life as well as taking away life. Yajnavalkya explained that you cannot see the person who is does the seeing, nor hear the hearer who does the hearing, nor think with the thinker who does the thinking, nor can you perceive the perceiver who does the perceiving. What Yajnavalkya revealed was that human beings can systematically make themselves aware of the deeper layers of human consciousness. Human beings can become fully self-conscious. (Karen Armstrong, 2006. pg. 152-53)

The Tao or the way helped mankind to disentangle the illusion that their surrounding environment dictates their movements and thoughts. The philosophy of this classic focused on concepts like: tao and te, wu-wei (usually translated as *non-doing*) and *fu* (the return of all things to their origins). The goal of the Taoist philosophy is, according to the scholars, to become one with *tao*, inwardly achieving the universal rule of the return to origins. But for this purpose the disciple has to achieve the emptiness (*wu*) and to practice the *non-doing*. Before the term paradigm was created the followers of Tao Te Ching was living with the Tao as part of their lifestyle. The ideal of Taoism was to live in harmony with the Tao and to cultivate a simple and frugal life, avoiding unnecessary action: *'Being one with nature, the sage is in accord with the Tao'*. As Humans have evolved from Nature (Tao) they ultimately depend upon Nature (Tao) for their survival. Until we understand what we are as humans (what matter is) and how we are connected to the universe (Reality, Tao), it is impossible for humanity to be wise, and to be able to evolve cultural knowledge that enables us to live in Harmony with Nature (Tao). The Tao of Abundance by Laurence G. Boldt offers timeless classics from thousands of years ago that helped those pressured and caught surprised by the uncertainties in regaining their focus and to co-exist with the struggle. *"In a world that defines abundance in terms of scarce resources and economic abstractions, the Taoist philosophy defines abundance in human terms and sees the world as a naturally abundant place. In a do-oriented society that puts its faith in future progress, it reminds us to be, and that here and now is the only place we live. In a world caught up in glamour and obsessed with consumption, the Taoist perspective offers an appreciation of leisure and beauty in the simple things in life. In a society that values the cerebral and abstract, the Taoists remind us to trust our intuitions and to recognize the power of the unconscious intelligence. In an increasingly narcissistic and artificial society, Taoist philosophy values humility, naturalness, and spontaneity. In a world facing a major ecological crisis, the Taoist philosophy offers a path to regaining a sense of connection and cooperation with nature. In a world where people are confused about their place in their world and their own direction in it, the Taoist philosophy tells us that every living thing has a place in the natural order of*

things and that each has its own destiny to fulfill. (Laurence G. Boldt, 1999) Here we see that the Tao Te Ching was a guiding factor that helped the way for critical thinking and self development for man in the ancient era of China.

The Sioux of North America sought knowledge through nature's creature. For hundreds of years their lives have been educated through the behaviors and astuteness of North American creatures who were hunting their prey. The Sioux passed their traditional way of thinking and believing to the next generation by communicating in the form of an analogy that resembles the actions and characters of certain animals. When the Sioux travels out into nature they observe and enjoy the world around them. Because nature is deliberate and truthful they believe that by observing nature directly they are seeing the natural entities as designed by the ultimate being as a learning lesson for life. According to the Sioux as an example, the eagle is a symbol of observation and symbolizes immense wisdom. It learns from all that it sees. It is the eyes of the all-seeing *Wakan Tanka*, the Great Spirit, the mysterious unknown entity that created all things. When the Sioux see an eagle flying, they are reminded of *Wakan Tanka*'s observation of their actions – both what they do and what they don't do, both good deeds and bad. Those actions are stamped into the memory of others whom they have helped or harmed. The Sioux feel that the past generations have memories of all those others that have "observed" them. (Ed McGaa, 2005)

Ancient Periods	Purpose of Knowledge
Greece, India, China, & Sioux Natives of North America	***Benefitting mankind for achieving better reasoning, consciousness, critical thinking, self-development, understanding, harmony with oneself and with their fellow man, and life-long learning.***

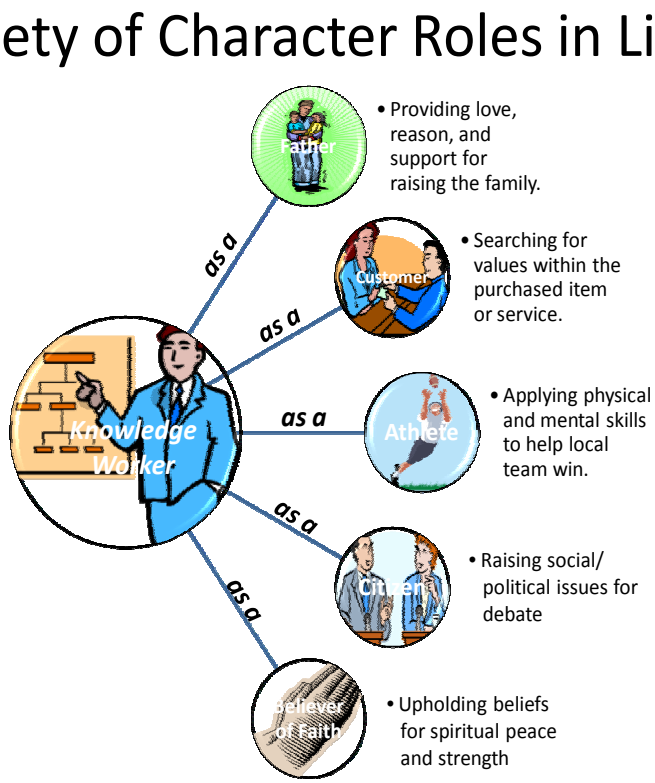
This part of the research was to present an idea of how knowledge was formed and used by people of different cultures. Here we see that back in these ancient periods knowledge was meant to develop the mind, spirit, and soul of mankind. Knowledge wasn't applied as a functional aspect but rather for one to know and know how to use it. From a historical method, it also showed the way how knowledge was utilized to benefit mankind of achieving better reasoning, understanding, and achieving harmony with oneself and with their fellow man. The result of utilizing knowledge is an intangible outcome that fosters learning and development. Overall, this shatters the industrial behavior towards managing the knowledge workers in a Fredrick Taylor- like mode.

RATIONALE

The late Peter Drucker informs us that knowledge worker productivity is the most important challenge for management in the 21st Century. One of the six major factors that he described in determining knowledge worker productivity was that *knowledge work requires continuous learning on the part of the knowledge worker, but equally continuous teaching on the part of the knowledge worker* (1999). Awad & Ghaziri (pg. 416, 2004) assert that *knowledge work implies innovation through continuous learning on the job, professional seminars, and working in an environment conducive to creativity and advancement. The learning corporation is the sponsor in allowing its employees to continue learning so that quality is the outcome of that product or service.* Learning should be designed in an atmosphere that induces the feeling for exploring, assessing, or trying to discover what can

and could be. Arcane method of punishment, force-dictatorship, and/or manipulation to make the employees learn would only breed an environment of disgust and mistrust within the organization; especially towards management.

We tend to have the perception that the individual who works at a specific organization or corporation is a worker of that job title. What we fail to see is that this so called worker has a variety of character roles in society. For example, when he/she returns home to their family he/she is a parent, brother/sister, child, or the caretaker of the household. At the shopping mall or supermarket, purchasing an item categorizes him/her a customer. Engaging in a sporting competition would depict him/her an athlete, team-player, or a fan of the game. Taking part in a public/political debate about a certain issue highlights him/her as an active citizen. Expressing a certain belief or traditional practice portrays him/her as a follower of that faith. Surly now when management refers to a fellow colleague as a knowledge worker the meaning should also crossover to their way of life or lifestyle. Using the sociological term in Wikipedia, a lifestyle is the way a person lives. It is a *characteristic bundle of behaviors that makes sense to both others and oneself in a given time and place, including social relations, consumption, entertainment, and dress. The behaviors and practices within lifestyles are a mixture of habits, conventional ways of doing things, and reasoned actions.* It reflects an individual's attitudes, values or worldview therefore forging a sense of self and to create cultural symbols that resonate with personal identity.



The ancient wisdom and knowledge that has come before us is self-evident that mankind has been guided from what has been taught and learn to make progress. Leading nations such as the United States and Great Britain would not be able to further the practice of democracy had it not been for Greek Sophists who urge that debating was necessary in order to establish

a strong political system. The fundamentals of the Tao Te Ching were so flexible in its way that it became a timeless philosophical method for managing and leading people. The Sioux Natives', of North America, close contact with nature allows them to develop a curriculum with nature's wild. This led them to explore and discover new concepts that enable them sustain their tribe. The key here for knowledge managers is to make learning as a part of their workers' lifestyle. Sometimes the working environment accumulates a black and white factor; thus workers only see what it is and block themselves from seeing beyond the imagination. This can result in a deficiency in innovation and creativity towards problem-solving or work performance. Managers will have to encourage their knowledge workers to learn outside the box. They will need to shift their workplace mentality and integrate their senses of sight, sound, smell, and sensation with the external environment to acquire an epiphany that will need to be imported back to support their task. Simply put, these workers have to learn from others and in another way. According to Garvin (1997), *this involves the study of practices employed in other organizations and adapting them to one's own circumstances*. Sometimes the most powerful insights come from outside the company's surroundings. A lot of new perspectives are gained by looking even at completely different businesses. The Milliken company calls the process of borrowing outside ideas SIS – "Steal Ideas Shamelessly". Robert C. Camp defined "an ongoing investigation and learning experience that ensures that best industry practices are uncovered, analyzed, adopted, and implemented" as benchmarking. It does not only require the thorough search for the best industry practice but also a careful study of one's own practices and performance (Hubner; Garvin 2002).

One of the best ways for the manager to encourage their knowledge to become a lifestyle learner is through the concept of sports. Sports, whether it's competition between individuals (tennis, car racing, running, etc.,) or in a team (football, basketball, ice hockey, etc,) or as leisure (fishing, chess, archery, etc.,), do offer some valuable lessons in enhancing individual performance, teamwork, and leadership. As a matter of fact, the Chinese term for "sports" is translated as *the education of the whole body* (HistoryAsia, 2004). Football (soccer) was a contest in ancient China for the soldiers and statesman to master the art of self-discipline and personal development of the mind. Archery during the Tokugawa period of Japan was mainly about purifying the mind so that one can be simultaneously clear, confident, and calm on focusing to achieve the objective. A leisurely game of 'Chaturanga', which is a chess game played in ancient India, was actually designed for the purpose of teaching Indian princes to hone their competencies of developing battle strategies and tactics (BBC: What the Ancients Taught Us, 2005).

Since problem solving is also considered as one of the key competencies of knowledge work, the main idea of this research is focused on how knowledge managers can use a popular sports such as football from the United States of America as an analogical tool for learning and analyzing ways to troubleshoot situations that may get in the way of work performance. Coaching strategic plans and game-commentary analysis from the collegiate level and professional league have been gathered to provide a guideline description on how knowledge managers can borrow their ideas and concepts and transfer them to their knowledge workers.

RESEARCH DESIGN

This research collected documents of literature notes and video footage to create the following:

- Generate philosophical insights from top football coaches who see the game as a part of the big picture in life.
- Explain how the rules and objective of the game are a metaphor to the work behavior.
- Highlighting a coaching philosophy that can serve as an action guideline for solving problems.

Football Philosophy at the Collegiate Level:

The coaches who coach their student at the college level understand that they have a commitment to their players' well-being. These coaches use the football plans and plays as an educational curriculum for their student athletes to be prepared for the bigger game of life in general and at work. The key message that some of these coaches like to articulate is about facing adversity and developing a positive attitude.
On Adversity:

"…It wasn't great coaching or strategy that carried the day. We won that game the moment our group of young men focused on what we had instead of what we lacked. That's the only perspective you can take in hard time. Remember that adversity presents us with numerous possibilities for success, if we are just willing to see them."(Holtz, 1998)

"*….You play like you practice. If you practice good technique when the game isn't on the line, you're more apt to perform well at game time. If I had to choose between good habits and high enthusiasm among my players in a big game, I'd take good habits every time. Enthusiasm ebbs and flows. Good habits are dependable….So before the storm comes, develop a strategy for dealing with life and start practicing it."* (Bowden, 2001)

"..Success is not about winning every game. You cannot control all of that, and sometimes it just does not happen. If you can play and coach to your ability, then in my mind you are winners. That means we will win forever because we are coaching to the best of our ability."(Carroll, 2008)

On Positive Attitude:

"The attitude you choose to assume toward life and everything it brings you will determine whether you realize your aspirations. What you are capable of achieving is determined by your talent and ability. What you attempt to do is determined by your motivation. How well you do something is determined by your attitude." (Holtz, 1998)

"Good morale can mean being focused on winning a game. It can mean being well prepared or determined to perform better on the practice field…Good morale means that we have a healthy, positive environment in which to do our jobs. And it means that everyone believes his job is important. It DOES NOT MEAN they all get what they want."(Bowden, 2001)

"There is an important distinction between players who have a professional attitude ('A' game attitude) versus those with a mediocre attitude ('C' game attitude). The major difference between these two attitudes is how one perceives practice: whether practice is viewed as an opportunity to play and improve or whether practice is something that is 'done to them'. (Carroll, 2006)

Football Philosophy at the Professional Level:

Football is a team sport. Coaches must find the right method of forming team chemistry and cohesiveness when the game becomes out of reach, unpredictable, and chaotic. Even if the goal and objectives are set and clearly understood by the players there are always personal factors that can inhibit performance. Good coaches must anticipate with a solution so that the team as a whole overcomes any negative behavior and remains focus on achieving the aims. Some football coaches have such an introspective insight to the game that it enables them to articulate the language as a precept for managing or leading a business organization.

On Teamwork:

"To achieve greatness as an organization, every person must do his part…There's no such thing as an unimportant job. Every job in your organization is the most important one and must be done as well as possible…If one person fails to do his job properly, then the whole organization suffers." (Shanahan, 1999)

"When every player executes his responsibilities, the team wins..This is what teamwork is all about. Everybody executes his job. There are no exceptions. This is what winning teams do. IT's a team effort – on the football field, in the workplace." (Reid; Lamonte, 2004)

"One of the first steps in building a winning team is skills building: making your current players better. Good leaders provide their people with what they lack, including training, information, confidence, and discipline. This was the reward that Lombardi put on his players: his absolute, unwavering commitment to making those players better. The other reward, of course was winning." (Lombardi; Lombardi, 2001)

Football Philosophy at the Business Level

Professional players and coaches who have retired from the league often go into business ventures with the same game plan mentality that had gave them names to be admired. The game of football is played from the head and then down to the body. The hours and minutes of preparation, practice, and executing the plays that these players and coaches go through in the season are the transitional learning blocks that can help them be successful of the field. Many former players and coaches give credit for the game itself which has equipped them to take on the challenges of life.

Utilizing the Playbook into the Game of Business

"I think part of buying the groceries is having a philosophy and trying to stick to it as best you can, knowing that occasionally you may make an exception. But, you do so knowing you're

attempting to do it for a certain reason and you have to be very careful not to try to make too many exceptions, because then you wind up as a franchise, as a friend of mine used to say, with a team full of exceptions, which is not what you want. So, we have a personnel philosophy at Miami, and the other places I've been before and we try to put it in place, and we try to integrate people into our system, and there may be good players, that are very good players, but they're not for us because they don't fit what we're trying to do, so we don't want to discard them, we acknowledge their qualities, but we try to integrate the ones we think fit us the best." (Parcells; Friedell, 2009)

"Preparation means studying your chosen field, finding good mentors and partners and understanding the ways in which the business world resembles football and, more critically, the ways in which it differs, he says. 'When you play football, you play four quarters, and there's an outcome. In business, you don't get a scorecard. We had an event at our car dealership this morning. What's the outcome of that? Did we win or lose? I know now that we won today. But how do I know that? In business, I had to learn a new lingo, a new way of keeping score.'(Lott, 2005)

"Pro football, like business, is evolving all the time. With the Redskins, we changed about 30 percent of what we did every year. That was typical of most teams. That means if you stood still for one season, you fell behind by 30 percent. I have a friend in Los Angeles who runs a company. He had matchbooks made up with a picture of a dinosaur and the message: 'Adapt or die'. That is a good assessment of modern business. You have to stay on top of what's going on, or the game is over for you."(Gibbs; Didenger, 1995)

ANALYSIS & DISCUSSION

The game of football is composed of people who have a different set of philosophical and pragmatic logic on how this sport should be played as well as viewed. The coaches, the players, and individuals that provide colorful commentary for the game show how this unique game is beyond the playbook and the statistical column of victories and defeat. The gridiron field is a natural stage that depicts the struggle of two teams endowed with the passion, commitment, and will to go 60 minutes of brutal action. The outcome in physical pain and sometimes mental anguish from the expression of the athletes and coaches are all part of the drama that enables this sporting event to become a part of America's national culture. Coaches that are active and have retired from the league have become popular speakers for important business conference and developmental workshop. Some athletes that have called it a career have used the play calls as concepts for managing their business and practical ideas to lead and motivate their project team. Football commentators and analysis have used the dynamics and participants of the game as a platform for lessons learned in dealing with difficult people or motivating people, overcoming fears and mistakes, designing a better strategic plan, being held accountable for making decisions and controlling emotional behavior. The game of football as a whole is a reflection of life. The numbers produced in the win-loss category, the yardage gain and allowed, and the amount of points scored are equally important for a non-football organization or corporation in terms of profit received to finance the business operation so that the vision and mission are being met. However, in life nothing can always be perfect. Whatever has been planned or prioritized from the hours, days, weeks, and months that have been spent upon can always be subjected to scrutiny or victimization when things don't produce the results as intended.

Sometimes we have teams that are able to overcome the mediocrity of losing the focus on the big picture and eventually progressing on to become champions. Then there are teams that have allowed doubts or other disruptive behavior to leak into the teamwork mentality that it slowly sinks the team into depth of misery and anger. The lifeblood for every team is based on winning. Winning is a result from handling the pressures of the game, stimulating the mental resources of the players, executing the game plan design correctly, and above all taming the problems being faced and reversing the situation on the opponent to deal with. The game gets drowned out by the dramatic plays and exciting victories but if the knowledge manager can navigate through the roaring cheers and joyous celebration he/she can actually reflect on how this game was played that led to a victory or defeat and also to see what lessons can be used to make their fellow workers learn from watching the event.

Knowledge Articulation

The first thing knowledge managers have to do is to review the mission of their organization and assess the gap situation that the knowledge workers need to know in order to be sure that their performance can be maintained to achieve the desired objective. For example, if the task specifically states that we deliver the furnished product with quality then management has to make sure that the infrastructures are set in place to allow these workers to utilize their skills and abilities to create that quality. Therefore, the systematic process of receiving the accurate information, having access to the required resources, and obtaining the mutual commitment and collaboration for getting the quality produced have to be installed in a complete setting. This will ensure that the knowledge is currently streaming to help each co-worker complete their task without having to compromise quality. But going back to the football analogy, sometimes everything doesn't always go according to plan. The manager can't always be there to douse the flames of conflict or political bickering. The best thing here is to approach the workplace as a competition event where the knowledge manager becomes the coaching manager and the knowledge worker becomes the knowledge athlete. The task to obtaining victory is through quality. The manager as a coach improvises the play to the workers to let him/her continuously find ways of making the situation better or raising the performance to ensure that the task gets completed by a certain timeline. The coaching manager identifies the working system to see what are the factors enabling or inhibiting the end result to become a quality finished goods or service. For example, if the knowledge manager was working at McDonald's where the mission is to "be our customers' favorite place and way to eat, and committed to improving our operations and enhancing our customers' experience", then the key mission terms should be highlighted and communicated to the employees. In this case the coaching manager translates it into a playbook design:

Task Focus	Enabling Factors	(Possible) Inhibiting Factors	(Ideas) Task Execution
Favorite place & way to eat	The safety and well-being of our customers is our first priority. That's why we maintain rigorous standards and evaluations in critical areas throughout the food and toy supply chains and in our restaurants.	Low morale on the part of key staff.	Treating key staff as a customer with the issue of safety to let them see the importance
Improving operations	Anticipate and respond to changing customer, employee and system needs through constant evolution and innovation.	Office politics displayed between departments.	Select specific members from each department to develop their career by forming a task group to collect intelligence.
Enhancing customers' experience	Providing them with high quality food and superior service, in a clean, welcoming environment, at a great value	Complacency within team leaders	Rotate the roles of team leaders to see and learn about the big picture of the mission

The playbook design can be communicated on the writing board, a monitor screen, or on handouts to the knowledge workers. The mission statement of the company is reviewed along with the factors that enable and inhibit the work performance, and a proposal to ensure that these workers are doing their best to have the mission sustained. The occupational process can then be articulated in an analogy of a football game. The language of delivering quality meal can be expressed in terms of a football perspective. The communication would be as followed:

"Ladies and gentlemen, the game of football is pretty much similar to what we're doing here. Football has four quarters and we have four periods or three months to make sure that we score some big points in order to win the game. For some of you, the game may look violent and highly aggressive. But what you're really seeing is the struggle of mankind fighting with his and his colleagues' compassion and sheer intelligence for just 60 minutes in order to claim a victory in the win/lose column. Now in our game of producing high quality food we have to do this throughout our lifetime. We work with each other's knowledge, skills, and abilities in order to make sure that our customers remember who we are and why they keep coming back to purchase our meal. When you see these customers coming back to eat at our place that is a victory for us being placed in the win/lose column. It's not the high priced equipments or standing next together wearing the same uniforms and calling yourselves as a team that wins the game. Rather, it's the talent that we utilized, the disciplinary execution of the plan, and the striving will and commitment that are going to help is become champions for the year. Also, just like in football the concept of teamwork is important only as long as you ask yourself 'what can I do to make sure that we as a team win'? You ask yourself before the business operation begins, when it's in operation, and after the operation has conceded. Serving quality is quite dynamic; therefore we have to prepare for any interceptions, fumbles, and sacks or in our case any unforeseen thing that can hamper our performance. I believe that everyone here in this meeting has the mission statement embedded into their attitude. As long as you know and believe in what you are doing your effort will enable us to stay on the right track to victory. What you see before your eyes is a game plan that gives us the knowledge to position ourselves to stay focused on the task. Here are the three things that give us credibility and purpose for doing what we do. For years, we've been doing the positives that have made us a favorite place to and way to eat, improving operations, and

enhancing the experience of our customers. These positives can be attributed to our direction on providing safety to our customers, anticipating and responding to the changes with innovation, and creating high quality in food and service. If we take care of these things in each quarter of the business operation period then we'll be a championship team by the end of the year. Now I know the competition and expectation to support the mission can sometimes be rough and quite challenging. But that's where the real test of character evolves in front of you. There's no need to have fear or be in despair, I'm here to help you to work and win together as a team. So believe me and in yourselves when I say that we're going to take on the obstacles that are trying to make us lose morale, wasting time by bickering over office politics, and drifting into a state of complacency. Yes, these complications will exist so I expect you to be prepared otherwise they will anchor us down and destroy what we're trying to accomplish. As your coaching manager my capabilities can be limited so I'm asking you to take the initiative and come up with your own tactical game plan to get us on track with the mission statement. Since we're going to take this approach as a football concept I want to tell you about one of the most important game design play that can help you find ways of either maintaining or preventing the dynamics of completing the task. This play was called the '46 Defense'. The philosophy is about probing the offensive pass protection and exploiting a weakness, keeping constant pressure on the opponent and their offense, creating multiple defensive schemes that hamper the ability to identify intentions by giving opponents an ever-changing picture on the defense. It's very hard for their quarterback to complete a pass when he is laying flat on his back. The 46 Defense brought a championship to a football based in Chicago. In translation and relevancy to our mission, I need for you investigate the issues that are causing to have these inhibiting factors arise and then look for the manageable spots that can be corrected. The ebb and flow of work morale, office politics, and complacency will have to be harnessed and guided through the value channels. I propose that we can do the following to take charge of the game:

- *Treating our key staff as a customer with the issue of safety to let them understand how important this is to our business.*
- *Select the specific members from each department to develop their career by forming a task group to collect intelligence. This way they won't be emotionally drained with having to repeat the same task over and over.*
- *Rotate the roles of team leaders to have them see and learn about the big picture of our mission. This gives them a chance to provide some useful inputs and insights to sustain the mission.*

I ask you to be sincerely creative in choosing the most effective methods to moderate the behaviors of others as well as yourself in concentrating on obtaining the objectives of the task. Things will definitely go towards our way and help us earn a championship season when these inhibiting factors are used as learning points and served as a stepping stone towards excellent performance in fulfilling the mission statement. I believe that the football plans can be used as a learning tool to help us accentuate more on getting the right things done rather than being bogged down of trying to think what can be done. So if you're a big fan of this game or any other game that involves teamwork, I want you to see the correlation of what you do at work and what you do that is non-related to work. Then picture how would this sports team design their plays to make the mission statement of your company become successful."

CONCLUSION

This paper was designed to give knowledge managers an alternative insight in making their knowledge workers learn by encouraging them to assimilate their lifestyle with their work. In order for these knowledge workers to become a lifestyle learner management has to re-examine the mission statement to see the following:

- Focus of the task – the duties that are prolonging the success of the company/organization.
- Enabling Factors – the supporting issues that are making these successes possible.
- Inhibiting Factors – the obstacles that pose as a learning point for meeting the challenges.
- Task Execution – the ideas that will either propel the enabling factors to prevail or prevent the inhibiting factors from getting out of hand.

With the right information at hand, managers can create a sense of direction and expectation on the part of the knowledge workers to come up with their own philosophical approach to the work by allowing them to learn from other institutions, organizations, or in this case from a sports team that have been successful in managing the competition.

This study provides a guide of taking the language of the football game and adapting it into a form of communication that knowledge managers can utilize to allow their knowledge workers to see their role beyond the job title. The concern that this work may have can be in the form of a fuzzy understanding between the knowledge of certain sports and how these game designs can be translated to the mission statement for that company.

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LEARNING CONDITIONS FOR IMPROVING ENGLISH VOCABULARY MEMORY RETENTION OF THAI PRIMARY SCHOOL STUDENTS WITH HEARING IMPAIRMENT

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ABSTRACT

Traditional teaching and learning procedures for the hearing impaired have been lacking the development of cognitive skills which are crucial for English language competency. Students with a disability in hearing will eventually find that most of the domain information and knowledge are in the English language format. Methods of learning have always been taught by the teachers using sign language, pictures, and behavioral demonstration. This paper illustrates a new way for teaching these students to improve their learning abilities and also function as part of society. A supplementary educational technology tool, known as the 'Total Communication with Animation Dictionary' (TCAD) has been proposed in this study.

Keywords: Total Communication with3D Animation, Vocabulary Language Acquisition, Language Immersion in Hearing Impaired, Web-based Learning, Teaching and Learning in Education

INTRODUCTION

This was a case experiment implemented at the Anusarnsoontorn School for the Deaf in the province of Chiang Mai, Thailand. The personnel staff at this school felt that there was a need for a special supplementary tool that would help their students learn better. Originally, the school used a pictorial-based paper for the students to learn the English vocabulary in a passive term; students will only know what they have been taught at the moment but are not able to put it into practice when recalled upon to use the word. It was believed that if these students were to look at the pictures of each situation then they would be able to develop their memory retention skills. However, the technique for teaching this skill could have been improved as the learning materials were separated from the context. For example, one subject would be kept in a file and divided from the whole learning topic. As a result, this

makes the learners unable to integrate the whole learning concept. Furthermore, these students miss out on developing their retention skills.

Many studies on hearing loss indicate that the hearing impaired has difficulties in speech understanding but they have a greater visual perception capacity. In terms of learning, when individuals with normal hearing abilities are compared with individuals that have a hearing impairment, the acquirement procedure of knowledge is absolutely different. Individuals with a hearing impairment learn from a sign based technique. This technique, however, has a limitation on vocabulary learning. Individuals that have a hearing impairment are denied the opportunities to learn from speech-based technique, basic language acquisition, and techniques which are text-based. Without learning text-based techniques and speech-based techniques not only is there a limit for acquiring vocabularies but these students also cannot socially function in a normal environment; especially communicating with ordinary people.

LITERATURE REVIEW

In this research, there were two major areas involved. First, cognitive learning is a theory that discusses about learning, memorizing, recalling, and recognizing. Second, disability learning describes the learning process that is focused on auditory processing order.

According to Schuman's research (1996), learning theory can be classified into behaviorism, cognitivism, and constructivism. Behaviorism focuses on a new behavioral pattern being repeated until it becomes automatic. Based on the thought process behind the behavior, cognitivism is used as indicators to describe what is happening inside the learner's mind. Constructivism focuses on preparing the learner to solve problems that are in ambiguous situations.

Cognitive Learning

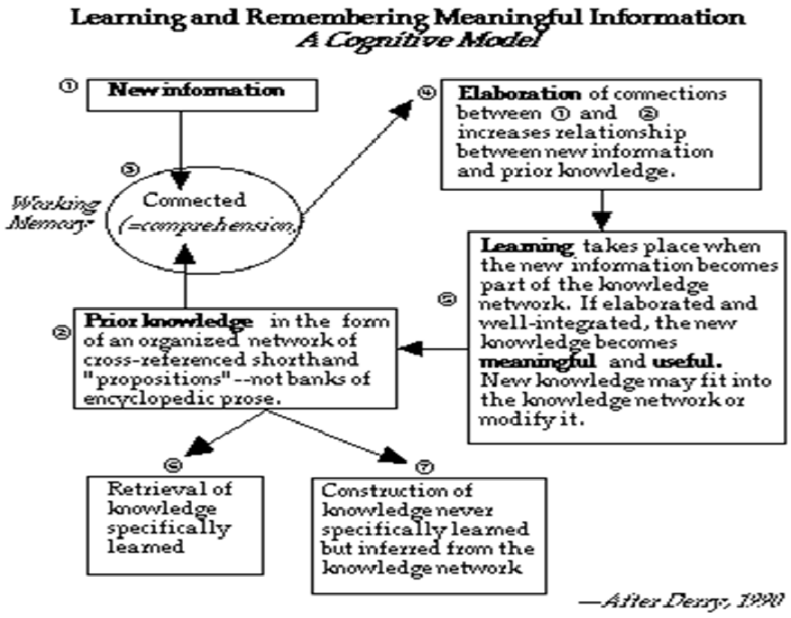


Figure1. A Cognitive Model of Learning from Derry 1990

Cognitive learning is the result of listening, watching, touching or experiencing. This is described in the following figure (Cognitive Model of Learning by Sharon Derry's review of cognitive learning theory)

Based on the Cognitive Model of Learning by Sharon Derry (1990), learning and remembering meaningful information for a person is set in a pattern. First, new information is obtained through human contact, reading literature, media, sound, etc. In addition, prior knowledge comes from experience or learning. Therefore, people have already gone through life absorbing useful information that provides benefit for their life and a way for living. From here, new information and prior knowledge has been fused together to form comprehension or a working memory. Next, elaboration is formed when there is a connection between new information and prior knowledge, thus increasing their relationship. After elaboration, learning starts to resume as new information has been integrated with the knowledge network. If utilized effectively knowledge then becomes meaningful and useful. Finally, learning revolves around prior knowledge. This enables the person to retrieve knowledge that was specifically learned. However, the construction of knowledge was never specifically learned. The conclusion derived from the knowledge network. Based on the literature of cognitive learning, the study provides a good start to set the concept of how a person learns. Although the work may seem to be biased against the hearing impaired, the cognitive learning model by Derry can be used as the critical link that maps out a structured plan in creating a device for the hearing impaired.

Memory retention

"Learning Strategies Development" (Queen's University, Australia, 2008) outlined the details of the things that make people forget. The assertion for "forgetting and remembering" are as followed

The interference or the confusion factor (e.g. mental overcrowding, multi-tasking) is one of the primary reasons that can make the person likely to forget things.

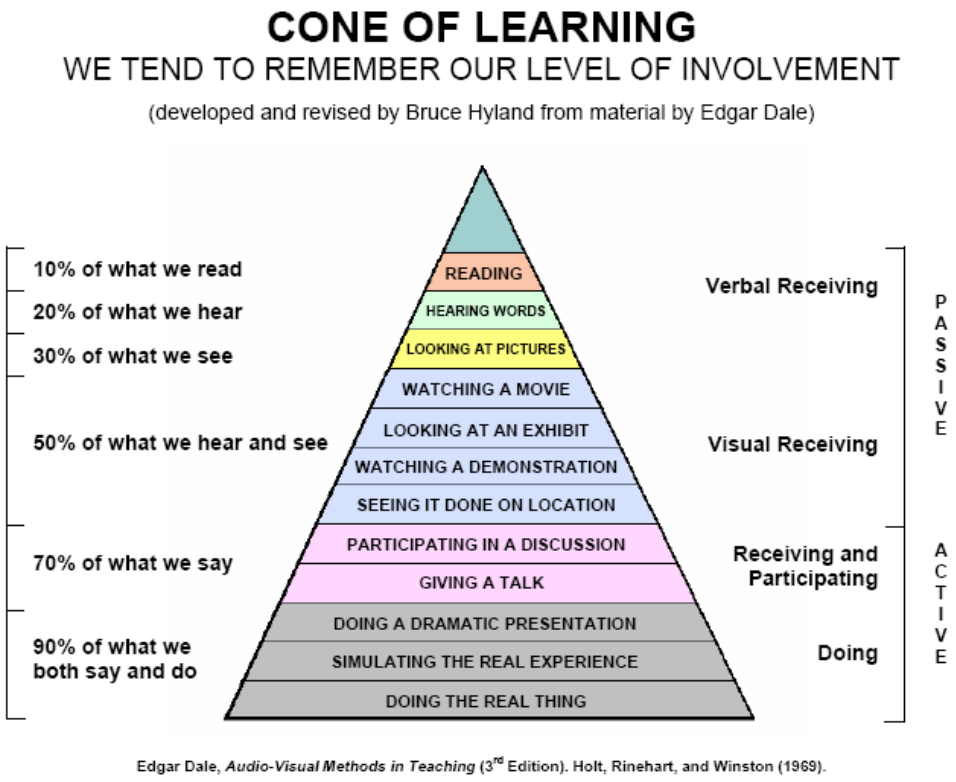
Other reasons for forgetting can be identified by the *n*egative attitude or self concept of the individual. Sometimes these individuals do not learn well enough and easily forget things. The individual can sometimes be face with not having the right cue, for example the person studied one way but the test question is presented in another way. Also, these individuals can experience a lack of attention or concentration on the material at hand.

Things are remembered by the process that starts from thinking to encoding to rehearsing and to retrieving. From here things start to be committed into memory based in pictures.

Memory is developed by organizing, funneling information, associating or connecting with prior knowledge, applying emotion, and grouping the sequence of information together.
Long term memory is developed by repeating, reciting, rehearsing, elaborating, connecting, and teaching someone.

Cone of Learning

Figure 2 Edgar Dale, Audio-Visual Methods in Teaching (3rd Edition). Holt, Rinehart, and



Winston (1969)

The cone of learning (Edgar Dale 1969) illustrates the learning level of normal people. There are two types of learning: passive learning and active learning. Passive learning is found in a traditional classroom: instructors lecture and verbalize information to passive note-taking students. The instructor is a 'verbal' textbook that reads the definitions to the class. Students are considered as 'empty' vessels being filled with knowledge or human 'tape recorders'.

In the case of active learning, the instructors create 'a learning environment' in which students can learn to restructure the new information and their prior knowledge into new knowledge about the content and for application. According to this cone, activities that stimulate verbal reception, visual reception, participation, and performing are brought to class. While active learning, the instructors create 'a learning environment' in which students can learn to restructure the new information and their prior knowledge into new knowledge about the content and to practice using it. According to this cone, activities that stimulate verbal receiving, visual receiving, participating, and doing are brought to class.

The cone of learning model is a classic example that paints a clear picture on how a person should learn. Since the participation of activities reinforces learning the device created will be able to act as a supporting learning tool to give the students with hearing impairment a rapid means to learn effectively. The device will link the learning behavior, environment,

curriculum agendas, as well as instructors to produce a positive outcome for these students' learning abilities.

Conditions of Learning

This work is attested to the theory of "Conditions of Learning" by Robert Gagne (Gagne, R. 1985). According to Gagne's theory, there are several different types or levels of learning. The significance of these classifications is that each different type requires different types of instruction. His work identified five major categories of learning: verbal information, intellectual skills, cognitive strategies, motor skills and attitudes. He states that different internal and external conditions are necessary for each type of learning. For example, for cognitive strategies to be learned, there must be a chance to practice developing new solutions to problems; to learn attitudes, the learner must be exposed to a credible role model or persuasive arguments.

Based on his further studies, there is a suggestion that the learning tasks for intellectual skills can be organized in a hierarchy according to complexity: stimulus recognition, response generation, procedure following, use of terminology, discriminations, concept formation, rule application, and problem solving. The primary significance of the hierarchy is to identify prerequisites that should be completed to facilitate learning at each level. Prerequisites are identified by doing a task analysis of a learning/training task. Learning hierarchies provide a basis for the sequencing of instruction.

Gagne outlines nine instructional events and corresponding cognitive processes:
(1) gaining attention (reception)
(2) informing learners of the objective (expectancy)
(3) stimulating recall of prior learning (retrieval)
(4) presenting the stimulus (selective perception)
(5) providing learning guidance (semantic encoding)
(6) eliciting performance (responding)
(7) providing feedback (reinforcement)
(8) assessing performance (retrieval)
(9) enhancing retention and transfer (generalization).

These events should satisfy or provide the necessary conditions for learning and serve as the basis for designing instruction and selecting appropriate media (Gagne, Briggs & Wager, 1992).

Vocabulary Language Acquisition

Vocabulary Language Acquisition (VLS) constitute a subclass of language learning strategies, which are applicable to a wide variety of language learning tasks, ranging from the more isolated (vocabulary, pronunciation, grammar) to integrative tasks like oral communication and reading comprehension. Studies such as Schmitt and McCarthy (1997) have shown that language learning strategies are not inherently 'good', but depend on the context in which they are used, their combination with other strategies, frequency of use, and

the learners' proficiency level. One of the first attempts at providing a comprehensive overview of language learning strategies can be found in Oxford .R. (1990)

Language Immersion

Language immersion is another method for improving in the communication of the second language (also called L2, or the target language). This method uses the target language as a teaching tool by surrounding or "immersing" students in the second language. In-class activities, such as math, social studies, and history, and those outside of the class, such as meals or everyday tasks, are conducted in the target language. Today's immersion programs are based on those founded in the 1960s in Canada when middle-income English-speaking parents convinced educators to establish an experimental French immersion program to enable their children 'to appreciate the traditions and culture of French-speaking Canadians as well as English-speaking Canadians. (Julie Sweitzer 2001) and (Baker, C. 1993)

Based on the French immersion program in Canada Allen, Mary (2004) reported that the students in the French immersion programs performed significantly better in reading than other students.

Learning disability

Learning disability is a general term that describes specific kinds of learning problems. A learning disability can cause a person to have trouble learning and using certain skills. The skills most often affected are: reading, writing, listening, speaking, reasoning, and doing math. Learning Disabilities can be categorized into Articulation Disorder, Attention Deficit Hyperactivity Disorder, Auditory Processing Disorders, Dyscalculia (Developmental Arithmetic Disorder), Dysgraphia (Developmental Reading Disorder), Dyslexia (Developmental Reading Disorder), Dyspraxia (Motor Planning / Sensory Disorder), Expressive Language Disorder, Receptive Language Disorder, and Visual Processing Disorder.

Auditory processing disorder (APD), also known as central auditory processing disorder (CAPD), is a complex problem affecting about 5% of school-aged children. These children can't process the information they hear in the same way as others because their ears and brain don't fully coordinate. Something adversely affects the way the brain recognizes and interprets sounds, most notably the sounds composing of speech. Kids with APD often do not recognize subtle differences between sounds in words, even when the sounds are loud and clear enough to be heard. These kinds of problems typically occur in background noise, which is a natural listening environment. So kids with APD have the basic difficulty of understanding any speech signal presented under less than optimal conditions. There are many possible causes of APD; they include head trauma, lead poisoning, and chronic ear infections. Sometimes the cause is unknown. Hearing disabilities cause five main problems that affect both home and school activities.

First, Auditory Figure-Ground Problems: This is when the child can't pay attention when there's noise in the background. Noisy, low-structured classrooms could be very frustrating.

Second, Auditory Memory Problems: This is when the child has difficulty remembering information such as directions, listing, or studying materials. Third, Auditory Discrimination Problems: This is when the child has difficulty hearing the difference between sounds or words that are similar. This problem can affect following directions, reading, spelling, and writing skills, among others. Fourth, Auditory Attention Problems: This is when the child can't maintain the focus for listening long enough to complete a task or requirement.

Lastly, Auditory Cohesion Problems: This is when higher-level listening tasks are difficult. Auditory cohesion skills — drawing inferences from conversations, understanding riddles, or comprehending verbal math problems — require heightened auditory processing and language levels. They develop best when all the other skills (levels 1 through 4 above) are intact.

In order to make this research comply with fairness and credibility, an investigation was implemented to see whether these students only had a hearing impairment. A list of all the students' educational profile has been completed.

Learning System for Students with Hearing Impairment

Sriyaa Niyomthum and Praputsorn Niyomthum (1975, p. 174 - 178) categorized learning system for students with hearing impairment as followed: First, oral method is the teaching that emphasizes on oral communication. Oral communication includes speech, lip reading and the use of residual hearing. Second, manual communication involves signs and finger spelling to mediate a message between persons. They are received visually and sometimes tactually upon being expressed manually. Manual communication, when it is a primary form of communication, may be enhanced by body language and facial expressions and other forms of communication. Third, total communication (Mayer, P. & Lowenbraun, S. 1990) is the use of any means of communication - sign language, voice, finger spelling, lip reading, amplification, writing, gesture, visual imagery (pictures). The sign language used in total communication is more closely related to English. In this research the focus is on total communication because this approach is suitable for bundling with animation technique and related with the teaching method for Thai schools for the deaf.

Mertzani, M. (2006) presented Computer-mediated communication (CMC) has high influenced in teaching and learning of Second Language Acquisition. This tool effect positively to traditional class and created new language teaching models focuses on learner centered teaching methodology based on constructivist approach. With the effective outcome, this tool is applied in interactive sign language class and other class for students with a hearing loss.

Massaro, D.W., & Light, J (2003) and Lecia J. Barker (2003) research is based on improving the vocabulary learning with text to speech and speech recognition through computer animated tools called Language Wizard / Player. This tool can encode a speech to word and be written to a speech together to generate visual speech by a speaking avatar, an animated talking face, nicknamed "Baldi". However, the language player doesn't cover the principles of total communication.

The literatures on the theories that were relevant to memory retention had to be reviewed intensively as the author of this work wanted to gain some basic understanding with the topic. The theories dealing with cognitive learning, memory retention, cone of learning, language development, vocabulary language acquisition, language immersion, learning disability, and the learning systems for hearing impairment have all provided a compass for obtaining a better idea and approach to lay out a proper framework.

Before the research team came up with an idea, an assessment was created and implemented to make sure that creating a technological learning tool would be the most effective solution for helping these students with a hearing impairment. The research methodology was as followed:

DATA COLLECTION

In the first stage, the study focused on the primary student at Anusransoontorn School for the Deaf Chiang Mai Thailand. We chose the primary student because this level is the optimal time for learning the languages. According to Allen, Mary (2004) and J. Piaget (1982)

Based on the observation and analysis of the English curriculum of primary level 4 to 6 (figure 4) the content was limited and detrimental for developing the skills in memory retention. The lessons were taught in a very simple and slow method which limited their cognitive skills in vocabulary usage (figure 1). Therefore, it was concluded that the idea for a technological supporter in developing the students' English vocabulary and communication skills would be the basis for reading, writing, and texting their message online with other students.

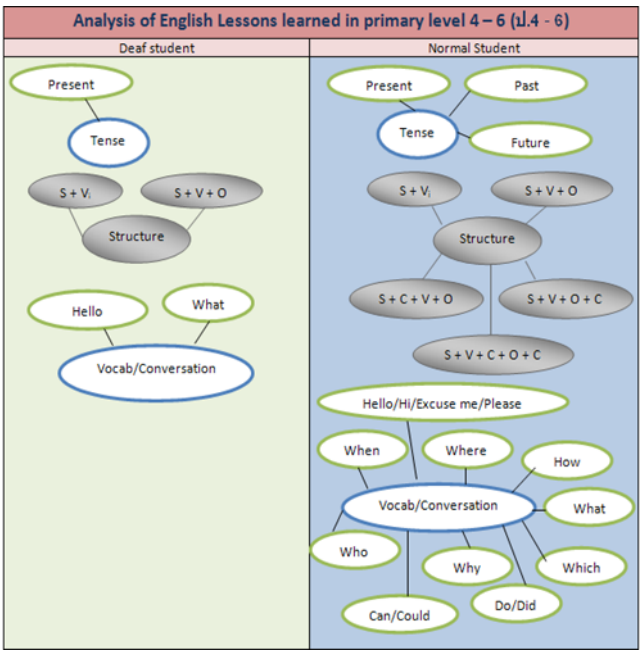


Figure3. Data Analysis Based on Curriculum

SAMPLING

In this stage, samples of 18 primary students were taken from grade 5 and were categorized as experimental samples. Both groups participated for a short term memory and long term memory test. The first group used total communication with a dictionary composed of animated characters (TCAD method). The second group was learning in the traditional method: classroom instruction, translation of verbal language to sign language, and finger spelling. The result of the short-term memory test in the TCAD class pre-test and post-test and the traditional method demonstrated that both significant students showed an improvement in their English vocabulary. After 9 months the result of the long-term memory test in the TCAD class post-test demonstrated that students showed an improvement in their English vocabulary score more than the short-term memory post test. The traditional method long-term post-test indicated that students showed an improvement in English vocabulary less than TCAD method.

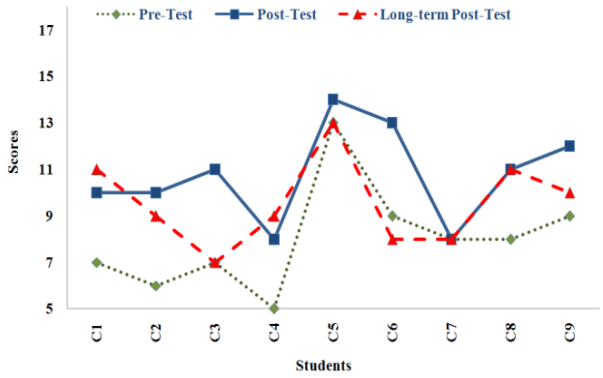


Figure 4 Pre-Test and Post-Test results graph of Traditional method

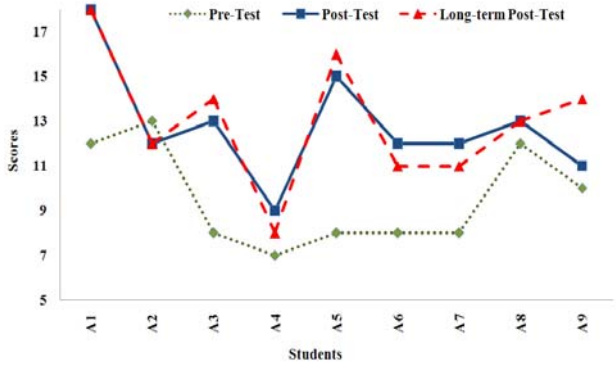


Figure 5 Pre-Test and Post-Test results graph of TCAD method

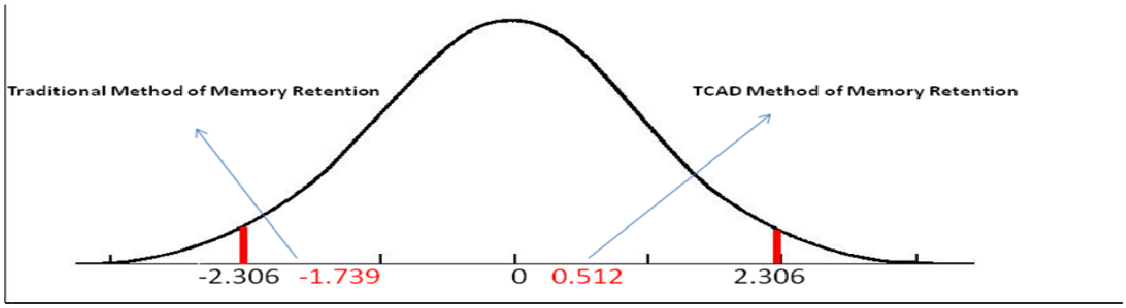


Figure 6 Pre-Test and Post-Test paired t-test results of TCAD method

From the results, the graph showed that there was a significant positive English vocabulary memory retention in the TCAD method by using a paired t-test in N<30;Df=8 ;α = 0.25 (2-tailed); t (from t table) =2.306 and t result between TCAD long-term post test after nine months of teaching. The TCAD short-term posted a test score of 0.512. This proves that the TCAD method supported the English vocabulary memory retention in the long-term memory

TOOLS, METHODOLOGY AND FRAMEWORK

The TCAD concept was created for helping these students to develop their memory retention. This tool was utilized in the English immersion program. It allowed for activities to be based on encouraging the students to learn a variety of English language vocabularies. This allowed for the learning environment to have an English immersion experience. The animation characters provided a lively, stimulating atmosphere by applying a multi-approach teaching tactic to give these students an absolute skill development for communication. The teaching methods consisted of sign language, finger spelling, auditory, lip reading, picture captioning, situation learning, reading, and writing. An example is shown below:

Figure 7 TCAD Screen (with boy and girl character)

DISCUSSION

What were the Learning Conditions?

From the case experiment at the Anusransoontorn School for the Deaf in Chiang Mai, the study found that there were some important factors that have made this learning environment unique as well as possible. The research breaks down the domain of the key agents involve in this experiment.

Students with Hearing Impairment

These students were highly active in learning with the new device. They devoted much of their attention to learning. The students already developed their basic skills from the previous learning experience. They were able to apply with what they already know to what they can know more from. What was most astonishing was that these students view learning as a leisure set of activities; thus taking a learning approach as a fun and games mentality.

Teaching Staff

The teachers were well versed in utilizing technology for teaching the students. The teaching concept was mainly focused on building close relationship and fostering trust. The teachers created a convenient learning environment so that these students would be highly motivated to learn. The teachers ensured that opportunities for better learning were always intact while difficulties were minimized as much as possible.

Learning Tool (TCAD)

The TCAD positioned itself to promote the current learning skills and abilities of the students. The technology's active instruction approach expanded the students' cognitive skills and motivated them to explore further into the English language vocabularies. The total communication animation dictionary supplemented the program of the course rather than converting the teaching staff and students' time and attention to administer the device. As a result, the tool enhanced a friendly environment that directed a positive attitude where making mistakes were also a part of learning.

According to condition of learning by Gagne,R (1985). This work takes the example of Gagne's nine instructional events and corresponding cognitive processes to construct a matrix that outlines the critical factors for improving long-term English vocabulary memory of primary school students with a hearing impairment.

View of learning theory	View of TCAD component		
Conditions of Learning (R. Gagne,1992)	Students with a Hearing Impairment	Teaching Staff	TCAD Learning Tool
1.gaining attention (reception)	Highly active & being devoted to the lesson plan	-	Characters demonstrated the sign language with a picture for clear understanding
2. informing learners of the objective (expectancy)	-	Identifying lesson aims and allowing time for learning	Showing the meaning of the word and the action of its meaning for awareness
3. stimulating recall of prior learning (retrieval)			Providing freedom of access to retrieve the lesson learned
4. presenting the stimulus (selective perception)			Allowing to choose the topic of interest
5. providing learning guidance (semantic encoding)			Making the learning simple to handle and topic for learning to be more comprehensible
6. eliciting performance (responding)	Enjoy with active instruction tool and positive attitude in learning	Facilitation support for colleague	Active content and user friendly
7. providing feedback (reinforcement)		Ability to relate with the learning situation and give recommendation for improvement.	Learning situation is in touch with (social) reality and provides explanation
8. assessing performance (retrieval)		Utilizing the results of the learning tool to indicate the students learning performance	
9. enhancing retention and transfer (generalization)			*Based on evaluation- After 9 months taught the memory retention curve still remains positive

Table1. The matrix between TCAD domain and Conditions of Learning from R. Gagne *Conditions of learning*

1. Gaining Attention

In the first condition, these students were highly active in their classroom environment. They were already eager to absorb the teaching materials. Therefore, any learning materials submitted to them were more than welcome as it gave them a chance to discover something new and interesting. With the TCAD displayed into their hands, the positive situation in

learning increased in double figures. The characters in the TCAD were simultaneously instructing the lesson topics in a sign language that was not only friendly and lively but also with a picture for clear understanding.

2. Informing Learners of the Objective

The teachers always identified the aim of the lessons. They also made sure that the objective was clear enough for the students to perform. But the greatest factor was to allow time for these students to digest the knowledge so that the objective of the lesson has been fulfilled. The TCAD learning tool followed the same ideal procedure as the teachers of the Anusransoontorn School for the Deaf. As a supplementary learning tool, the teachers could guide the students with confidence in demonstrating what the students have to do in their lesson. For example, if the lesson was based on understanding the action of the words the teachers can use the TCAD to display the meaning of that word and then show the action of its meaning for the students to be aware of it. From here, the students repeat the same steps with each vocabulary until they become completely familiar with each action of the words. The teachers then go over the lessons with the students to make sure that they fully understand the lesson.

3. Stimulating Recall of Prior Learning

Based on the original system of learning at this school, the learning topics and materials were given in a separate form of papers, documents, and books. At times, this made it quite cumbersome for both teachers and students to have to go into the files and pull out a specific lesson that they just want to learn about. When the lesson topics and materials are not present it creates an anxious of moving on towards other lessons. The TCAD allowed the students and teachers the freedom to retrieve the lessons that have been previously learned or that needs to be re-examined upon for clarity and understanding. The freedom of retrieving generated a sense of being empowered and control of the situation at hand.

4. Presenting the Stimulus

It was already mentioned before that the TCAD learning tool displayed the characters that were friendly and lively with a picture for clear understanding. At that time, the students were only taught with the method of using a picture to identify the objects and then demonstrating the hand signal to provide a meaning to that object. However, the tool's multi-approach teaching tactic allows the students to get an absolute development in skills for communication. The teaching method which consisted of sign language, finger spelling, auditory, lip reading, picture captioning, situation learning, reading, and writing provided a total learning experience for these students. The TCAD tool gave an injection of adventure in learning. The students were able to get an emotional feeling and thinking with the lesson.

5. Providing Learning Guidance

Normally, any teaching method that incorporates technology as part of the course outline would become quite a challenge. This challenge includes working with hope that the technology would cooperate with one's agenda. The TCAD served as tool for the students to

handle the learning situation in a simple manner as well as adjusting the learning topic to be more comprehensible. The tool gave an encouraging feeling to the students by maintaining the course for gaining the right answers.

6. Eliciting Performance

Learning performance was visible due to the students relaying their enjoyment with the active instruction tool and exhibiting a positive attitude towards being taught. The teachers received some facilitation support from their colleagues. This gave them the motivation to strive on in making sure that their students get the best from the training. The TCAD tool made the learning content in an active mode and presented as a user friendly gadget which invited the students to apply their best effort to find out more about the subject content.

7. Providing Feedback

The teachers had the ability to relate with the learning situation and provided proper recommendations for the students to improve themselves. The teachers' feedback to the student was always to ensure that the learning performance would progress further on. The TCAD tool used subjects based on settings that dealt with the real world. Whenever these students picked the right or wrong answers an explanation would be shown to make them identify with the response.

8. Assessing Performance

In this part of the condition the teachers utilized the results of the learning tool to indicate the students learning performance. The teachers would gather this information and try to come up with a better teaching method that will enhance their performance.

9. Enhancing Retention and Transfer

After the nine months that were taught to the students it was clear that the memory retention curve still remains positive. There is an expectation that the students will understand not only the meaning of the object but also on its practical usage. Comprehension of the matter will be transformed into implementing it as part of the daily lives upon the nearest period of time.

The TCAD tool did not replace the instructors' teaching method nor did it became the central principle for developing the students learning skills. The TCAD became an effective tool in serving the purpose of having students with a hearing impairment to retain their memory of the English vocabulary. The reason for the TCAD's current success can be related to the theory of Gagne's "Condition of Learning". There were other conditions that were already present or have allowed the TCAD tool to integrate with other aspects in allowing its feature to be employed. The most important thing here is that the learning environment can only be conducive when the students and teachers have created an opportunity for that environment to occur. Here we see that the mental attributes of students being highly active, enjoying learning, and showing a positive attitude allow the flow for the teachers to be focused on helping the students, capitalizing on the resources, and giving support to one another. Such a pleasant workplace for teaching and learning allocated a educational technology tool, such as

the TCAD, to position itself as an added benefit to the training course. Simply put, this was a perfect match for learning behavior and technology to contribute for the greater good for those whose lives have been challenged from unwanted circumstances.

CONCLUSION

This research showed the improvement of short term and long term vocabulary cognition after nine months of teaching between traditional method and animation dictionary method. The long term memory of students teaching through animation method is higher than another class. This is because hearing impaired students perceive well through visualization. Therefore researcher takes this as significant point for designing 3D animation character in vocabularies teaching. 3D cartoon animation matched students' interest. With the advantages of animation encouraging learners to learn, it is used for creating intelligence environment. Learning through their interest will decrease tension and increase attention. Besides, using animation for improving vocabulary cognition motivates students to learn more than text based learning. There are factors affect learning such as emotional and intelligence. Emotional is the most affective one. Animation vocabularies immersion environment will decrease emotion factors and help the students to learn better.

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AN EMPIRICAL STUDY OF BELIEFS AND VIEWPOINTS ON TRANSFORMATIONAL LEADERSHIP – OBSERVATIONS FROM LEADERSHIP TRAINING PROGRAMS

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ABSTRACT

This study has focused on a research problem that how can we improve the training and adoption of transformational leadership skills as part of management education programs. Transformational leadership has been widely adopted as an approach for the training of new managers and leaders. There is also lot of discussion and dialogue regarding what essentially depicts the phenomena of transformational leadership. We have studied the premises of transformational leadership, beliefs and views on this topic among the participants of management training programs. Two related research questions have been analyzed: a) What constitutes transformational leadership? Are there specific leadership practices we can train and educate? b) What kind of complementary leadership and management practices and descriptions would support training and adoption of related skills and capabilities? These questions have been studied by using questionnaire surveys and personal interviews. Empirical data covers three surveys conducted as part of management training program, in comparable settings. Our analysis of the data shows descriptive information and following conclusions were made, which will form new hypotheses for follow-up research activities. H1) The younger the manager or superior is, the more his personal leadership behavior is based on individual consideration and building of trust with their employees, whereas the older the manager is the more likely their personal leadership behavior is based on use of broader organizational approaches than individual level interactions. H2) Development of leadership capabilities from individual consideration and building of trust towards broader capabilities for organization level leadership is moderated by leader's behavior and beliefs regarding managerial control. H3) Less experienced managers have relatively higher belief on the benefits and importance of leadership when compared with respective beliefs and values of more experienced managers. Our findings are reviewed with recent literature and discussion in this field. Key conclusion from our study is that premises of transformational leadership training should focus on how a leader can challenge, encourage and support his subordinates and employees working towards new and challenging goals and objectives, how to enable transformational learning and develop employee behavior in their work. We will also discuss how leaders can develop themselves more capable in transformational leadership behavior, while reducing their passive and

control oriented aspects of their behavior. This research paper provides literature analysis, development of research questions, empirical data collection and analysis, discussion and conclusions from findings as well as suggestions for new research on this topic.

Keywords: Leadership training, transformational leadership, management training, deep leadership, leadership behavior, learning model, learning orientation, decision-making

INTRODUCTION

This paper focuses on an analysis of transformational leadership and training of leadership. Two related research questions have been addressed: a) what constitutes transformational leadership? Are there specific leadership practices we can train and educate? b) What kind of complementary leadership and management practices and descriptions would support training and adoption of related skills and capabilities?

This paper is structured in following way, first topic being covered and discussed is theoretical background of main concepts and main principles of transformational leadership, secondly we describe the conceptual model of transformational leadership being used in this study, then the empirical research design and data collection is discussed in detail, followed by analysis of data and testing of our research hypothesis set forth to this paper, finally paper is concluded with analysis and discussion of the results, review of the findings, critique and limitations of the research and suggested questions and issues for future studies continuing in this topic area.

This paper is part of work related with a research program on transformational leadership, including study and development work in this project since 2003 by University of Vaasa, Department of Production. The aim of the study on transformational leadership is to focus on improving application possibilities and effectiveness (impacts) of the leadership training programs. Development of leadership capabilities is associated with higher emphasis in decision-making for achievement of results and use of resources. The method of leadership profiling and analysis of the impacts training periods (from half a year to one year), basing on unique analytical models, has already been tested with over 200 participants of leadership training courses. This present paper addresses also aspects of leadership behavior, on personal level, focusing on the way how the trainees in the leadership training course can learn and adopt capabilities for transformational leadership, in versatile manner. Several new tools have been developed as part of this study, for leadership and decision making profiling. Leadership profiling has been made as simple and easy as possible by developing a web based tool (www.sandcone.eu) to gather and analyze empirical research data. Website offers for every research participant an opportunity to have an instant feedback of leadership capabilities and development possibilities in a holistic but simplified way. By combining the feedback with individual leadership consultation session during the training period the potential of leader's leadership capabilities can be utilized more efficiently and effectively. The power of leadership consultancy has been proved by looking the changes in leadership profiles and impacts by longitudinal (follow up) studies of the informants, too. Previous study shows that 80 % of leader candidates turn to the direction that they have been guided in individual consultation sessions. Various application possibilities of this study exist in development of leadership training and in recruitment processes. The most important impact

to different kinds of organizations is, however, transformational leadership capability integrated to decisions of operations strategies, especially within manufacturing and service strategies globally. This has been the final objective of transformational leadership study from the early beginning. About 100 experts and leaders in about 10 countries, by collaborating with our partner universities, have given their decision making profile integrated to their operations principles to find out the overall operational competitiveness inside an organization by this internationally unique manner. This offers these organizations an effective tool to adapt to global business operations e.g. by finding out the optimal locations for their operations in turbulent situations like during the crisis of world economy. This methodology has been utilized by about 25 students in their M.Sc and PhD theses, and in other studies by now, and the interest among the students is still increasing in other fields of science as well. More than 20 international publications have been written in scientific journals and conferences.

LITERATURE REVIEW AND RESEARCH HYPOTHESIS

What constitutes transformational leadership?

Kotter (1990) described some key differences between management and leadership. They differ in that good management can help us in controlling complexity while effective leadership may produce useful change for the organization, like a company pursuing successfully a new business area. Obviously leadership drives change and related processes and it is in the heart of the concept of transformation for both individual and organizational transformation and learning processes. Change focused leadership models underline active handling of issues and people in the changing and uncertain circumstances. Detail conceptual analysis of transformational leadership may be started by splitting the main concept to two parts, into main concept of transformational leadership and secondly to its constitutive element on notion of transformation.

Transformational leadership has been studied in terms of leadership development (Bass 1990, Bennis 1989), educational psychology (Mezirow 1998), and implementation of transformational leadership for leadership training programmes (Nissinen 2006, Nissinen et al 2008). Main line and ideas of the theories for transformational leadership are based on studies of learning, training and human leadership development. Concept of transformational learning is good introduction to this topic, as Mezirow (1998) suggested that transformational learning is based on interpretation and formation of meaning, based on understanding and learning from the experiences. Subsequently later then our experiences and their interpretations form the base for learning how we can use experience based learning and new knowledge as guideline for our decision making and actions. Mezirow further described learning as a process where meaning of a specific experience will be reinterpreted or that its interpretation will be revised and updated, and that the developed later interpretation will then guide our later understanding, valuing of issues and things and reflecting those on our activities. Transformational learning is a continuous process, based on reflection and re-interpretation of the events and actions. These ideas of transformational learning were originally developed in area of educational psychology for adult education and training theory and concept development. Notion of transformational leadership may be more recent

concept than transformational learning; in essence both of these concepts describe learning in different ways.

This present study has focused on empirical analysis of transformational leadership and its training for leadership trainees. We have applied "deep leadership" (Nissinen 2006) as a working concept to focus the study in more specific way. Empirical data collected for this paper delves on questions that how could we use the success factors of deep leadership in more versatile ways in the training of leadership behavior and skills? And in more detail that how could the application of deep leadership in leadership training be improved, with aims to improve the quality and effectiveness of leadership training? Premises for our research are based on findings from literature that the concepts and notion of deep leadership as a major item for leadership training curriculum have both pros and cons, and besides of using this specific model, broader complementary approaches might be useful for leadership training, especially for trainees which don't always have experience from working in management positions.

Previous work in this area has led to development of a new conceptual model of multi-focused strategies, and how a specific type of "sand cone" model of leadership can be used as a framework for developing operations plans, and specific action programs like quality assurance strategies for a government air force organization (Takala et al 2004). Main idea in the sand cone model is related to a prescriptive rule that improvement and creation of competitive operations capabilities should typically follow a sequential and cumulative logic; first improve your products and organizations quality, then delivery performance, then flexibility and finally cost effectiveness of the operations. This is a generic recipe for operational improvements in a company, especially in its manufacturing operations. Sand cone model implies an idea that operational capabilities are like castles built on sand, they erode and fall if they are not continuously improved and managed. Applying the idea of sand cone pyramid to the transformational leadership, gives us a model for the planning of the cumulative levels of capabilities that should be trained in a specific order. We return to this question after we first discuss and review the concept of transformation. Next chapter addresses the question that what constitutes the notion of transformation?

Viewing leadership development through personal learning, as a learning process

Learning objectives for the leadership work are based on demanding, versatile requirements that leaders face in their work. Primary motives for development towards a leader career must be on personal level, goals for work, life, achievements, willingness to compete, capacity to take responsibility, risk taking, among others. Both learning and training for leadership have been addressed widely in literature. Self-reflection based views on managers or leaders work have been used in studies like Schön (1983), where professionals were studied in terms how they solved problems in their work. More expanded views on leaders work have focused on analysis of the outcomes of the leaders work; we can include some of the related literature on this field. Impacts and effectiveness of leaders work should create results on many levels. Dansereau (1995) reported how a dyadic mode of leadership (leader-followers) provides support for subordinates both via individualized consideration and also by supporting their growth of self worth. More recently, Nissinen, Anttalainen and Kauppinen (2009) reported also on multiple levels of outcomes as a result of implementing longer term training programs

for deep leadership. Doz and Kosonen (2009) have discussed how organization level outcomes from transformational leadership (renewal and transformation of business processes) can be measured and analyzed in terms of improved business agility. These examples show that leadership work requires versatile worldviews and broad knowledge of markets, customers, technologies, products etc. Work environment provides the natural context for the leaders work. In that context, leaders must be able to learn and adapt to different situations. And eventually leaders are responsible for their own learning, on individual level, and they must trust on their own judgments and decisions, taking their companies and organizations forward towards their goals.

Managers and leaders have to manage their own learning, and create their own interpretation frameworks, learning models. Eventually this is an individual level question, leadership is personal, individually learned and practiced. Leaders learn most by doing their work and implementing their decisions and solutions to practice. Leaders work continuously through wide range of issues and activities, and resolve problems and situations for the guidelines and principles for their organization and company, set the goals and objectives to be achieved. Leaders measure and manage themselves throughout various situations, so they also need background knowledge and capabilities to be able to use the information from experience and to apply their own interpretation as base for new activities. Selected premises and values adopted by leaders create the individual and organizational value premises and cultural base for learning, "what must be and can be done to succeed and thrive in this organization, our environment and the business where we are in". Proper identification of the environment and valid interpretations create match or mismatches between leader's actions and his environment. In bigger picture the characteristics of successful leadership behavior tend to be generic. Bass (1985, 1997) has described that four main cornerstones of transformational leadership (idealized influence, inspirational motivation, intellectual stimulation and individual consideration) can transcend different nationalities and cultures, so that he effectively argues that these main premises are generic in their nature, and not limited to specific type of operating environment for a leader.

Leadership training should provide leader trainees with self awareness and required background knowledge they will need when pursuing their career paths. In literature review several development models for transformational leadership have been found, and those are discussed here briefly. Bass (1985, 1990) was one of the first to define and discuss the exact topic of transformational leadership, identifying four cornerstones of transformational leadership as key elements of the conceptual model of transformational leadership. Furthermore Bass has presented also a development model for evolution from transactional leader towards characteristically transformational leadership behavior. Nissinen (2006) has further developed this model by applying a different type developmental model of leadership, moving from passive and control oriented leadership towards deep leadership capabilities. Conceptual model of deep leadership relies quite much on same four cornerstones as Bass presented as main elements of the transformational leadership. Common to both Bass (1985, 1997) and Nissinen (2006) is that these models focus on leadership behavior based model of transformational leadership. Recent empirical studies on transformational leadership support a view that human behavioral traits like emotions and personality traits can impact positively on development of transformational leadership capabilities (Rubin, Munz and Bommer 2005). Is behavioral side of leadership so important that it would be a sufficient approach to

depict and describe the phenomena and notion of transformational leadership? This question is raised as the four cornerstones of transformational leadership are behavioral in their nature, not so much addressing the content or context of leadership. Bommer, Rubin and Baldwin (2004) discussed that there is not so much research done on the antecedents of transformational leadership, what actually then would constitute transformational leadership. Bommer et al identified two organizational variables, peer relationships among managers and practitioners can support positively the actualization of transformational leadership, while negative attitudes towards aimed at organizational changes and transformations can reduce the effectiveness of transformational leadership.

Our question remains on that what constitutes transformational leadership, as phenomena, to be studied, to be measured, how should we define it? Premise for any leadership and management tasks is defined by the nature of the pursued objectives, do we aim to achieve a vision that our company has, or does our organization work to achieve a mission set for the improvement of our competitiveness, e.g. to make cost reduction on products and services, in order to survive in the markets. Concepts of vision and mission fit well to the discussion and analysis of transformational leadership, as in many cases the targeted changes aim to achieve new competitive positions and performance improvements. Sand cone model thinking gives a model for the development of a mission, “the improvement of our organizations manufacturing capability should achieve first quality, then delivery performance, then flexibility and then cost effectiveness. These represent the substance domain of operations management, and respectively these also form the typical contents of the leadership’s mission for the manufacturing operations. Further findings from the literature on manufacturing strategy of a firm underline the need to identify both content of manufacturing strategy, as well as process of it (Leong et al 1990). This is quite good way to study phenomena and aim to identify the antecedents of the subject. Applying this to main findings from literature on transformational leadership can be summed up as a list of aspects of transformational leadership: four main cornerstones (idealized influence, inspirational motivation, intellectual stimulation and individual consideration), emotions and personality of a leader, peer relationships in an organization of the leader, existing organizational views and attitudes towards change, and the developmental stage of a leader. Secondly the process of transformational leadership can be covered with the change and progress models (personal development of a leader) from transactional leader towards transformational leader (Bass et al), self reflection processes of a leader (Schön 1983), organization level addressed in either direct worker-superior relationships, or in more wide ranging and changing organizational roles such as boundary-spanning new product champions or different executive leaders roles. Table below illustrates these ideas in a classification of attributes of transformational leadership, defined either as content issues or process issues.

Table 1. Contents and processes related with transformational leadership

Contents (what depicts TL?)	Processes (How TL is implemented?)
- individual consideration	-transactional management
- idealized influence	-managerial control
- inspirational motivation	-direct/indirect transformational engagements
- intellectual stimulation	-self reflection of a leader
- leader personality	-sphere of influence
- leader personal emotions	-(fixed/changing) organizational settings
- peer relationships	-change scope, boundary spanning roles
- organizational climate/resistance	-management level
- developmental level of leader	-agency issues, incentives schemes

Previously we discussed how the sand cone model thinking could be applied to the transformational leadership. Reviewing the above list of issues leads quickly to conclusion that the concept of transformational leadership is broad. On one side, transformational leadership can be seen as "style of leadership in which the leader identifies the needed change, creates a vision to guide the change through inspiration, and executes the change with the commitment of the members of the group" (www.businessdictionary.com). On other hand, Nissinen (2001, 2004) has further developed a new model for deep leadership and defines that deep leadership is a model which gives background and direction for the development and growth of a leader. Nissinen has developed a model of deep leadership which includes potential (professional skills), leadership behavior (building trust and confidence, inspirational motivation, intellectual stimulation, individualized consideration, management by control, and passive management; and finally outcomes from leadership (creates extra effort, effectiveness, and satisfaction). This model is in line with the ideas of Bass on the cornerstones of transformational leadership.

How can we train leadership using the above concepts and models? Practical situation is that new leader and management candidates need to make sense of the aspects and premises of leadership, they need to understand both the contents of leadership work and the process of working as a leader. Some ideas from sand cone model are good, create discipline and focus on selected few priorities at a time. This however does not sufficiently cover the whole breadth of the issues, just as an example, the multi-focused strategy for the improvement of quality management in Finnish Air Force (Takala et al 2004), included 7-10 strategy related issue categories that must be part of the comprehensive improvement program, in order to ensure effectiveness on multiple levels of an organization. Transformational leaders must be capable in running and operating this type of parallel and multi-level processes, work through their employees and organization. Leader empowers and resources his employees and organization with his/her full leadership capacity, to summarize the real challenges. This is why some of the most important lessons for new leadership trainees may be to understand that what leadership actually is, and what is transformational leadership. Basic premises of organization, management, project management, people management, decision making, communications, team work, leaders responsibility, personal integrity, personal commitment and so on, the list of leaders skills and capabilities, should be sufficiently understood prior the utilization of transformational leadership can be effective.

Growth towards leadership could be presented also with an analogy that how can one develop from master of details and specifics towards a master of change and transformation. Adequate conception of this process relies on multiple levels of leadership knowledge, from intra-individual, dyadic (typically two way description of leaders work in superior-employee relationships), group and organization level conception of leadership (Yukl 2009). Broad approach and multiple level views may be required to depict and describe the phenomena of transformational leadership. Yukl (1999) argued that transformational leadership concepts and theories discussed literature suffer on some level of conceptual weakness, methodological problems related with measurement and validation of the hypotheses. Views from Yukl (1999) can be compared with the discussion by Leong et al (1990) in their influential paper on the needs to improve quality of research on manufacturing strategy.

Conclusions from the literature analysis

Main conclusion from literature review is that transformational leadership is often studied by behavior of the leaders, and the successful behavioral patterns of leaders. This work has also resulted in the identification of the content issues of the phenomena of transformational leadership. Research on leadership as a topic would seem to be more related with behavior than on detail content of the topics of work. In comparison with other topics such as technology management, product marketing and management, quality management, in general more management related studies, are typified by common focus on specific type of management practices and approaches taken to carry out specific activities. Some studies led to conclusions that transformational leadership practices are contingent, dependant on the circumstances, but that the expert/leader thinking is related with these practices and that it would not be contingent (Leithwood 1993). This means expert judgments can prevail in changing circumstances and environments, and that focus on leadership studies might better be put on the expert evaluation and thinking processes, instead of trying to find specific best practices for the implementation of transformational leadership. Decision making behavior alone would not seem to be focused in the analysis of transformational leadership, broader approaches are preferred instead of this kind of narrow focus. On this basis our literature review can be concluded that training of the transformational leadership should be sufficiently broad, challenging the mental and behavioral capacity of the trainees with a range of issues and different management practices and problem situations. It is important to exercise leader trainees to use their analysis and judgment processes to cope with different issues, while being simultaneously capable in versatile use of the full behavioral, adaptive capacity for influential interactions with people using cornerstones of transformational leadership. Leithwood (1993) argued that all main elements of transformational leadership are interdependent, and that among them, individual consideration should be always addressed, no matter how big or small decision or change process would be at hand. Effective transformational leaders are so capable in getting their messages and issues through to people on one-to-one level, even in big organizations. Findings from literature suggest that training for the transformational leadership should always address individual consideration and leader's self-reflective learning processes, then expand this view towards multi-level view on other cornerstones of transformational leadership, aiming to achieve a mature view and premises for understanding leadership as a sum of many interdependent and mutually important factors. Effectively this underlines that the adopted value premises of a transformational leader should reflect the equal and balanced appreciation of different

cornerstones of the transformational leadership. From this basis onwards, more advanced and fine-tuned applied thinking and actions will yield better results in different situations.

The research questions defined in the start of the paper were analyzed in the literature review, and conclusion was that no specific set of transformational leadership practices would seem suitable for a base of a training program. Premises for teaching and training transformational leadership are more generic, they should focus on creating capability for self reflection, expand and diversify the personal behavioral capabilities, and to develop capabilities to work on multiple levels with many parallel and interdependent issues going on simultaneously, while still being focused on the main goals at hand. Relying on our key conclusion from the literature review that training for the transformational leadership should always address individual consideration and leader's self-reflective learning processes and expand from this, we believe that study and analysis of the individual and peer level beliefs of different management and leadership practices would enable us to develop a model that can add new information to the topic area of transformational leadership.

Research framework and empirical research work

Research approach

This study is part of longer term research program. The results reported in this paper reflect both qualitative and quantitative research approaches. Premises for the research were based on findings from earlier work that there are needs to improve the applicability of the transformational leadership training, its implementation as a leadership training subject was to be analyzed in fresh ways, and could we find new ways to better train the ideas and practice of transformational leadership? As discussed earlier, subject matter is related with need to address leadership behavior, and aims to improve our understanding on how the self reflection based development towards individual learning processes can be enabled and supported with the help of training of transformational leadership. First phase of this research was based on review of earlier statistical results from leadership trainee's leadership profiles, interview and personal development consultations with the trainees, and finally study of their beliefs and values on different leadership and self assessments. Overall we have used explorative, constructive research approach, that allows us to adopt research question from the literature and researcher community working in this area, then a new hypothetical model based on the operations management literature based "sand cone" was developed, finally aiming to develop new type of model to describe and characterize the suggested new way to model transformational leadership training and its challenges. This section of the text presents first the conceptual framework, then the empirical data collected, and finally the new explorative model developed in this paper. Main objectives with the modeling work presented and discussed in this paper have been to create new model to describe and analyze the ways how the content learning of substance matter related with training of transformational leadership evolves to a more actor/decision maker level individual process learning, where new information should be forged to actual skills and capabilities for leadership and management tasks. Empirical data is based on four different surveys. Total number of respondents is over 109. All respondents have provided both survey responses and personal interviews, as response material for the data collection of this study.

Conceptual framework

Self-reflection and endogenous reflective improvement of individuals own capabilities are based on the existing values and attitudes of a person. Development of individual leadership capabilities follows this type internal development and growth process (Nissinen 2006). This idea can be expanded and utilized purposefully as starting point for the development of a conceptual model, see Figure 1 below.

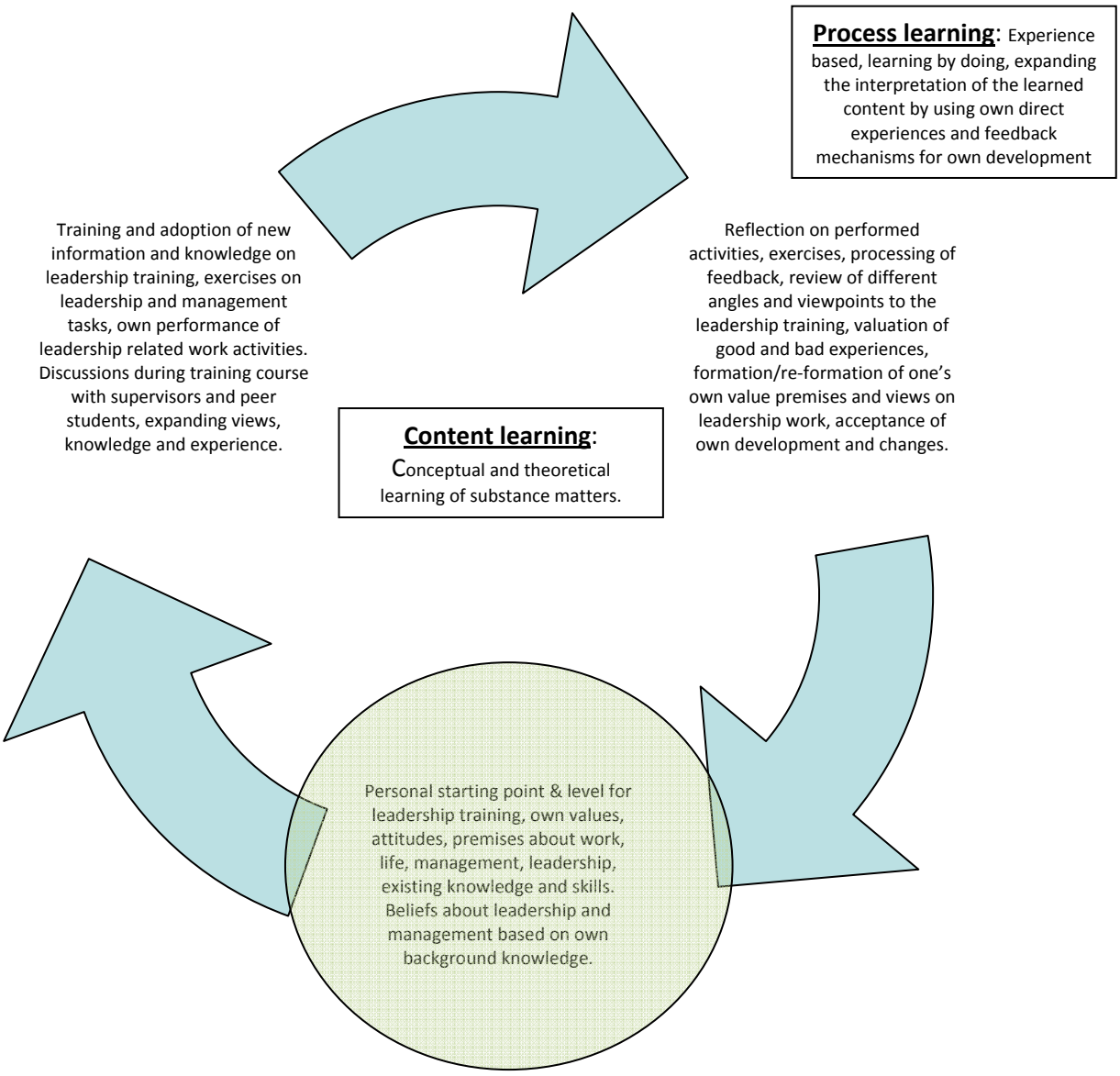

Figure 1. Self-reflection and reinterpretation process about views and values on leadership and management

Development of transformational leadership capabilities among students and leadership trainee's should be based on understanding and development of self reflection capabilities, and utilization supporting training. Students should understand that the development of their own leadership skills and capabilities is an individual learning process that they must take responsibility of. This is a significant educational challenge especially among young people who doesn't have based on their age or earlier work history extensive experience background. Does it have a meaning that what types of values, attitudes and knowledge the leadership trainee's and students have about leadership and managerial work? This must be the case, because essentially transformational leadership is about enabling person to develop voluntary, in his/her own pace in their own ways, towards improved level of leadership capabilities. During the training periods the leadership trainee's students may get more

perspective to develop their leadership skills and capabilities by studying more carefully one's own background. To this purpose, different kinds of consultative tools and methods can be also used. In order to focus in more detail to the research question and issues discussed previously, we have carried out statistical surveys on management courses, where transformational leadership has been part of the training curriculum. In the first parts of these surveys, we have addressed the views, premises and valuations of the students related with the different management practices. Next section of the text discusses the surveys where leadership trainees have been questioned about their views, beliefs and valuations of different management practices.

Questionnaire surveys measuring views, beliefs and valuations of management practices

As discussed in previous parts, key issue in the training of the transformational leadership is in the enabling of self-reflection processes of a leader. We have studied this with explorative surveys, with aim to collect information on the views and beliefs towards different management practices, as well as create base for the modeling of the required learning process. Methodologically we have followed an empirical research process utilized in Maunuksela (2006), where survey data is used for creation of an explorative model describing the successive steps in the improvement of a company's product development process. Idea is based on use of hierarchical cluster analysis for the modeling of survey data, based from the questionnaire. Using two response-based modeling of the survey responses, we can create statistical clustering and related dendrogram presentations that characterize the relationships between the variables. In Maunuksela (2006) it was possible to found an exploratory model where a logically right improvement logic and sequence of the type of improvements first from non-financial performance measures towards financial performance was found. In a way we ordered first the items where uncertainty is low, and then it was expanded towards items where uncertainty or deviations between respondent's views were bigger. When same idea is applied to management practices and their evaluation based on the beliefs and values of the respondents, we can get a structural model that can be argued to represent a model of a learning process that the leadership trainees need to learn and acknowledge. This type of exploratory learning model is also presented and discussed in detail in this paper, but first we show and report the type of the surveys that were arranged during the training course, where also the transformational leadership training was included.

Questions were developed iteratively, combining results from personal interviews with the trainees, other statistical surveys and tools used for the collection of the information from the trainees and instructors. We also tried to reflect the model of deep leadership (Nissinen 2006) in the selection and definition of the questions, by including questions covering transformational leadership, cornerstones of deep leadership, control based management and passive leadership. Range of issues covered reflected general situations, events and beliefs that can be encountered in most organizations on daily basis. Trainees beliefs on leadership was also probed with questions concerning how they would view on encouraging their subordinates to develop themselves for new tasks and challenges, to test that how the trainees view the tasks where leader can create people focused (individual level, group level) improvement objectives, and to implement those to practice.

Two different types of surveys were used, and the results of both of these are presented in tables 2 and 3 here below. Main conclusion from these surveys is that trainees agreed better on statements reflecting the human oriented issues, or practices exemplifying the cornerstones of the transformational leadership. Managerial control and passive leadership were rated as areas where they mostly disagreed on the practices. As mentioned two different types of surveys were analyzed, and first survey was repeated three times on a same type of course, in same point of time during the conduction of the course. Table 2 shows these results, and conclusion was that the respondents on different courses viewed quite similarly the different management practices, and statements concerning leader's work.

Table 2. Respondents agree/disagreements on leadership and management work, first survey set

Question	C-4	C-5	C-6
Compensation and motivating schemes for people cannot be solely based on information systems	9,6	9,3	9,5
Leader can direct and guide people to right direction by using individual consideration and encouragement	9,4	9,0	9,4
True interest about other people helps a superior when he encourages and motivates people to develop towards more challenging tasks	9,5	9,3	9,3
Mutual trust and true interest on his employees helps a superior when he encourages his subordinate to develop himself towards more challenging tasks	9,0	8,5	8,7
Wellbeing, co-operation and relationships between people can be improved by communicating and guiding people towards right direction	8,6	8,4	8,5
A superior can build and develop mutual trust with his employee by encouraging and challenging him to to develop towards more challenging tasks	8,6	8,1	8,5
Genuine interest on other people cannot be built solely on thinking about their motivating and rewarding, or utilisation of different operating and organising methods	9,1	8,3	8,4
Individual interaction can be implemented both by encouraging and acting in an exemplary manner	8,5	8,2	8,3
Employees creativity, learning and exemplary behavior is best developed through personal encouragement	8,3	7,5	8,3
Exemplary actions can be achieved through both encouragement and focusing on creativity and learning	8,1	8,1	8,2
Achievement of defined goals strenghtens the groups willingness to try and it is also a sign of succesful leadership	8,6	8,1	8,2
Utilisation of different organising practices can support the siginificance and improvement of creativity and learning	7,7	7,8	7,9
Wellbeing, co-operation and relationships between people can be improved by focusing on creativity, learning and exemplary behavior	8,2	7,0	7,9
Utilisation of different operating practices can support both the usage of information systems and different ways of organising	8,0	7,6	7,2
Employees competence areas can be effectively utilised both by using information systems and different organising practices	8,0	8,0	7,2
Information systems should not only be seen as a technical competence area, but more broadly so that usage of information systems supports the siginificance of creativity, learning and exemplary behavior	7,8	6,9	7,0
Utilisation of different organising practices requires often fast and problem-focused decision making	7,3	6,1	6,7
Information systems based support for a superior's work management requires that the applied management practices correspond with expectations and agreed principles	6,7	6,0	6,6
Detail control and search for mistakes is often associated with that a manager himself tries do as much as possible of the tasks	7,2	6,0	6,4
Controlling of the performance of the tasks is based on measurement of things, utilisation of measurement results and conclusions from this information	7,1	5,7	6,3
Response scale: 1 (Disagree fully)..10(Agree fully), Mean values			
Numbers of responses from three courses(n): C-4(28), C-5(24), C-6(26)			

Further detail review of the results shown in table 2 point that the use of main cornerstones of the transformational leadership in the questions received generally very consistent support. Differences in the points where respondents agreed or disagreed enables us to take a close view on the valuing of different types of management premises by the trainees. Surveys were implemented during the training course, so the survey only measured the viewpoints and valuations during this time. Table 3 contains a different list of questions, as we wanted to improve the clarity of the questions and change the scope of issues being addressed in the survey. Questions used in previous surveys were more exploratory in their nature, but the new set of questions contains in-built hypothesis and statements that were tested, after earlier analysis of the findings from the previous results. Main conclusion from the Table 3 is that

trainees believe that their leadership capabilities have improved during the training course, which is an important result. Secondly, many questions address respondents personal views, how they think about their own capabilities. Survey does not measure their true capabilities, just their views and valuations of different aspects of both leadership training, and more general questions how they think about on the differences on less and more experienced leaders.

The questions in the table 3 were further analyzed by using hierarchical cluster analysis to screen out similar group of responses.

Table 3. Respondents agree/disagreements on leadership and management work, second survey set

Question	Mean	Median	St. Dev
My leadership capabilities have improved during last 12 months	9,03	9,00	1,26
I understand well what leadership means	8,83	9,00	0,80
I can easily recognize situation where leader acts as an example	8,70	9,00	0,86
The more experienced leader is, the more his/her leadership style emphasises wider perspective towards subordinates and issues	8,40	9,00	2,00
Feedback about leadership training is important to me	8,40	8,00	1,65
Leader has to challenge subordinates towards continues self development	8,37	8,00	1,22
I feel confident (well aware) of my strenghts as a leader	8,33	8,00	0,99
I am able to adapt quickly to new changing situations	8,23	8,00	0,85
My decision-making skills and preparedness have developed as a result of leadership training	8,07	9,00	1,78
For me developing self-esteem and self-confidence is easy	7,43	8,00	1,63
My leadership skills are on a good level	7,40	7,00	1,02
Applying transformational leadership is easy	7,40	8,00	1,81
It is easy to motivate other people	7,30	8,00	1,43
I am able to identify clearly such persons who I could select for management training	7,30	8,00	1,50
The less experienced leader emphasises individual consideration of subordinates	6,72	7,50	2,91
Less experienced leaders and managers consider value and meaning of leadership especially important	6,70	7,00	2,18
Monitoring and controlling of people's actions is easy for me	6,37	7,00	2,40
Development of my own leadership skills is mainly based on the ways how I think about managerial control and its implementation	6,10	7,00	2,61
My own perception of different leadership styles is based on my own experience of management and leadership work	5,93	7,00	2,81
My own insecurity makes me sometimes passive in a new and changing situation	5,27	5,00	2,91
Coaching of an ice hockey or base ball team would be a very suitable task for me	5,13	5,00	3,53
The more experienced leader is, the more strickly he/she is to control and steer things	4,27	4,00	2,16
My own perception of different leadership styles is based on my age	3,80	3,00	2,50
Well experienced leaders do not value meaning of individual consideration	3,07	2,00	2,65
[1= Strongly disagree....10: Strongly agree]			

These results give a quick overview about how students' value different type of aspects related to leadership. Based on the students self assessment content of the courses have had positive impact on developing students' leadership capabilities. The most important result about positive assessment is that students' understanding and knowledge of leadership have developed positively. Also the meaning of development of students' self-conscious and applying feedback processes during the course is positively assessed. On the other hand some leadership practices and situations are questioned and the opinions about it are differing strongly. The most differing opinions are related to assessment of own insecurity, controlling leadership behavior as well as questions that are considered as conflicting. Based on this we have developed according to the results of the study new conceptual model, construction that aims to demonstrate and show step by step students learning process of deep leadership. Model describes student's leadership capabilities and problem solving skills development step by step. The model below is developed by utilizing the statistic research methods (Hierarchical clustering). The model is a view how students' development of leadership capabilities could work through step by step self reflection learning process. The new constructive model is presented in the next section.

New explorative model framework

A new statistically based explorative model was developed which aims to demonstrate and show how stepwise learning process for adoption of skills and capabilities for the transformational leadership would work. The model describes student's leadership capabilities and problem solving skills development phases in a step by step way, in a layered manner. Idea in the building of the model was the same as in the sand cone principle, that more refined performance categories can only be achieved once required preceding levels of performance are achieved and maintained.

Table 4. Accumulative phases and steps in adoption of transformational leadership skills and capabilities

Subcluster 7: I understand results and effects of my leadership work, through reflection and experience own self-conscious and leadership skills strenghens and diversifies	1.Reliability (1. I understand well meaning of leadership) 20.Reliability (20. The more experienced leader is, the more his/her leadership style emphasises wider perspective towards subordinates and issues) 4. Reliability (4. I feel confident (well aware) of my strenghts as a leader) 14. Reliability (14. The less experienced leader emphasises individual consideration of subordinates) 2.Reliability (2. I can easily recognize situation where leader acts as an example) 1. I understand well what leadership means
Subcluster 6: Doubts about my interaction skills and management work decrease, values of my leadership behaviour crystalises and renews	12. Reliability (12. Leader has to challenge subordinates towards continues self development) 18. Reliability (18. My own perception of different leadership styles is based on my own experience of management and leadership work) 21. Reliability (21. Development of my leadership capabilities is based on what type of attitude I take towards monitoring and controlling different issues) 6. Reliability (6. Monitoring and controlling of people's actions is easy for me) 11. Reliability (11. It is easy to motivate other people)
Subcluster 5: I learn how to act in leaders position in changing situations, I am able to master the situation and adapt to changing	7. I am able to adapt quickly to new changing situations 7. Reliability 2. I can easily recognize situation where leader acts as an example 4. I feel confident (well aware) of my strenghts as a leader
Subcluster 4: Voluntary self development and use of reflection permanently, impacts on professional values	23. Reliability (23. Feedback about leadership training is important to me) 24. Reliability (24. My desicion making skills and preparedness have developed as a result of leadership training) 3. Reliability (3. For me developing self-conscious and self-confidence is easy)
Subcluster 3: Leader needs to promote goals and objectives, and improvement needs continuously	12. Leader has to challenge subordinates towards continues self development
Subcluster 2: Improvement of leadership capabilities strenghens belief on own leading skills	10. My leadership capabilities have improved during last 12 months 10. Reliability
Subcluster 1: I have to win my doubts and believe in my own leadership skills	8. Reliability (8. My leadership skills are on a good level) 9. Reliability (9. Applying deep leadership is easy)
20. The more experienced leader is, the more his/her leadership style emphasises wider perspective towards subordinates and issues	
Cluster 9: Key things that I have learned in leadership training, these things support strongly each other (r=0.63)	23. Feedback about leadership training is important to me 24. My decision-making skills and preparedness have developed as a result of leadership training
22. Coaching of an ice hockey or base ball team would be a very suitable task for me	
Cluster 8: Value premises for controllive leadership,, on this basis I will select the issues which I will advance and support through supporting my subordinattes develomment, and recruitment of people working for me	19.Reliability (19. Less experienced leaders and managers consider value and meaning of leadership especially important) 13. Reliability (13. I am able to identify clearly such persons who I could select for management training) 13. I am able to identify clearly such persons who I could select for management training
Cluster 7: I am able to win my passiveness by mastering cornerstones and solving my doubts	Reliability 16 (16. Well experienced leaders do not value meaning of individual consideration) Reliability 15 (15. The more experienced leader is, the more strickly he/she is to control and steer things) Reliability 17 (17. My own perception of different leadership styles is based on my age) 5. Self-confidence (My own insecurity makes me sometimes passive in a new and changing situation)
Cluster 6: Cornestones of development own leadership skills, positive self image leans and strenghens with help of these	8. My leadership skills are on a good level 9. Applying transformational leadership is easy 11. It is easy to motivate other people 3. For me developing self-esteem and self-confidence is easy
Cluster 5: Acknowledging value of leadership, believing in leadership is a cornerstone for leadership knowledge and development	19. Less experienced leaders and managers consider value and meaning of leadership especially important
Cluster4: Mastering controlling leadership is one of the basic leadership skills	6. Monitoring and controlling of people's actions is easy for me 21. Development of my own leadership skills is mainly based on the ways how I think about managerial control and its implementation
Cluster 3: Own experience background is independent and important factor	18. My own perception of different leadership styles is based on my own experience of management and leadership work
Cluster 2: Leaders passiveness can be first based on these	5. My own insecurity makes me sometimes passive in a new and changing situation 14. The less experienced leader emphasises individual consideration of subordinates
Cluster1: Values related to leadership, about these I strongly disagree	16. Well experienced leaders do not value meaning of individual consideration 15. The more experienced leader is, the more strickly he/she is to control and steer things 17. My own perception of different leadership styles is based on my age 22. I would be well suitable for ice hockey or baseball team's coach

Model was developed by using hierarchical clustering analysis, using 24 survey questions from 31 respondents, using two response indicators for each question. First response indicator showed the disagree/agree rankings and second indicator contained respondents estimation on the confidence level that they can give to their answers. All 48 questions from 31 respondents were then processed by using hierarchical clustering algorithm that provided structure stratification of the 48 questions to 9 main clusters, and 7 sub-clusters for last cluster. Statistical processing of the results was implemented with a software enabling use of hierarchical clustering and structured dendrograms for the results. (Detail statistical information on the groups and formatted clusters is not included in this paper, that information is available from the authors of this paper.)

Interpretation of the results was described in the boxes included on the left hand side of the table 4. Firstly we identified main issues on which the respondents disagreed strongly. These views form the value premises and underlying personal viewpoints on leadership. Here it is important to recognize that the resulting model characterizes the group level beliefs and views on leadership. When the group level model is now interpreted and discussed here in more detail, we refer to the group level, non-personal generalization of the results.

Guideline for the interpretation was adopted from the sand-cone model in manufacturing strategy literature (De Meyer and Ferdows 1990). "*An alternative theory is proposed, namely that those manufacturers who create deep and lasting manufacturing capabilities follow a pattern of allocation of efforts and resources that is built on the assumption that these capabilities are cumulative: lasting capabilities are not built at the expense of each other, but upon each other, following a specific pattern of quality, followed by dependability, then reaction speed and finally cost efficiency*." Analogy in our model here shown in table 4 is that the cumulative layers of learning and increasing levels of confidence grow from the bottom up towards more demanding and maturity requiring levels of leadership capabilities.

In similar way, we argue on the basis of the shown clustered model that stepwise, cumulative and iterative learning process characterizes the adoption of the capabilities and skills for transformational leadership. One cannot practice transformational leadership unless one will really understand the premises of management, and why one person as himself behaves and views on leadership in his/her own ways. People need feedback and iterative loops to measure and understand better the relationship between doing and getting results. And leader must see these results through the people working for him in the organization, to achieve the set goals. Leader needs to learn and grow through different phases and levels of maturity, he/she needs to trust on himself and increase the confidence level on his own performance. This cumulative increase of confidence level is shown in the model with the help of the questions addressing the reliability of the main questions.

Results can be viewed as clusters, or sets of leadership issues. In many cases the set of results is formed so that accumulation of the results is not straightforward, or linear, there are irregularities, where one's view on a subject matter is lower on the "pyramid", while actually confidence level behind the statement is higher in the model. Conclusion from this is that values and premises on the viewpoints towards transformational leadership represent a very complex phenomena, where some beliefs may on first look be very clear, but then secondly in reviewing that whether a person can actually perform and implement related practices

confidently, depends eventually on different set of issues. So our beliefs and views on leadership practices do not turn or convert directly from thoughts to action, capability to implement leadership practices with high confidence level is a different level of capability than our own basic views on the same issues.

Leadership behavior is versatile and complex phenomena. According to previous studies, individuals own personality and behavior as a reflection of it is a very dominant and stable. Training and education can't change person's personality and individual qualities significantly. With leadership training it is possible to educate and improve person's leadership capabilities and managerial readiness. The benefit from the model shown here is that it can offer a conceptual, high level blueprint for the personal development process that trainees should review and think, in order to improve and train their own capabilities for the transformational leadership. Specific new aspects of the shown model may be related how the multi-layered levels of self confidence in issues and practice of leadership represent relatively complicated learning process. Effectively the results shown in table converge towards a statement that on a group level, before we should accept the claim that these trainees really understand well the notion of leadership, they should first be very confident in their views on recognizing situations where leader acts as an example, how they view individual consideration towards employees, confidence on their own strengths, experience based learning to cover bigger set of issues and operation scope of actions, and finally really trust on their own interpretation of leadership, what it means to them (see table 5 below, a part from table 4). Their understanding of leadership is multifaceted, web of interrelated issues. Once trainees will better understand what leadership is, they have better capabilities to develop themselves for leadership tasks and activities.

Table 5. Factors related with the understanding that what leadership means

Subcluster 7: I understand results and effects of my leadership work, through reflection and experience own self-conscious and leadership skills strenghens and diversifies	1.Reliability (1. I understand well meaning of leadership)
	20.Reliability (20. The more experienced leader is, the more his/her leadership style emphasises wider perspective towards subordinates and issues)
	4. Reliability (4. I feel confident (well aware) of my strenghts as a leader)
	14. Reliability (14. The less experienced leader emphasises individual consideration of subordinates)
	2.Reliability (2. I can easily recognize situation where leader acts as an example)
	1. I understand well what leadership means

DISCUSSION; REVIEW OF THE RESULTS, EXAMINATION OF THE HYPOTHESES

This model presented has to be considered as an exploratory model, it should be verified with bigger empirical data sets, before we can make generalizing claims based on this approach. Main result of this present paper is the explorative model for the learning process for the capabilities for transformational leadership, which is an empirically based result from survey data. We believe that the presented model is an instructive, conceptual blueprint type description of the challenges and issues people face when they evolve and study leadership. Analysis of the results is started with review of few hypotheses that we made from earlier empirical analysis of the interview and survey material. This latest survey was also used to test couple working hypotheses. Three more detail hypotheses were developed also addressed in this study, embedded in the question statements that were used in the survey questionnaire. These are analyzed briefly below, on the basis how the trainees viewed these issues:

- 1) The younger the manager or superior is, the more his personal leadership behavior is based on individual consideration and building of trust with their employees,

  - This is not supported and may be rejected (average 6.7 on scale 1..10)
- 2) The older the manager, more likely their personal leadership behavior is based on use of broader organizational approaches than individual level interactions.
  - This is supported and can be confirmed (avr= 8,4)
- 3) Development of my own capabilities from individual consideration and building of trust towards broader capabilities for organization level leadership is moderated by my behavior and beliefs regarding managerial control.
  - This is not supported and may be rejected (avr=6,1)
- 4) Less experienced managers have relatively higher belief on the benefits and importance of leadership when compared with respective beliefs and values of more experienced managers.
  - This is not supported and may be rejected (avr=6,7)

Our initial hypotheses were not all supported by the information collected from these trainees. Only H2 supported stronger support in the ratings of the respondents. These hypotheses might be also studied with additional testing on comparative groups of respondents.

We believe that the presented model of learning process and challenges for the adoption of transformational leadership complements the earlier knowledge base on leadership training. Questions arise that can a group level model be applied on generic level, or should the modeling be developed towards a personal learning profile. Further research is being planned on how we could stratify and decompose the individual profiles from among the group data, to show differences in individual learning process models. That kind of consultative modeling and tool can be integrated as feedback and development tool for the development discussions with the trainees, in order to pinpoint the challenges and issues they may have in adoption of transformational leadership capabilities.

Generally viewing this model has to be considered a preliminary, exploratory approach to model the learning process of the trainees. Same basic approach was previously tested with success on the analysis of the improvement of the product development process and development of firm level innovation processes (Maunuksela 2006). Survey research and self assessment based responses contain also risks of validity and reliability. In this model the analysis of the reported confidence levels is built into the questionnaire design, but it cannot be controlled that how reliably or honestly the respondents filled up the questionnaires. All data collection arrangements used in all the training courses where this and preceding surveys have been implemented, have been replicated in similar manner, so settings and environment for the conduction of the survey were very carefully prepared.

This survey measures the viewpoints and valuations of the leadership trainees, focusing on issues that we believed to be on the agenda of a student who should learn transformational leadership. Self-assessment based responses do not allow us to make conclusions on the actual behavior of the trainees, and the focus of the survey has been to analyze the premises of their learning objectives. Model is descriptive in its nature, based on the empirical work, using qualitative research, and conceptual analytic research approach (Alasuutari 1993; Kasanen, Lukka and Siitonen 1993). This type constructive research approach focuses on development of new conceptual and theoretical constructs, that can be tested for their value

and advantages offered for the practicing managers and leaders. Empirical verification and study of the value of the presented learning model for the transformational leadership has not been done yet, it will be addressed in the follow-up research work in this project.

Our aim has been to develop a generic model that can be used in different type of environments, as Bass argued that benefits and strengths of transformational leadership transcend cultural or national boundaries, so it is aimed here that the developed model would be possible to generalize on some level, if we can proof the benefits and value from this approach in new subsequent studies. Training of transformational leadership is often focused on the leadership behavior, we believe more versatile approach may beneficial. Especially on courses where trainees may be young and they don't always have experience on management or leadership work. That is why we suggest that training and study of transformational leadership should always be given and applied in a context, where its relative position among management and leadership approaches is rightly framed and proportioned carefully. Leadership is not only about transformational leadership, even if the basic elements of it can be quite generic in their nature. In training of transformational leadership, it should be addressed first that what is management, how it is practiced, what kind of skills and knowledge managers need, and how leaders and managers behave, and why use of transformational leadership would be good way to practice leadership. Proceeding through appropriate steps and development levels of the trainees, it is possible to create sustainable learning and motivation for self improvement and learning. No practice or approach on itself can be claimed to be a panacea in the area of management and leadership. Following figure presents the cumulative generic levels of the sand cone of leadership evolution and growth, how to

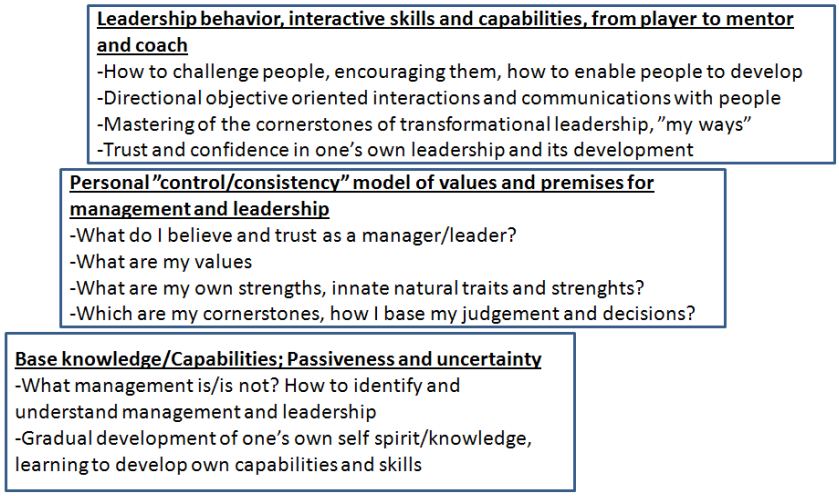

Figure 2. Accumulation of individual abilities and capabilities for leadership work

CONCLUSIONS

The model discussed and analyzed in this paper shows a new type of empirically derived model for the individual/group level learning process for the adoption of transformational leadership skills and capabilities. Model is descriptive, and actual leadership behavior was not addressed, nor predicted with this model. How should we train leadership behavior? We believe this question needs further research and to reflect our model widely on this basis. Different learning styles and learning orientations of people impact on the way how they will learn new capabilities for leadership behavior. Earlier discussion on the training of transformational leadership has focused on highlighting of passive, controlling and transformational leadership, implying that trainees should move away from passive and control oriented leadership behavior, towards versatile use of cornerstones of transformational leadership. Generally we believe this kind of approach is good and valid, but there might be need to view this in broader way. Effectiveness of leaders behavior depends also on many situational factors, sometimes passive approach can be good, because in order to focus on given main issues and goals at hand, sometimes other less urgent issues will not be handled, but this does not make a leader passive, if he sets priorities on some selected issues, and focuses on those. All encompassing views on passive, controlling and transformational leadership are too broad, more subtle approaches are needed. More agile and flexible adaption of applicable decision making model and behavior types are required from leaders. Leaders and managers need interpretation capacity, to have eye for the events and circumstances, and then adopt their behavior accordingly. Transformational leadership can be trained and educated in different ways, leading to question that what type of training or education approach would be a best, or generally valid? One important conclusion from our study is that actual decision making, analysis of issues, preparation of decision and decision making activity of a leader should be trained, and link that effectively with the training of transformational leadership. This would give more thrust to the learning and use of transformational leadership capabilities. Ideas and models of transformational leadership originate from studies of military leadership and generic leadership studies. We believe that this type effectiveness driven context for training of transformational leadership would be beneficial for learning results. Follow-up research is being planned to combine the individual/group level decision making profiles (Takala et al 2004) with the executive decision-making styles (Gallén 2010) to the developed learning process model that was presented in this paper. Moreover, both individual and group level addressing of the perceived uncertainties in capabilities for leadership work require distinct handling of “individuals issues, and groups issues” in applicable ways. Besides of decision-making, we need to understand in more detail how the externalization and communicativeness of a leader develop, once they learn to become better leaders. Leaders must enable and create transformation and change processes in their organizations. Related training should help leaders to find their own natural “externalization points” and “transformation thresholds” when they move from analysis to actions and put their decisions to actions. It is not sufficient that trainees learn the content matters, their readiness to act needs to be improved parallel to adoption of ideas and principles of transformational leadership. By continuing the development of personal and group level leadership profiles and learning models, we hope to be able to find the underlying threshold and externalization variables, when identified and recognized will help individuals to implement their leadership capacity, and use the

cornerstones of transformational leadership in their own way for the success of their activities.

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AUTONOMOUS MAINTENANCE USING TOTAL PRODUCTIVE MAINTENANCE APPROACH: A CASE STUDY OF SYNTHETIC WOOD PLANK FACTORY

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ABSTRACT

This study purposes to improve the effectiveness and efficiency of equipment by using an autonomous maintenance activity following the total productive maintenance system. Due to a case study, the equipments in focused factory that is synthetic wood plank factory had many losses especially from breakdown, setup and adjustment which came from many causes and it would consume a large time to improve, therefore for reducing these losses and times the autonomous maintenance activity is selected, because this activity focuses on total participation of all employees. This research implemented autonomous maintenance activity just only step 1 to 3 which consist of (1) Perform initial cleaning and inspection of all equipment, (2) Establish countermeasures for the causes and effects of dirt and dust and (3) Create cleaning and lubrication standards for all activities. After activity was implemented at model machine (H4) for 8 months, Availability Rate increased from 85.3% in 2008 to 93.3% in august 2009, and at the same time period Overall equipment effectiveness increased from 78.6% to 86.4%

Keywords: Total productive maintenance, Autonomous maintenance, Overall equipment effectiveness

INTRODUCTION

Nowadays, intensive business competition forces industrial sectors to improve their products in the aspect of quality, price, and delivery time. Furthermore, modern production technology has been developed rapidly. Therefore, machines are invented in order to be a key for success in this high competitiveness. Since machines which can produce mass production within short period and also operate at lower cost are more required than intensive labor, thus having the machine with actual production capacity below maximum production capacity, low efficacy and effectiveness of the machine and high operating cost will affect such industrial organization negatively in the competition. From the information provided by Mobley [1], it showed that 28% of production cost happened in maintenance activities. The importance of maintenance activity is increasing continually because of its roles and advantages for improving machine performance, product quality, security, and factory cost due to maintenance cost significantly relate to production industry [2]. Therefore, Total Productive Maintenance (TPM) becomes wide spread in several industries since TPM system emphasizes all employees in the organization to autonomously maintain and improve equipment through small group system. The most importance is successive maintenance through the effort of small group. Every employee is responsible for maintaining his/her own machine [3]. In addition, TPM aims to totally eliminate organizational losses which consist of malfunction, wastage, and accident. TPM system also focuses to resolve six big losses including setup and adjustments loss, breakdown loss, minor stoppage loss, speed loss, reject and rework loss and initial loss. Therefore, several researchers have applied TPM and they have successfully resolved the problem [4-8]. This research focuses on autonomous maintenance (AM), which is major pillar of TPM system. The

research has been conducted in a particular synthetic wood plank factory that confronted problem regarding to setup and adjustments loss and breakdown loss.

Research Problem

The case study is wood plank factory which operates with continuous process. It consists of 5 machines. The Overall Equipment Effectiveness (OEE) of each machine in 2008 is depicted in Table 1.

Table 1 OEE of each machine in 2008

Machine	A	P	Q	OEE
H3	86.21%	95.32%	99.41%	81.69%
H4	85.32%	93.14%	98.85%	78.55%
H5	88.34%	92.39%	99.15%	80.92%
H6	86.56%	94.71%	98.59%	80.83%
H7	87.16%	95.32%	99.32%	82.52%

From table 1, Availability Rate (A) in all machines is the lowest element. This availability rate is related to setup and adjustments loss and breakdown loss. Figure 1 depicts information in 2008 collected by the factory presents the causes of main losses in term of availability rate.

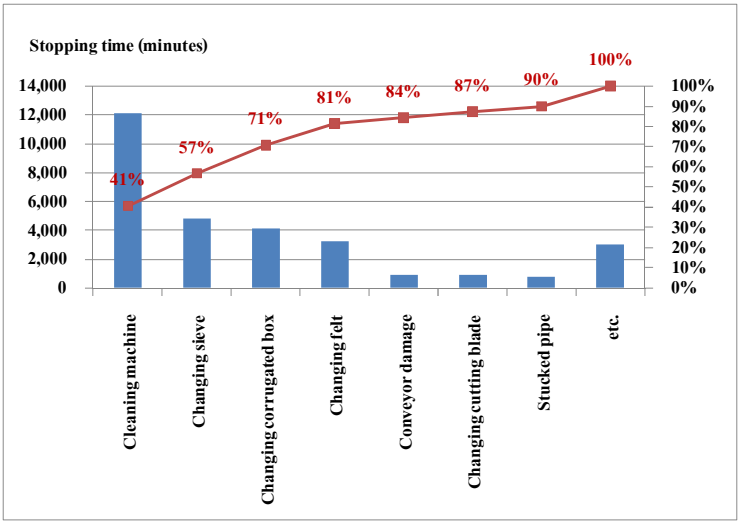

Figure 1: Losses in term of Avialability Rate

Figure 1 shows major losses in term of availability rate that contain rather high level of time loss. Consequently, the factory loses time for production, which results the organization to lose opportunity for production and sale. From mentioned problem, organization's traditional solution normally assigns only department manager and engineer to find the causes of problems and solve all of them, since it consumes a lot of time. Therefore, in order to solve many problems in a short period, this research has applied autonomous maintenance according to TPM concept for solving problem in term of availability rate of OEE in focused factory.

METHODOLOGICAL APPROACH

Preparation for TPM Activities

Due to the case study, a company has not implemented TPM system before, so the TPM approaches are needed in preparation for launch TPM. Procedures for the activities are shown in table 2.

Table 2 Preparation for TPM activities

No.	Procedure
1	Executive announce the intention to TPM activities.
2	Instruction to TPM activities.
3	Establish the team to promote and support TPM activities, the activities committee and the project secretary.
4	Identify the goals and policies of TPM activities.
5	Set up the master plan for TPM activities.
6	TPM Kick off, all employees participate an event.

Autonomous Maintenance Implementation as a Key to TPM

Autonomous maintenance activities start by setting up a team to identify the program activities and policies. Then, require all workers to establish small group activities (SGAs) in order that maintenance activities could have been operated through these SGAs. Autonomous maintenance is activities that require a relatively long time in order to perform all of the required steps. Therefore, this study focuses on autonomous maintenance from step 1 to 3 in the period January to August 2009 of machine H4, which specifies the activities below.

Step 1: Perform Initial Cleaning

At the beginning, the requirement is to find a variety of machine defects such as loosen or any damages. The method in this step is used to hang tag to indicate a problem and the tag will be removed after troubleshooting completed. Tag is divided into 2 types of deficiencies control. First is that workers can control deficiencies by themselves (white tag) and the latter is the type which workers cannot control deficiencies by themselves (pink tag) shown in Figure 2.

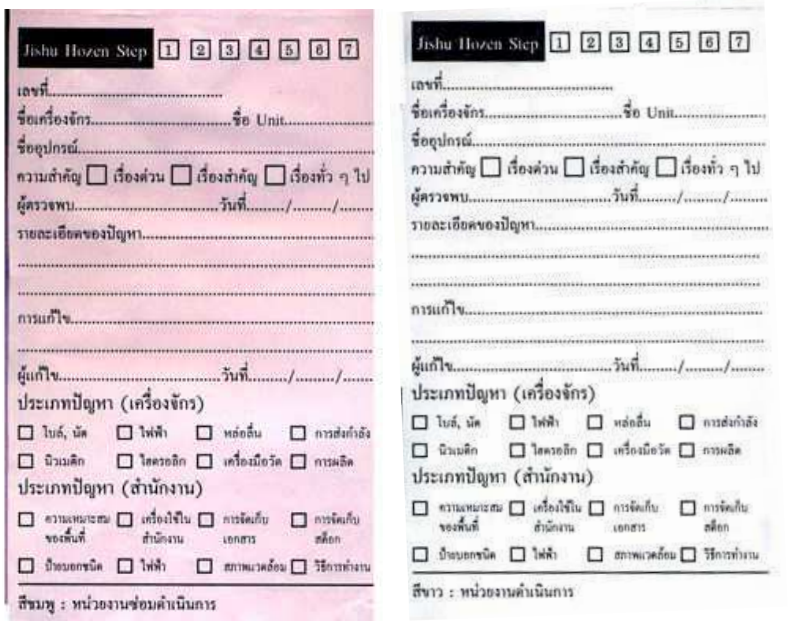

Figure 2 example of Pink and White Tag

Step 2: Eliminate sources of contamination and inaccessible areas

The second phase is a process-oriented activity for SGAs to find sources of contamination and inaccessible areas. After finding the sources of all problems, continuous improvement activities consisting of individual kaizen and small group kaizen will be applied to solve these problems. The example of small group kaizen is illustrated in Figure 3. In this stage, it also creates knowledge through One Point Lesson (OPL) in order to explain all concerning employees to know what has been improved in this step. Figure 4 depicts example of OPL.

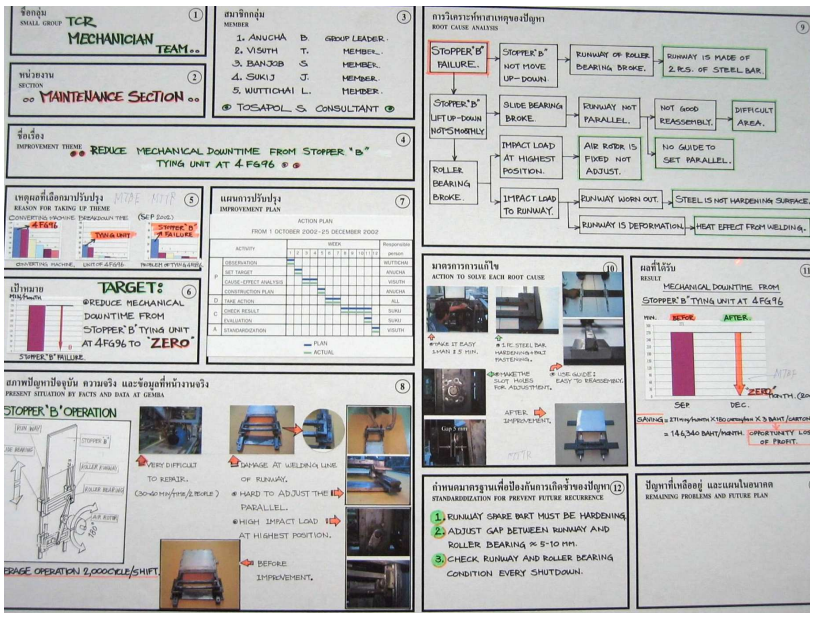

Figure 3 example of small group kaizen

ระบบ	ชื่ออุปกรณ์	เครื่องจักร	ผู้อนุมัติ	วันที่	เลขที่
(ลม) Pneumatic	วาล์วควบคุมความดันลมอัด (Air Regulator)			1/10/2003	Pneu-2

ภาพโครงสร้างการทำงานของอุปกรณ์	การทำงานของอุปกรณ์
	เมื่อลมออกมาจาก ตัวกรองลมอัด จะมาเข้าวาล์วควบคุมความดันลมอัด (Air Regulator) ให้มีค่าคงที่ตามที่กำหนดไว้ ถ้าความดันลมที่ออกนี้มีค่าสูงกว่าที่กำหนด จะดันสปริงด้วยบนให้ยกแผ่นไดอะแฟรมขึ้น เป็นผลให้ก้านของพอพเพตถูกยกขึ้นด้วยทำให้ปากวาล์วปิดทางลมเข้าวาล์ว เราจึงสามารถตั้งความดันลมที่ต้องการได้ โดยตั้งค่าของสปริงโดยใช้มือหมุน

Figure 4 example of One Point Lesson (OPL)

Activities carried on this process will bring advantages as follow

- Reducing setup and adjustment time
- Reducing inspection time
- Reducing lubricating time

Step 3 Establishes tentative standard

In the third step, the process focuses on increasing reliability and facility of maintenance by creating a tentative standard for cleaning, inspecting, and lubricating. The example of a tentative standard is shown in Figure 5. Normally, the tentative standard is made for reminding when to clean and inspecting the level of fuel and lubricants. This activity will be performed after achieve step 1 and 2, and then allow small group to establish tentative standard and adhere to their own reasonable standard. This action encourage to stop equipment deterioration due to the improper action will not be performed and the machine will be continually maintained.

TCR : TENTATIVE INSPECTION STANDARD

มาตรฐานการตรวจสอบเครื่องจักรชั่วคราว

ชื่อเครื่อง : UNIT :

ลำดับที่	รายการ	วิธีการ	จำนวนจุด	มาตรฐาน	ความถี่	เวลารวม (นาที)	ช่วงการตรวจสอบ		ชื่ออุปกรณ์	ผลการตรวจสอบ
							เดินเครื่อง	หยุดเครื่อง		
		เวลาตรวจสอบรวมทั้งหมด (นาที)					ผู้ตรวจสอบ_____		วันที่_____	

Figure 5 example of tentative checklist

Measurement

The indicators used for measuring progress and success of autonomous maintenance following TPM are different for each step. Therefore, performance indicators for each step are shown in table 3

Table 3 Indicators used in each step

	The succes of activities	Tag colour and percentage of removed tags	Individual and Small Group Kaizen	The number of OPL	Elimination of sources of contamination and inaccessible areas	Provisional Standard	Availability Rate	OEE
Step 1	✓	✓	-	-	-	-	✓	✓
Step 2	✓	✓	✓	✓	✓	-	✓	✓
Step 3	✓	✓	✓	✓	✓	✓	✓	✓

- The success of activities is the indicator used to measure the progress of the plan in order to keep in mind that when the status of the process which should be done, so we can meet the expected plan.
- A number of pink tag and white tag and percentage of removal tag indicate the problems found in working area and the success of maintenance.
- Individual and small group kaizen are used for measuring the participation in work improvement in the second step.
- A number of OPL is used for measuring the participation in creating knowledge through OPL which played an important role in both individual and small group kaizen in step 2.
- Elimination of sources of contamination and inaccessible areas (sources of problem in step 2) indicates the progress of autonomous maintenance activities directly. This indicator refers to the success of eliminating sources that are difficult to clean, lubricate and check.

- A number of tentative standards are an indicator for measuring progress of created standards which are created for cleaning, inspecting, and lubrication standards. This indicator directly refers to the progress of autonomous maintenance activities in step 3.
- OEE and availability rate are the indicators relate to the outcomes of autonomous maintenance activities. Especially, the availability rate which is the direct result from the autonomous maintenance activities.

RESULTS AND DISSCUSSION

After the focused company implemented autonomous maintenance activities with machine H4 by using approaches mentioned in section 3.1 and 3.2. It was found that the operating results from January to August 2009 showed as follow

The success of activities

Autonomous maintenance activities are divided into 3 steps in 8-month period which were able to perform as planned. The planned activities and actual results are shown in Figure 6.

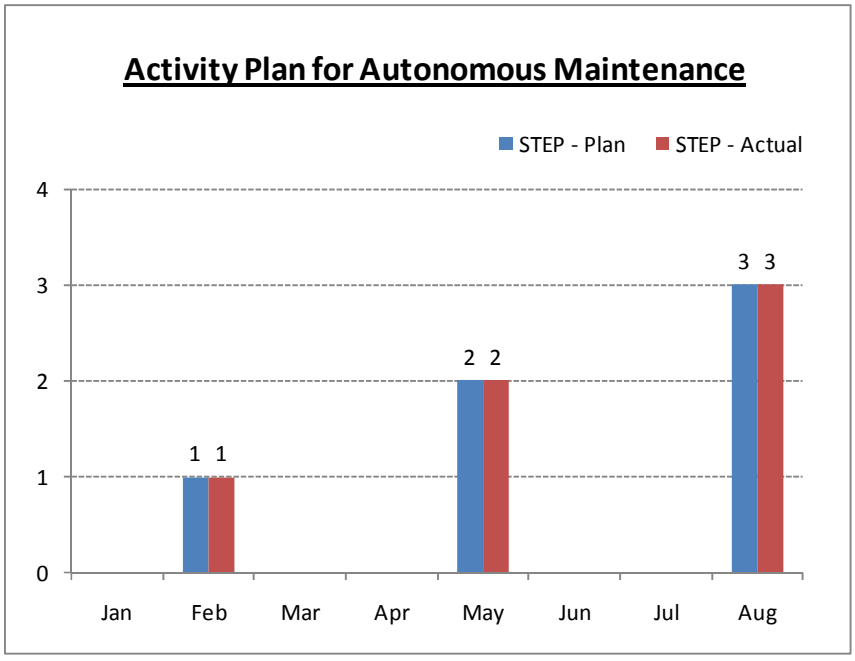

Figure 6 planned steps and results of autonomous maintenance activities

White tag, pink tag and % removal tag

Whenever autonomous maintenance step 1 is implemented, normally it result in the high volumes of tag and gradually decrease in a following step. In this case study, focused machine also has the same pattern. Tag results are shown in Figure 7. In the beginning period of AM, most of problems were discovered and corrected by tag activity, For the pending tags, these problems require more time for solving or wait for ordering replacement parts to return into original state.

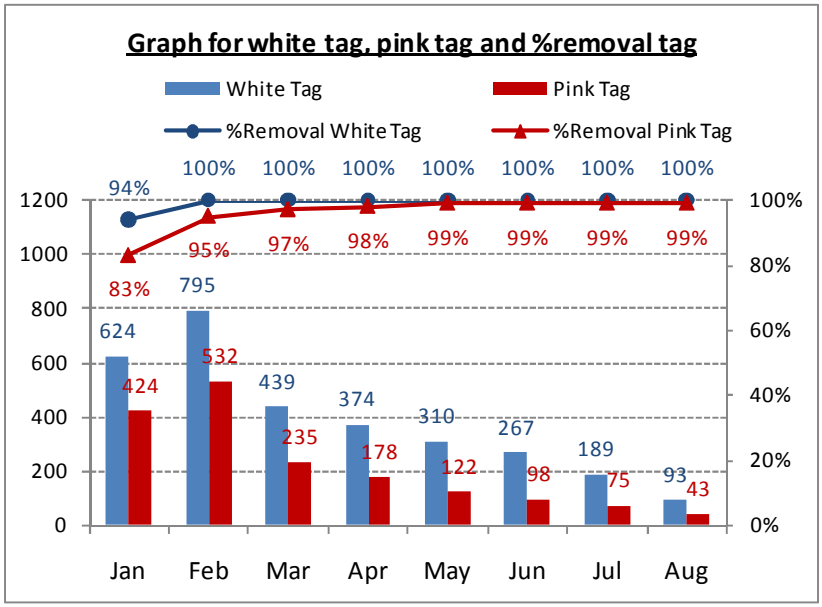

Figure 7 numbers of white tag and pink tag and % released tag

Number of kaizen activities

Kaizen activity is divided into 2 main types of work which consist of individual kaizen and small group kaizen. For autonomous activities, a number of individual kaizen increases highly in step 2, because employees will correct the problems found in step 2 which are sources of contamination and inaccessible areas. Most of these problems will be amended through individual kaizen. For small group kaizen, it will process from middle step 2, because small groups are set for face with though problems which require a relatively long time to improve. Moreover they also have high improving cost. The results of kaizen activities are shown in Figure 8.

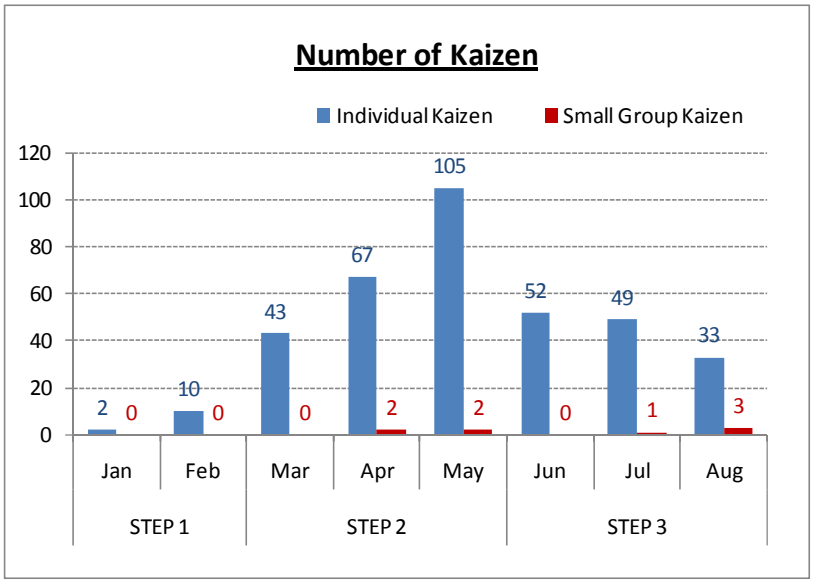

Figure 8 numbers of individual kaizen and small group kaizen

Number of One point lesson (OPL)

OPL will be started from step 2 of autonomous maintenance activities. These works focus to describe on works and equipments which have been created in step 2. It educates all operators to understand how to use and what should to do. For OPL in step 3, It will focus describe how to perform inspection and cleaning with correlate with temporary standards. OPL result is shown in Figure 9.

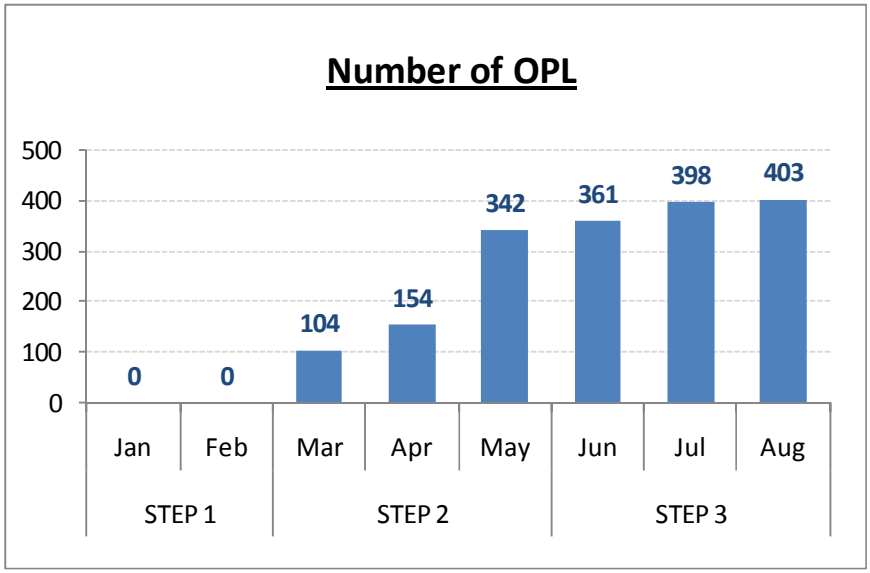

Figure 9 number of one point lesson

Eliminate sources of contamination and inaccessible areas

Eliminating sources of contamination and inaccessible areas is the main activities to perform in step 2 of the autonomous maintenance activities. The activities will be made and directly affect to Availability Rate because these help to reduce time for setting up and cleaning Performance of eliminating sources of contamination and inaccessible areas are shown in Table 4.

Table 4 Result for eliminating sources of contamination and inaccessible areas

Type of problems	No. of problem	Finished
Sources of contamination	109	109
Inaccessible for cleaning	154	147
Inaccessible for inspecting	67	67
Inaccessible for lubricating	87	85

Number of tentative standards

Creating tentative standard instruction is standard activities in step 3 of autonomous maintenance activities. Temporary standard instruction intends to focus on checking unusual condition and cleaning equipment. This activity helps to reduce machine breakdown directly. The results of creating temporary standard are depicted in Figure 10.

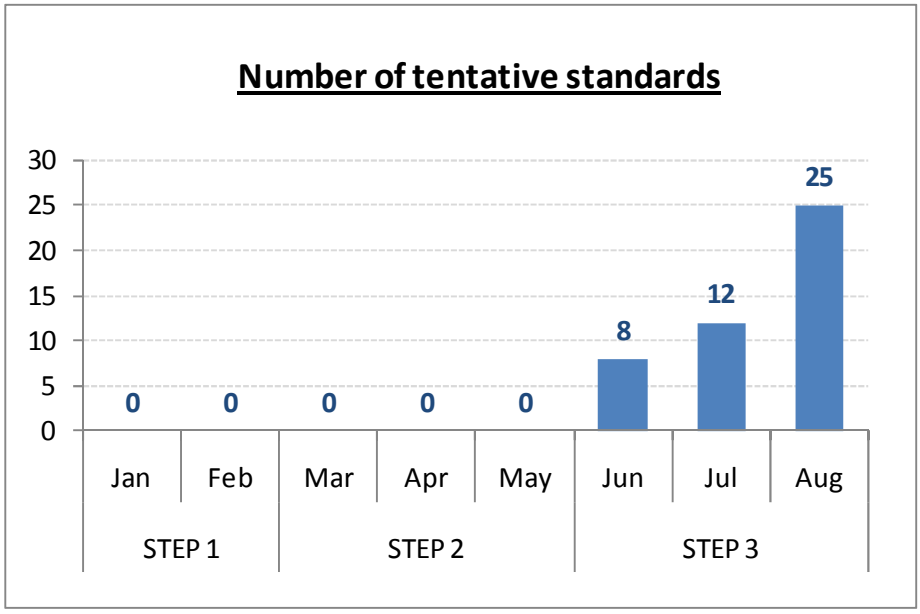

Figure 10 number of tentative standard

OEE and Availability Rate

Availability Rate and OEE are the values reflecting to the operating results of manufacturer directly. Moreover these KPIs have directly been benefited from autonomous activity following total preventive maintenance approach. Especially for availability rate will be resulted directly by autonomous maintenance activity. Availability rate begin to increase from step 1 due to find several machine abnormalities and restore them to normal condition. These activities can reduce machine breakdown and minor stoppage. In step 2, availability rate will be increased continuously from continuous improvement activities or kaizen. Kaizen can largely reduce not only cleaning time but also lubricating time. Final step in this study is step 3. In this step, increasing of availability rate come from routine checks defined in the temporary standard. This can help operators find out unusual condition before problems occur. Therefore the activities are able to reduce a number of breakdowns. In case of OEE, it is also resulted mainly similar to availability rate. OEE increases since the beginning of autonomous activities, but in some period OEE direction may be different from availability rate due to OEE consists of 3 main elements as follow availability rate, performance efficiency and quality rate. Sometimes the percentage of performance efficiency or quality rate may reduce because these elements do not directly receive effect from autonomous activities. These could make the reduction of OEE although availability rate increased. Result of OEE and Availability Rate of H4 during 2008 and January to August 2009 are shown in Figure 11.

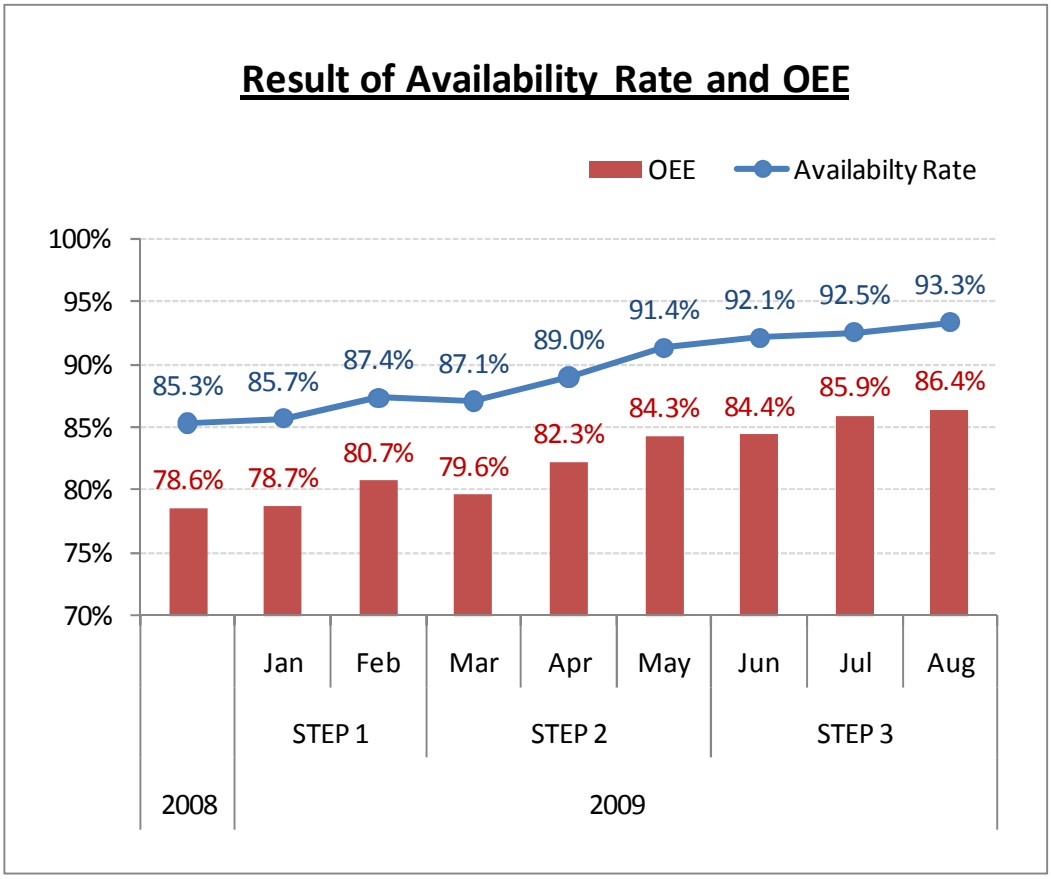

Figure 11 result of availability rate and OEE

CONCLUSION

From autonomous maintenance activity from January to August 2009, the result of focused machine can be summarized as follows

1. The autonomous maintenance activities have been completed step 3 on August 2009.
2. Performing of autonomous maintenance activities focus on initial cleaning and searching for deficiencies. This activity does by attaching white tag or pink tag to unusual points. From activities, white tag can be applied for 3,091 tags and 100% released and pink tag 99% of 1,707 points had been solved.
3. For continuous improvement, 361 and 8 topics have been complete for individual kaizen and small group kaizen respectively.
4. OPL was published for 1,762 topics.
5. Eliminate sources of contamination and inaccessible areas have been found for 417 and 408 points respectively. All of them have been corrected for 97.84%.
6. Temporary standard instructions have been made for 45 documents.
7. From 2008 to August 2009, Availability Rate increased from 85.3% to 93.3%, and OEE increased from 78.6% to 86.4%.

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"IMPACT OF TQM IMPLEMENTATION ON PROFITABILITY: A REVIEW"

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ABSTRACT

This research will presents new data and empirical insights into the relationship between TQM implementation and Profitability. The main purpose of this research is to determine the impact of TQM implementation on in the context of Indian manufacturing Industry.

As very few research on TQM has been done in the developing countries, so our aim is to analyze the status of the Indian manufacturing industry for TQM implementation, as India is becoming a major sourcing base for the world and there is a paucity of such research.

The main implication of the findings for managers/decision makers is that a typical manufacturing organization is more likely to achieve better performance in profitability, with TQM than without TQM.

Keywords: TQM; Manufacturing; Implementation; Customer; Satisfaction

INTRODUCTION

Total Quality Management is a management approach that originated in the 1950's and has steadily become more popular since the early 1980's. Total Quality is a description of the culture, attitude and organization of a company that strives to provide customers with products and services that satisfy their needs. The culture requires quality in all aspects of the company's operations, with processes being done right the first time and defects and waste eradicated from operations.

Total Quality Management, TQM, is a method by which management and employees can become involved in the continuous improvement of the production of goods and services. It is a combination of quality and management tools aimed at increasing business and reducing losses due to wasteful practices.

TQM is a management philosophy that seeks to integrate all organizational functions (marketing, finance, design, engineering, and production, customer service, etc.) to focus on meeting customer needs and organizational objectives.

TQM views an organization as a collection of processes. It maintains that organizations must strive to continuously improve these processes by incorporating the knowledge and experiences of workers. The simple objective of TQM is "Do the right things, right the first time, every time". TQM is infinitely variable and adaptable. Although originally applied to manufacturing operations, and for a number of years only used in that area, TQM is now becoming recognized as a generic management tool, just as applicable in service and public sector organizations. There are a number of evolutionary strands, with different sectors creating their own versions from the common ancestor. TQM is the foundation for activities, which include:

- Commitment by senior management and all employees
- Meeting customer requirements
- Reducing development cycle times
- Just In Time/Demand Flow Manufacturing
- Improvement teams
- Reducing product and service costs
- Systems to facilitate improvement
- Line Management ownership
- Employee involvement and empowerment
- Recognition and celebration
- Challenging quantified goals and benchmarking
- Focus on processes / improvement plans
- Specific incorporation in strategic planning

This shows that TQM must be practiced in all activities, by all personnel, in Manufacturing, Marketing, Engineering, R&D, Sales, Purchasing, HR, etc.

IMPLEMENTATION PRINCIPLES AND PROCESSES

A preliminary step in TQM implementation is to assess the organization's current reality. Relevant preconditions have to do with the organization's history, its current needs, precipitating events leading to TQM, and the existing employee quality of working life. If the current reality does not include important preconditions, TQM implementation should be delayed until the organization is in a state in which TQM is likely to succeed.

If an organization has a track record of effective responsiveness to the environment, and if it has been able to successfully change the way it operates when needed, TQM will be easier to implement. If an organization has been historically reactive and has no skill at improving its operating systems, there will be both employee skepticism and a lack of skilled change agents. If this condition prevails, a comprehensive program of management and leadership development may be instituted. A management audit is a good assessment tool to identify current levels of organizational functioning and areas in need of change. An organization should be basically healthy before beginning TQM. If it has significant problems such as a very unstable funding base, weak administrative systems, lack of managerial skill, or poor employee morale, TQM would not be appropriate.

However, a certain level of stress is probably desirable to initiate TQM. People need to feel a need for a change. Kanter (1983) addresses this phenomenon be describing building blocks

which are present in effective organizational change. These forces include departures from tradition, a crisis or galvanizing event, strategic decisions, individual "prime movers," and action vehicles. Departures from tradition are activities, usually at lower levels of the organization, which occur when entrepreneurs move outside the normal ways of operating to solve a problem. A crisis, if it is not too disabling, can also help create a sense of urgency which can mobilize people to act. In the case of TQM, this may be a funding cut or threat, or demands from consumers or other stakeholders for improved quality of service. After a crisis, a leader may intervene strategically by articulating a new vision of the future to help the organization deal with it. A plan to implement TQM may be such a strategic decision. Such a leader may then become a prime mover, who takes charge in championing the new idea and showing others how it will help them get where they want to go. Finally, action vehicles are needed and mechanisms or structures to enable the change to occur and become institutionalized.

METHODOLOGY USED IN THE STUDY

There were four main steps in the methodology used in our research study:

1. Choosing the appropriate performance measures.
2. Gathering a sample of firms that have effectively implemented TQM.
3. Choosing a time period (when and over what time) for measuring performance.
4. Selecting appropriate benchmarks for comparing the performance of sample firms.

Choice of Performance Measures

To establish the value of TQM, it is important to link it to financial measures. The primary focus of our study was to examine the stock price performance of firms that have effectively implemented TQM. The reason is that stock price performance is widely reported and tracked, and easily understood. Stock price performance is of great interest to many stakeholders including senior management, employees, suppliers, mutual fund managers, institutional and other individual investors. Many believe that goal of a firm should be to maximize its share value. Clearly, it makes sense to use stock price performance as the primary performance measure for this study.

In the long-run stock prices are driven by profits (or net cash flows). Our study examined profit performance by estimating the changes in operating income, defined as net sales less cost of goods sold and selling and administrative expenses. This measures the profits generated from operations before interest and taxes. Operating income is influenced by changes in the growth rate and efficiency. Our study measured growth by estimating the percent change in sales, total assets, and employees. We measured improvement in efficiency by estimating the percent change in return on sales and return on assets. Return on sales is the ratio of operating income to sales and measures the profit per dollar of sales. Return on assets is the ratio of operating income to assets and measures the profit per dollar of assets.

Gathering a sample of firms that have effectively implemented TQM.

Any attempt to establish the link between TQM and financial performance must focus on firms that have implemented TQM effectively. This is important because while most firms

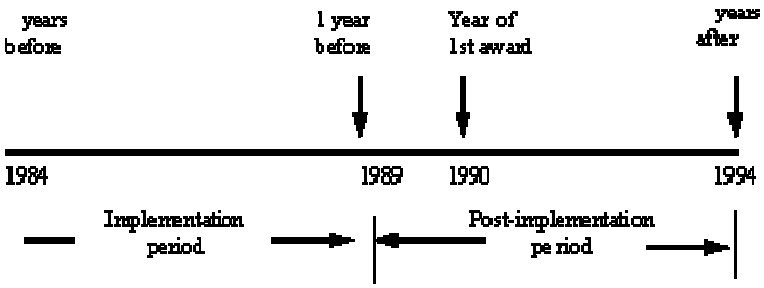
will claim that they have implemented TQM, few are doing it effectively. Including non-effective implementers will obscure the impact of TQM. Effectively implementation means that the key principles of TQM such as focus on customer satisfaction, employee involvement, and continuous improvement are well accepted, practiced, and deployed within the firm.

We used the winning of quality awards as a proxy for effective implementation of TQM. A review of various quality award criteria confirmed that the core concepts and values emphasized are those that are widely considered to be the building blocks of effective TQM implementations. Awards are given after the applicant goes through a multi-level evaluation process where internal or external experts judge the applicant. A stringent process seems to be in place to ensure that winners are effectively implementing and practicing TQM.

Choosing a time period for examining the performance.

Choosing when to begin measuring the performance and over what time period should the performance be measured are critical issues in linking TQM to financial performance. Ideally, one should begin to measure performance from the point in time when the firm first started implementing TQM. The measurement period should also include the time after the firm has effectively implemented its TQM program. Furthermore, as many experts have emphasized, TQM takes a long time to be fully absorbed and integrated in the normal operating mode of doing things at a firm. Hence, any attempt to establish the relationship between TQM and financial performance must examine performance over a long-time period. We examined performance over two five-year periods. The first period -the postimplementation period- starts one year before and ends four years after the date the winners won their first quality award. Clearly, winners have a reasonably effective TQM implementation by the time they win their first quality award. Since, it takes award givers about 6 to 9 months to evaluate and certify the effectiveness of the implementation, we assumed that the winner's TQM implementation was effective about a year before the date of winning the first award. Examining performance from this point provides an estimate of the financial impact of TQM implementations once they are effective.
The second period -the implementation period- starts six years before and ends one year before the date the winners won their first quality award. It is during this time periods that winners are implementing TQM and incurring the associated implementation costs. To provide a balanced perspective on the net benefits of TQM, it is important to estimate the magnitude of these costs.

Figure 1 depicts the determination of the two periods for a winner that won its first award in 1990. In this case the implementation period would cover the years from 1984 to 1989, and the post-implementation period would cover the years from 1989 to 1994. Similarly, for a winner that won its first award in 1988, the implementation and post-implementation periods would covers the years from 1982 to 1987 and 1987 to 1992, respectively. It is important to emphasize that the performance of all quality award winners is not examined over the same calendar time period. The time period is unique to each award winner and depends on when each won its first quality award.



1: Determining the implementation and the post -implementation periods for a firm that won its first quality award

RESULTS

Results for the implementation period

No significant differences in performance are observed during the implementation period. Basically, there was no difference in the performance of the winners and the benchmarks. This is good news since one would have expected worsening performance during this period because of the direct and indirect costs in implementing TQM. It is plausible that during the implementation period winners find easy improvement opportunities. Capitalizing on these opportunities pays for the implementation costs. On the other hand, the results could also suggest that the implementation costs may not be as high as widely believed.

Stock price performance of award winners during the post-implementation period

Results for the post-implementation period indicate that quality award winners outperformed the benchmarks on almost every performance measure. Figure 2 compares the stock price performance of award winners against the various benchmark portfolios using the following process. For each award winner, a hypothetical $100 is invested in the winner's stock one year prior to the date of winning their first quality award. At the same time an equal amount is also invested in a benchmark portfolio. Both investments strategies are tracked for the next five year. At the end of five years the average stock price return from holding the stocks of the award winners is compared against the average returns from investing in the benchmark portfolio.

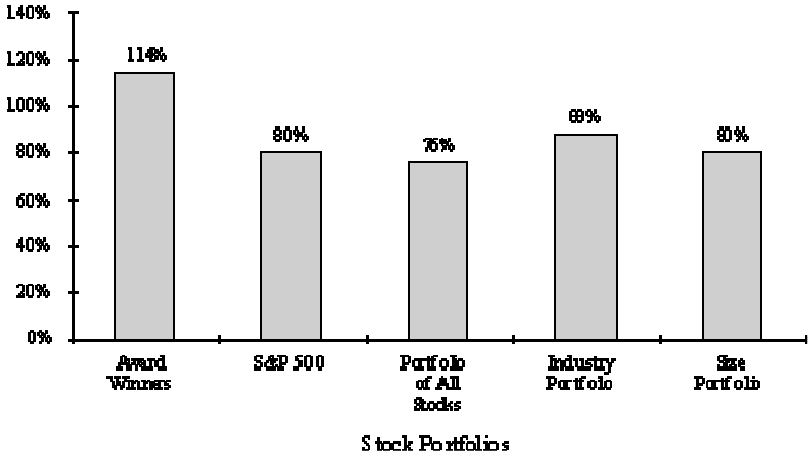


Figure 2: Comparison of the stock price performance of award winners and various benchmark portfolios. The results depict the changes in performance over the five-year post-implementation period that starts one year prior and ends four years after the date of winners winning their first quality award.

The results indicate that award winners significantly outperformed the benchmark portfolios. The stock prices of award winners increased by an average of 114% over the fiveyear period. Over this same time period an alternative strategy of investing a similar amount in S&P 500 Index and holding it over the same time period would have resulted in a 80% return. The difference of 34% is a statistically and economically significant level of outperformance - it translates to an average market value creation of an extra $669 million. The chances of observing the difference of 34% purely by luck is about 1 out of 150.
Figure 2 also show that award winners outperformed a benchmark consisting of all stocks traded on the New York, American, and NASDAQ stock exchanges. This portfolio experienced a 76% gain as compared to the 114% gain from investing in award winners. Award winners also beat a benchmark consisting of firms in the same industry by 26% and a benchmark consisting of firms of similar size by 34%.

A more detailed analysis of the pattern of stock price outperformance reveals some additional and interesting insights. Figure 3 compares the stock price performance of the award winners against the S&P 500 Index on an annual basis for each of the five years in the postimplementation period. The award winners beat the S&P 500 Index in four out of the five years, with most of outperformance occurring from the third year onwards. Award winners beat the S&P 500 in the third year by 5%, fourth year by 7%, and in the fifth year by 12%.

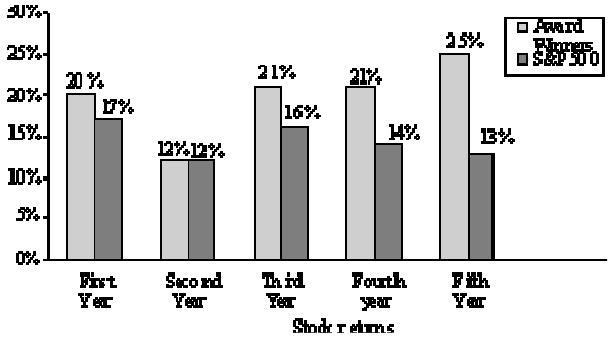


Figure 3: Comparison of the stock price performance of award winners and the S&P 500 on an annual basis. The results depict the annual changes in performance over the five-year post-implementation period that starts one year prior and ends four years after the date of winners winning their first quality award.

Since award winners are likely to have an effective TQM implementation a year before they win their first quality award, the pattern of annual stock price performance of Figure 3 suggests that it might take a couple of years after effective implementation before the benefits of TQM begin to show up in the form of higher stock returns. Organizations should view TQM as a long-term investment and must allow time for its benefits to show up in financial performance.

To summarize, the overall evidence indicates that firms that have an effective TQM program do better in terms of stock price performance when compared to appropriate benchmarks.

Profit, growth, and efficiency performance of award winners during the postimplementation period

Figure 4 depicts the performance of award winners and benchmark firms on accounting based performance measures. The differences are striking. Operating income for award winners increased by an average of 91% over the post-implementation period. This is in contrast to an average 43% increase over the same time period for the benchmark firms. The difference of 48% is a statistically and economically significant level of outperformance. The chances of observing this difference in operating profit purely by luck is about 1 out of 200.

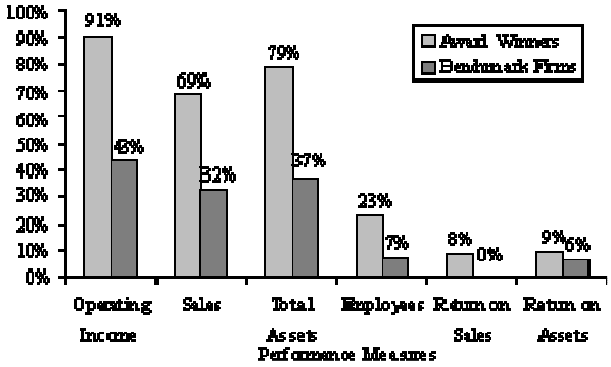


Figure 4: Comparison of the average percent change in performance of award winners and benchmark firms for the postimplementation period. The results depict the changes in performance over the five-year post-implementation period that starts one year prior and ends four years after the date of winners winning their first quality award.

Award winners also experienced higher growth as compared to the benchmark firms. Winners increased sales by 69% sales (compared to 32% for the benchmarks), increased total assets by 79% (compared to 37% for the benchmarks), and increased the number of employees by 23% (compared to 7% for the benchmarks). Winners also showed higher improvement in efficiency measures. The return on sales improved by 8% compared to no improvement for the benchmarks, and the return on assets improved by 9% compared to 6% for the benchmarks. These results clearly indicate that TQM does improve profitability, leads to higher growth, and improves efficiency. Furthermore, they provide additional validity to the winners' stock price performance shown in Figure 2. The improvement in profitability is the reason for the rise in stock prices of the award winners.

How the benefits of TQM vary by firm characteristics?

Many firms are also interested to learn how the gains from TQM vary by firm characteristics so that they can set realistic expectations of what to expect from successful implementations of TQM. To provide insights into this issues, we segmented the sample of award winners by type of quality award won, capital intensity of the firm, size of the firm, and the extent of diversification. Results are examined separately for the various segments. Some interesting insights are obtained about how the extent of benefits from TQM vary by firm characteristics.

Independent versus customer award winners

There are some very dramatic differences among firms that won independent awards such as the national and state quality awards, and those winning customer awards such as those given by Chrysler, Ford, and Texas Instruments, among others. The national and state awards have more comprehensive and stringent evaluation criteria, and use a multi-stage evaluation process conducted by independent third-party examiners. Thus, winning independent awards could indicate more mature TQM implementations when compared to the maturity of implementations at firms that have only won awards from their customers.
Consistent with this conjecture independent award winners significantly outperformed customer award winners (see Figure 5). For example, in terms of improvement in operating

income independent award winners outperformed their benchmarks by an average of 73% whereas customer award winners outperformed their benchmarks by 33%. Independent award winners do better than customer award winners on sales (39% vs. 23% increase), on return on sales (19% vs. 9% increase), and return of assets (10% vs. 6% increase). Independent award winners also do better on stock price performance. They outperformed the S&P 500 by 51% compared to the 26% outperformance of S&P 500 by customer award winners.

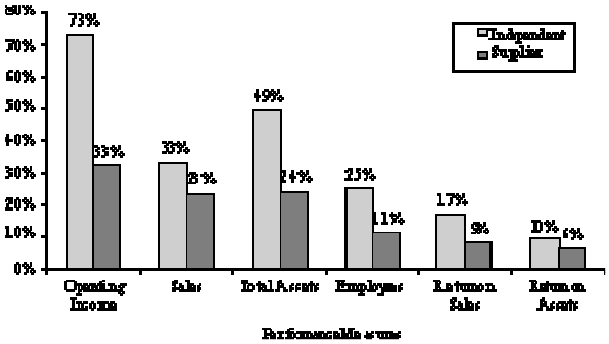


Figure 5: Comparison of the average percent change in performance of independent award winners and supplier award winners. All performance numbers are the average of the differences between the performance of the winners and their respective benchmarks. The results depict the changes in performance over the five-year post-implementation period that starts one year prior and ends four years after the date of winners winning their first quality award.

Although independent award winners do better than customer award winners, it is important to emphasize that winning customer awards also pays off since these winners do better than their corresponding benchmarks on all performance measures. Note that Figure 5 gives the performance numbers after adjusting for the performance of the benchmarks. However, in the long run a firm should benchmark their TQM implementations against the criteria and evaluation process used by independent award winners.

Low capital-intensive versus high capital-intensive award winners

An important component of TQM is adopting practices such as employee training, involvement and empowerment, and information sharing. Employees are the driving force for improvements originating from activities such as suggestion programs, quality circles, crossfunctional teams, and process improvement teams. Clearly, the opportunities for gains from these activities are likely to be higher in a less capital-intensive environment than in a more capital-intensive environment.

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Figure 6 shows that low capital-intensive award winners do better than high capitalintensive award winners on all performance variables except growth in employees. For example, in terms of improvement in operating income low capital-intensive winners outperformed their benchmarks by an average of 65% and high capital-intensive winners outperformed their benchmarks by 21%. Low capital-intensive award winners do better than high capital intensive winners on sales (33% vs. 25% increase), on return on sales (17% vs. 7% increase), and return of assets (10% vs. 4% increase). Also note that Figure 6 indicates that both low and high capitalintensive winners gain from effective TQM implementations as both these segments outperform their respective benchmarks.

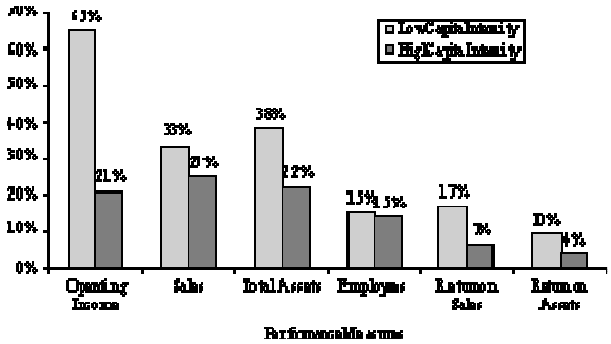

Figure 6: Comparison of the average percent change in performance of lower capital and higher capital intensity award winners. All performance numbers are the average of the differences between the performance of the winners and their respective benchmarks. The results depict the changes in performance over the five-year post-implementation period that starts one year prior and ends four years after the date of winners winning their first quality award.

Focused versus diversified award winners

Focused firms are likely to benefit more from TQM than diversified firms because the different operating units in a more focused firm are likely to be very similar in terms of organizational culture, technology, operating procedures, and competitive priorities. Therefore, the lessons learned from a successful TQM implementation in one operating unit can easily be implemented in other operating units. As operating units gain experience with TQM, the knowledge created in the process can be transferred at low cost to other units. Such economies of scale and learning synergies may not be present to the same extent in more diversified firms.

Figure 7 supports the conjecture regarding how the benefits of TQM will differ for focused and diversified firms. Focused award winners do better than diversified award winners on all performance variables except efficiency measures such as return on sales and return on assets. Focused winners experienced a 56% improvement in operating income (compared to 30% for diversified winners), a 39% increase in sales (compared to 20% for diversified winners), and a 7% improvement in return on sales (compared to 17% for diversified winners). Figure 8 also shows that both the focused and diversified award winners gain from effective TQM implementations as both these segments outperform their respective benchmarks.

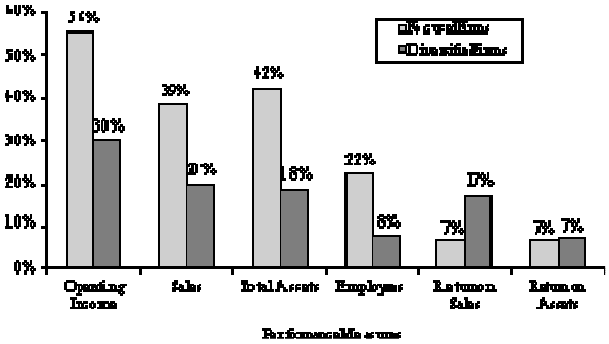

Figure 7: Comparison of the average percent change in performance of focused and diversified award winners. All performance numbers are the average of the differences between the performance of the winners and their respective benchmarks. The results depict the changes in performance over the five-year post-implementation period, which starts one year prior and ends four years after the date the winners won their first quality award.

IS TQM VALUABLE?

In contrast to the anecdotal and perceptual evidence that have been used by many experts to pass judgment on whether TQM is valuable or not, the evidence presented in this paper provides a more factual, objective, and statistically valid assessment on the impact of TQM on financial performance. The message from the analysis of the financial performance of 600 quality award winners is clear and simple. When TQM is implemented effectively, financial performance improves dramatically. The criticism that TQM has produced lackluster economic gains is unwarranted. The proclamation that TQM is dead is premature. TQM is well and alive.

Our results should be reassuring to those firms that have made heavy investments in TQM and had to defend themselves against both internal and external critics of TQM. For those firms that were considering disbanding their TQM for some other management paradigms, these results should cause them to rethink their decision. It should also provide encouragement to those firms that have contemplated about adopting TQM but have been discouraged by the controversy about its potential payoff. One would hope that managers responsible for implementing TQM would use these results to debate, and perhaps put to rest, many questions that others might have about the legitimacy of TQM as a viable and effective management system.

Our results also support what many quality gurus have said repeatedly. Firms that want to implement TQM effectively must have patience. It is widely accepted that TQM takes a long time to implement as it requires major organizational changes in culture and employee mindset. Hence, the benefits will be realized in the long-run. The evidence reveals that even after effective implementation, it still takes a couple of years before financial performance starts to improve. This is in contrast to the expectations of many firms who sent employees for education and training on TQM methods and implemented a few other things, and then expected to see instant results. Managers that embrace TQM for quick gains will be surely disappointed. To get the benefits from TQM, one must be patient. It improves performance in the long-haul.

Firms should be realistic about what to expect from TQM. They should not be carried away by the hype associated with TQM. Keep in mind that TQM is a philosophy or foundation to develop a management system. A management system based on TQM can only improve the probability of making the right decisions. It cannot guarantee that all decisions will be right. For example, even the best performing Baldrige award winners have had periods of poor financial performance after winning the Baldrige award. Furthermore, as we have shown, organizational characteristics such as size, capital intensity, extent of diversification, and the maturity of implementations, all influence the gains from TQM. These and other factors should be considered in setting expectations. Finally, the gains from TQM are likely to be tempered by the behavior of competitors. As more and more firms in a particular market segment adopt TQM, the extent of gains from TQM will diminish.

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AN EMPIRICAL STUDY OF INFORMATION TECHNOLOGY GOVERNANCE AMONG ELECTRONICS MANUFACTURING SECTOR IN MALAYSIA

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ABSTRACT

Based upon the framework developed by Weill and Ross (2004), this study attempts to investigate the applicability of information technology (IT) governance and its relationship with IT governance performance in the electronics manufacturing sector in Malaysia. Thirty-three companies participated in this study. The findings indicate that having the right decision maker/owner on IT governance issues is important because they can lead to better IT governance performance. Specifically, it implies that business and IT executives should work together on IT principles and business application needs; with business executives providing greater focus on making decisions on IT investments while the IT executives concentrate on IT architecture and IT infrastructure. The results also suggest that awareness of IT governance framework does not guarantee high IT governance performance. Implications and conclusions of the findings are further elaborated in the paper.

Keywords: Information technology governance, performance, electronics manufacturing sector, Malaysia

INTRODUCTION

The electronics manufacturing industry is recognised as the leading industrial sector in terms of investment, industrial output and employment in Malaysia. As a major export earner for the country, electrical and electronics products accounted for 38.7% of total exports during the period of January to September 2008. It was reported that factors contributing to the industry growth included in increase in the usage of information technology (IT) (Mahadvan, 2006). However, sales value of the sector was down by 24.3% or RM109.2 billion to register RM340.9 billion during the period of January to September 2009 due to softening of demand from US, Europe, and Japan (Department of Statistics Malaysia, 2010). Despite the recent economic downturn, Malaysia still remains a profit centre for many global manufacturers, offering many opportunities in the consumer electronics, and electronic manufacturing services. This is due to the initiatives undertaken by the government to continuously engage in improving the business environment by allowing new investment in electronics industry and also encouraging existing companies to boost their operations. One of the important steps

taken by the government included reducing corporate tax from 27% in 2007 to 26% in 2008, and another one percent of reduction or 25% in 2009.

Due to the important contributions made by the electronics manufacturing sector to the Malaysian economy and the industry's increasing use of IT, this study aims to investigate IT governance and its relationship to IT governance performance among the companies in this industry which is relatively under much discussion. Specifically, it purports to answer the following research questions, which are collectively known as IT governance:

1. Who should make these IT decisions?
2. What IT decisions should be made?
3. How will these decisions be made and monitored?

The following section delineates the theoretical background of IT governance and IT governance performance, in which primary reference was made on Weill and Ross' (2004) work. A research framework is presented and relevant hypotheses are constructed. This is followed by research methodology, data analysis, and discussion before the paper is concluded.

LITERATURE REVIEW

Van Grembergen (2002) defines information technology (IT) governance as the unified role played by the Board, executive management and IT management to achieve alignment of business and IT strategies through control over formulation and implementation of IT strategies. This definition suggests that it is imperative for people at different levels of a company to work together on IT governance to ensure its implementation success. On the other hand, the IT Governance Institute (2003) defines IT governance as the responsibility of the board of directors and executive management. Being an integral part of enterprise governance, IT governance is thought to consist of leadership and organisational structure and processes that ensure an organisation's IT sustains and extends its strategies and objectives.

Weill and Ross (2004) define IT governance as specifying the decision rights and accountability framework to encourage desirable behaviour in the use of IT. As shown in Table 1, their study involves classifying IT decisions into five key areas in terms of IT decision model and their functions.

Weill and Ross (2004) outlined three key considerations in IT governance: (1) what decisions should be made; (2) who should make these decisions; and (3) how will these decisions be made and monitored. The questions of "what" and "who" lead to the ownership of decision making, while the question of "how" refers to formal IT governance mechanisms.

Table 1.0: IT Decision Areas and Functions

IT Decision Areas	Functions
IT Principles	IT principles are the high-level statements about how IT is used in the business (Weill & Ross, 2004) or referred to as maxims by Broadbent and Kitzis (2004). According to Kayworth and Sambamurthy (2000), organisations are often confronted with two contradictory dilemmas. On one hand, IT is expected to be responsive locally within individual business units. On the other, IT is responsible as a business enabler to exploit synergies between business units to achieve enterprise-wide integration. Hence, a set of IT principles is needed to clarify the priorities consistent with the organisation's goals.
IT Architecture	IT architecture addresses both business processes and technological aspects of IT solution implementation. Effective information architecture is the answer to the dual challenge of "speed and flexibility" and "low cost and efficiency (Allen and Boynton, 1991). A proper IT architecture in a company can ensure consistent IT execution. The benefits of IT architecture standardisation would result in IT predictability and efficiency.
IT Infrastructure	IT infrastructure is the foundation of planned IT capabilities available throughout the business as shared and reliable services and used by multiple applications (Weill, Subramani and Broadbent, 2002). The study by Weill et al. (2002) demonstrate significant correlation between strategic agility and IT infrastructure capability. Managers use IT principles to identify IT infrastructure services that enable the organisation to achieve competitive advantage.
Business Application Needs	The business value of IT is delivered through fulfilment of specific business needs. However, identification of business needs for IT applications often has two conflicting objectives. Users may want IT to be creative while at the same time IT needs to remain disciplined (Weill and Ross, 2004). Hence, both business and IT need to have a common agreement. For example, if new IT functionality causes deviation to architectural principles, the new IT functionality might need to be sacrificed.
IT Investment and Prioritisation	IT investment and prioritisation refers to the amount to be spent on IT, identifies the IT projects to be initiated, and reconciles the conflicting needs of individual business units. There is no specific framework to determine IT expenditures. However, Ross and Beath (2002) and Irani and Love (2002) propose alternative approaches to justify IT investments and expenditures.

According to Weill and Ross (2004), there are different groups of people in a company who can make IT decisions. Based on five IT decision areas, different groups of people are needed to make appropriate decisions based on the following categories:

- Business Monarchy: A group of business executives or individual executives (CxOs). This includes committees of senior business executives which may include the Chief Information Officer (CIO) but excludes the IT executives who act independently.
- IT Monarchy: Individuals or groups of IT executives.
- Feudal: Business unit leaders, key process owners or their delegates.
- Federal: C-level executives and business groups (e.g. business units or processes) which may also include IT executives as additional participants. This is equivalent with the central and state governments working together.
- IT Duopoly: IT executives and one other group (e.g., CxO or business unit or process leaders).
- Anarchy: Each individual user.

In terms of the formal IT governance mechanisms, Weill and Ross (2004) identified three aspects of making and monitoring IT decisions: (1) coordinating the decision-making process; (2) monitoring to ensure decisions are executed as agreed upon; and (3) communicating constantly with stakeholders. The commonly found mechanisms include steering committee with membership from IT or mixture of both business and IT, account management teams, and programme and project office. Once decisions are made, monitoring and periodic reviews are necessary to ensure that execution is on the right path. The mechanisms for monitoring execution include standard operation management processes, service level agreements (SLA), organisation-wide project management methodology and key performance indicators or balanced scorecard (Van Grembergen and De Haes, 2005; Van Grembergen and Van Bruggen, 1997). Communication in this case includes formal announcements, information channels and education efforts that propagate IT governance principles, policies and as reflected in the outcome of IT decision-making processes (Weill and Ross, 2004).

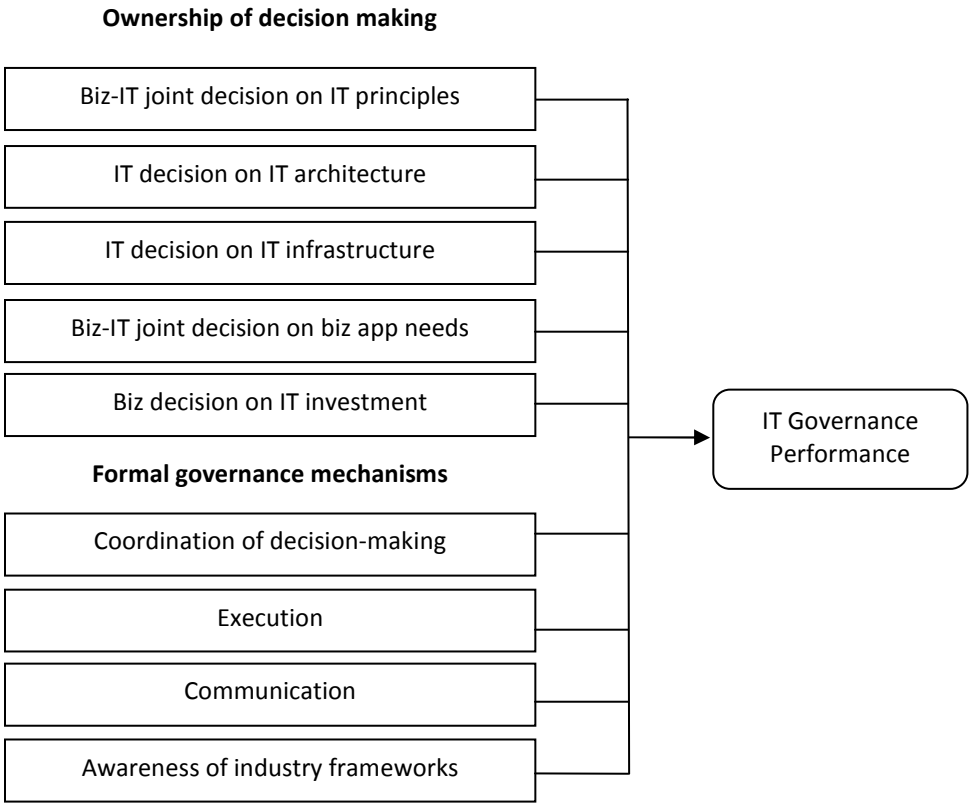
Organisations can have very different expected outcomes for implementing IT governance. The objectives could be one or more of the following: (1) cost-effective use of IT; (2) effective use of IT for growth; (3) effective use of IT for asset utilisation; and (4) effective use of IT for business flexibility (Weill and Ross, 2004). Weill and Ross (2004) concluded that strong IT governance leads to more successful business outcomes.

RESEARCH METHOLODGY

Research Framework

Figure 1 shows the research framework for this study as adopted from Weill and Ross' (2004) study. Such a proper framework is deemed to be important because it can guide the behaviour of users in a company to utilise IT. There are two main constructs that constitute the independent variables. "Ownership of decision making" represents the type of IT decision owners on five key IT decision areas, while "formal governance mechanisms" represents the ways IT governance is executed. Consistent with the literature, the IT governance performance has been identified as the dependent variable.

Figure 1: Research Framework



Hypotheses Development

Ownership of Decision Making and IT Governance Performance

Davenport, Hammer and Metsisto (1989) observe that keeping with the corporate strategy means technology decisions must be guided by agreed principles. However, periodic review on IT principles is required, not only for alignment with changing corporate strategy, but also to harness new possibilities arising from technological development. Therefore, it is imperative that both business and IT are jointly involved in the formulation and review of IT principles, both from perspective of corporate strategy and technology development. The following hypothesis thus ensues:

H1a: Joint decision-making by business on IT for IT principles is correlated with high governance performance.

According to Weill and Ross (2004), business process integration and standardisation are key responsibilities of the process owner from the business side. A pre-requisite for integration and standardisation is the formulation of IT architectural decisions. These provide the foundation for IT capabilities of the organisation. Although IT architecture and infrastructure are based upon requirements articulated as part of IT principles, these are technical decisions within the domain of IT specialists. Therefore, effective decision-making is best left to IT

specialists guided by objective criteria, independent of input from non-specialists. These lead to the following hypotheses:

H1b: Sole decision-making by IT on IT architecture is correlated with high governance performance.

H1c: Sole decision-making by IT on IT infrastructure is correlated with high governance performance.

To decide on the business application needs, creativity in delivering customer value through IT and disciplined execution consistent with architectural principles are two key considerations. As such, both business and IT have to agree on the trade-off between fulfilment of business needs and compliance with architectural principles. It is therefore posited that:

H1d: Joint decision-making by business and IT on business application needs is correlated with high governance performance.

The IT investment justification model proposed by Ross and Beath (2002) categorises investments as one of transformation, renewal, process improvement or experiments. Except for renewal, the other three categories of IT investment are usually driven directly by business needs, including the need to support a new business model, improve operational performance and enable new technologies or ideas. The IT organisation's annual budget allocation is usually used to fund renewal activities. Since such allocations are decided by business, considering financial standing of the organisation and input from IT with regards to mandatory renewal activities, it makes sense to anticipate that:

H1e: Sole decision-making by business on IT investment is correlated with high governance performance.

Formal Governance Mechanisms and IT Governance Performance

Weill and Ross (2004) identified three important aspects of making, monitoring, and communicating IT decisions. Accordingly, these formal governance mechanisms are important as they lead to good IT governance performance as evident from the results of the study. As such, it is expected that:

H2a: Organisations with formal governance coordination of decision-making mechanisms have high governance performance.

H2b: Organisations with formal governance execution monitoring mechanisms have high governance performance.

H2c: Organisations with formal governance communication mechanisms have high governance performance.

Awareness of industry frameworks related to IT governance, such as Control Objectives for Information and Related Technology (OBIT) (IT Governance Institute, 2007), IT Infrastructure Library (ITIL) (UK Office of Government Commerce, 2007), and the Capability Maturity Model Integration (CMMI) (Carnegie Melon Software Engineering Institute, 2005), is expected to lead to widespread activities to improve IT governance. Availability of these industry-wide frameworks means organisations starting out on this journey do not need to reinvent the wheel and reduce implementation risks, thereby increasing chances of success. The following proposition thus ensues:

H2d: Awareness of industry frameworks related to IT governance is positively correlated with governance performance level.

Research Design

This research is carried out using a set of questionnaire which comprises of 5 sections:

- Section A: Organisational context
- Section B: IT decision-making
- Section C: Coordination, monitoring and communication mechanisms
- Section D: IT governance framework
- Section E: IT performance governance

Section A uses dichotomous and interval-scale items. The most commonly studied organisational context variables and their results are shown in Table 2.

Table 2: Organisational Context

Variables	Prior Findings
Organisation Size	Olson and Chervany (1980) found no differences by organisation size. Interestingly, Ein-Dor and Segev (1982) discovered inverse relationship between organisation size and degree of centralisation (however this study was limited to one city in the United States).
Governance Form	Ein-Dor and Segev (1982) found positive relationship between organisation structure and IT governance. Such finding was also found to be true for organisations in Israel where the only significant determinant in distributing computing resources was the decision-making process of the organisation (Ahituv et al., 1989).
Competitive and Business Strategy	Tavakolian (1989) studied competitive strategy (defender, prospector, and analyser) as the organisational variable relating to IT governance. The study found that companies with defender strategy have more decentralised structure of IT governance compared with prospector strategy. This was extended by Henderson and Venkatraman (1993) on the range of competitive strategy to what was termed as "fundamental domains of strategic choice". The four strategic choices identified in the study were business strategy, information technology strategy, organisational infrastructure and processes, IT infrastructure and processes.
Diversity in Business	Business synergy is found not to be a dominant contingency for IT governance mode or IT synergies of multi-business firms (Sambamurthy & Zmud, 1999). However, Tanriverdi (2006) argued that IT resources can create an IT-based coordination mechanism in a multi-business firm and enhance boundary-spanning organisational capabilities that exploit cross-unit business synergies.
Industry	Of all the organisational context variables discussed, industry is the only one with common agreement by authors of past studies. Olson and Chervany (1980), Ahituv, Neumann and Zviran (1989) and Clark (1992) found no relationship between industry and IT governance. Furthermore, Brown and Magill (1994), in their study of antecedents (predictors) for movement from one to another form of governance, found that industry type is not a strong predictor.

For sections B and C, 5-point Likert scale is used (1=Never, 2=Rarely, 3=Sometimes, 4=Often and 5=Always). The 4-point Likert scale is used for section D (1=Currently Used, 2=Intend to Use, 3=No Intention to Use, and 4=Never Heard of), while Section E uses 5-point Likert scale (1=Totally Not Important, 2=Not Important, 3=Quite Important, 4=Important). The questions are adapted from Weill and Ross' (2004) study. Respondents are also provided the opportunity to provide response in free text where an open-ended question to gauge the respondents' opinions on the meaning and objectives of IT governance is included in the questionnaire. The questionnaire was piloted prior to dissemination where a number of minor amendments were made. As such, face and content validity were achieved.

Sampling

The list of organisations was obtained from the Federation of Malaysian Manufacturers (FMM). The FMM represents more than 2,200 manufacturing and industrial service companies of various sizes in Malaysia (Federation of Malaysian Manufacturers, 2010). The organisations participated in this research are involved in the manufacturing of one or more of the following products: diode, electronic, integrated circuit, memory product, resistor, semiconductor, sipmos, transistor, and wafer. About 84 companies are identified and contacted. Out of the 84 surveys distributed, only 33 usable survey responses were collected, yielding a response rate of 39.3%.

Reliability Analysis

Table 3 indicates the Cronbach's Alpha values for all the variables scored using Likert-scale. The scores indicate that the questionnaire is reliable (Nunnally, 1978) and thus the data can be applied for further analysis.

Table 3: Inter-item Consistency

Item	Cronbach's Alpha
IT principles	0.662
IT architecture	0.694
IT infrastructure	0.722
Business application needs	0.722
IT investment and prioritisation	0.702

Descriptive Statistics

The descriptive statistics are shown in Tables 4 and 5. The mean and standard deviation scores for all the items under "ownership of decision-making" and "formal governance mechanisms" are illustrated respectively. IT governance performance is measured by how important the IT governance outcomes are to the electronics manufacturing companies. The mean score for this item is 3.42 with a standard deviation of 0.44.

Table 4: Descriptive Statistics for Ownership Of Decision-Making

Variable	Mean	Std. Dev.
Extent of joint business-IT involvement in decision-making on IT principles	3.36	0.30
Extent of independence of IT in decision-making on IT architecture	2.99	0.33
Extent of independence of IT in decision-making on IT infrastructure	3.09	0.27
Extent of joint business-IT involvement in decision-making on business application needs	3.40	0.38
Extent of independence of business in decision-making on IT investment and prioritisation	3.19	0.38

Table 5: Descriptive Statistics for Formal Governance Mechanisms

Variable	Mean	Std. Dev.
Extent of usage of formal governance coordination of decision-making mechanisms	3.47	0.58
Extent of usage of formal governance execution mechanisms	3.62	0.63
Extent of usage of formal governance communication mechanisms	4.12	0.44
Extent of awareness of industry frameworks related to IT governance	2.09	0.60

RESULTS

Correlation between Ownership of Decision-making and Governance Performance

Table 6 shows that significant correlation exists between items of "ownership of decision-making" and governance performance (p-value < 0.05):

- Extent of joint business-IT involvement in decision-making on IT principles
- Extent of independence of IT in decision-making on IT infrastructure
- Extent of joint business-IT involvement in decision-making on business application needs
- Extent of independence of business in decision-making on IT investment and prioritisation

The extent of independence of IT in decision-making on IT architecture showed significant correlation with IT governance performance (p-value of less than 0.05).

Table 6: Pearson Correlation Coefficient Results between Ownership of Decision Making and IT Governance Performance

Variables	1	2	3	4	5	6
1. Joint decision-making by business on IT for IT principles						
2. Sole decision-making by IT on IT architecture	-.047					
3. Sole decision-making by IT on IT infrastructure	.243	.876**				
4. Joint decision-making by business and IT on business application needs	.663**	.105	.210			
5. Sole decision-making by business on IT investment	-.075	.282	.238	-.139		
6. IT governance performance	.483**	.348*	.505**	.509**	.494**	

*: significant at 0.05
**: significant at 0.01

Based on Table 6, the following hypotheses pertaining to ownership of decision making and governance performance are accepted:

H1a: Joint decision-making by business on IT for IT principles is correlated with high governance performance.
H1b: Sole decision-making by IT on IT architecture is correlated with high governance performance.
H1c: Sole decision-making by IT on IT infrastructure is correlated with high governance performance.
H1d: Joint decision-making by business and IT on business application needs is correlated with high governance performance.
H1e: Sole decision-making by business on IT investment is correlated with high governance performance.

Correlation between Formal Governance Mechanisms and Governance Performance

Formal governance mechanisms for communicating IT issues also show high significant correlations with IT governance performance (p-value < 0.05), while formal governance mechanisms for coordinating IT decision-making activities and monitoring execution of IT decisions show significant correlation with IT governance performance (p-value of less than 0.05). Details of the inferential statistics are shown in Table 7.

Table 7: Pearson Correlation Coefficient Results between Formal Governance Mechanisms and IT Governance Performance

Variables	1	2	3	4	5
1. Organisations with formal governance coordination of decision-making mechanisms					
2. Organisations with formal governance execution monitoring mechanisms	.813**				
3. Organisations with formal governance communication mechanisms	.420*	.166			
4. Awareness of IT governance framework	.267	.162	.185		
5. IT governance performance	.353*	.364*	.467**	-.059	

*: significant at 0.05
**: significant at 0.01

Based on the Correlation results, the following hypotheses pertaining to formal governance mechanisms and governance performance are therefore accepted:
H2a: Organisations with formal governance coordination of decision-making mechanisms have high governance performance.
H2b: Organisations with formal governance execution monitoring mechanisms have high governance performance.
H2c: Organisations with formal governance communication mechanisms have high governance performance.

There is no significant correlation exists between awareness and usage frequency of various industry frameworks with IT governance performance. Therefore, the following hypothesis is rejected:

H2d: Awareness of industry frameworks related to IT governance is positively correlated with governance performance level.

The mean value of IT governance performance is 3.42 with a standard deviation of 0.44. However, this high mean value seems to be contradictory to low response on the level of awareness concerning industry frameworks related to IT governance. These conflicting findings may imply that the understanding of positive IT governance performance is on track, though familiarity with technicalities of the frameworks should be improved.

DISCUSSION AND IMPLICATIONS

The findings show that IT governance performance is related to the type of individuals who make IT decisions. Specifically, it is recommended that in order to obtain high IT governance performance, the question of "what" and "how" on IT decisions should be based on the following decision model:

- Business and IT jointly make decisions on IT principles;
- IT makes decisions on IT architecture, independently from business;
- IT makes decisions on IT infrastructure, independently from business;
- Business and IT jointly make decisions on business application needs; and
- Business makes decisions on IT investment, independently from IT.

Business and IT executives should make decision together pertaining to IT principles. As mentioned earlier, IT principles require periodic review to align with changing corporate strategies and new possibilities arising from technology development. Hence, joint ownership of business and IT in the formulation and review of IT principles ensures a balanced perspective of corporate strategy and technology development.

IT architecture and infrastructure are technical decisions based upon requirements articulated as part of IT principles. IT specialists are in the best position to make effective decisions based on technologies available in the market. It is important that IT specialists do not succumb to specific wants (not needs) of "IT-savvy and power users" of the organisation. Instead, they should make objective judgments in the interest of the organisation.

Fulfilment of specific business needs is the most obvious business value of IT. This explains why this is also an area where business exerts great pressure on IT to deliver value. It is important that IT actively participates in decision-making of business application needs. Creativity and discipline, though conflicting in nature, are important to guide IT when to turn down specific requests for functionality that deviates from architectural principles. What seems to be a short-term loss to the organisation will prove itself as the right decision in the long run. Compliance with architectural guidelines ensures integrity, flexibility, and scalability to meet future business needs.

In almost all organisations, IT remains as a service centre with budget allocated from business. Investment and prioritisation decisions are best made by the business with input from IT. The only exception is technology renewal investments which are funded through periodic budget allocation from business, leaving the individual spending under discretion of IT executives/managers. Having businesses to make investment decisions will avoid potential

problems of IT being caught in the middle when business units/processes dispute over the priority of IT projects.

In deriving the hypotheses relating formal governance mechanisms to high governance performance, it was argued that good IT governance does not happen by chance. Coordination of decision-making process, execution monitoring and communication are the three categories of governance mechanisms.

Whether IT governance mechanism is viewed from a generic perspective, or based on specific COBIT control objectives, findings from this research showed that formal governance mechanisms are necessary to achieve good governance.

Contrary to the expected outcome, awareness of industry frameworks was found not to be related to IT governance performance. The level of awareness of IT governance was also not encouraging. Out of the 33 respondents, 12 (36.4%), 10 (30.3%) and 6 (18.2%) have not heard of COBIT, CMMI and ITIL respectively. COBIT and CMMI are currently used in only 5 (15.2%) organisations, while ITIL trailed closely with 4 (12.1%) organisations. Obviously more initiatives in this aspect are imperative.

On a positive note, when asked to describe what the term "IT governance" means, a significant number of respondents could accurately describe the issues underlying and goals of IT governance. About 3 respondents stated precisely the fundamental concerns of IT governance – IT's delivery of value to the business and mitigation of IT risks. In their own words:

- *"IT governance means to measure, monitor and optimise the business value from investment in IT"*
- *"Management of IT performance and risk"*
- *"Compliance of IT department to rules and regulations set forth to ensure company wide risks and costs are minimised".*

Comments from several other respondents describe one or more objectives of IT governance, in terms of strategic alignment, value delivery, risk management, resource management and performance management. The following are quoted directly from the survey responses:

- *"Centralised controlling for IT cost, headcount, and investment"*
- *"Control of flexibility of expanding"*
- *"Management of IT investment, service delivery, change of projects and etc."*
- *"Ensuring security and meeting requirements or compliance necessary for IT system within the corporation"*
- *"With the IT governance, it can bring the tool and knowledge used to benchmark and measure IT function to meet those needs with confidence and assurance"*
- *"Control and policies of IT and implementation"*

CONCLUSION

This study has addressed all the three research questions in analysing IT governance and its relationship with IT governance performance in a relatively important sector in Malaysia. The best practices of who should make the different types of IT decisions have been

established through this research. It is imperative to note that awareness of IT governance framework alone does not guarantee high IT governance performance. It is only through putting formal mechanisms in place that firms are able to achieve good governance.

There are two major challenges faced throughout the research. Firstly, availability of data was a big hurdle. A number of organisations explicitly declined to participate in the survey, even though anonymity was assured. The number of responses received is sufficient to provide a preliminary view of the as-is situation of IT governance, but this could be challenged statistically.

Secondly, IT governance itself is a relatively new topic in Malaysia. Some respondents reported confusion with usage of certain terms (e.g. corporate executives vs. business unit managers). Such clarity could only be achieved using case study research methodology with interviews and investigation of archival records in multiple organisations.

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DEVELOPMENT OF CONTINUOUS FLOW SYSTEM: CASE STUDY BED LINER MANUFACTURING

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ABSTRACT

A continuous flow system is an approach based on the principle of Just-in-time manufacturing environment. The goal of the continuous flow system is to optimally balance production line with little waste, the lowest possible cost, on-time and defect-free production. Most articles and books focused on how to design and implement this continuous flow system from the scratch without considering possible outcome related to the implementation cost. This article objective is to describe one company journey to turnaround its batch production environment into a "practical" continuous flow system suitable with company's strategy and market. This case manufacturing facility is an automotive accessory manufacturing, especially in bed liner products. This manufacturing facility has problems about high work-in-process and long lead time causing complaints and cancelation from customers. This article demonstrates the use of several fundamental industrial engineering techniques in order to develop the continuous flow system implementation plan and analyze the impact estimation of the continuous flow implementation. The company executives can use the results of this study to prioritize the activities and their relationships to overall productivity improvement for both financial related and operational related measures.

The main techniques used in this study were: 1) Production facility design and layout 2) Discrete event simulation and 3) Design of Experiment . As a result, the new layout provide a shorter the in-process travelling between workstation from 1602 meters to 713 meters (56% improvement). The distance is measured by computer-aided design program (AutoCAD). This shorter traveling distance causes the deduction in the required number of forklifts. In order to find out the operational performance of new layout and to identify the impact of lot size reduction at each workstation, the simulation models are developed to provide the estimation of the key operational performance of the system such as production rate, daily average work-in-process, and flow time of each order. With the assistance from the statistical technique (Design of Experiment), the critical locations of batch size reduction are founded. In addition, the results also provide the impact of each level of batch size reduction. This helps company executives to design what methods, equipments and techniques the company should invest in order to trade-off between investment and benefits received from approach of batch size reduction. This trade-off

analysis allows the company executives to clearly see the impact of the continuous flow system based on its short and medium term.

1. Background

The major problems in the case factory were high volumes of work-in-process and slowly response to customer in particular the bed liner production line. These problems leaded the company to have large storage area and long lead time. The concept of a continuous flow production has intrigued the company executives as a solution to improve production lead time of bed liner manufacturing for daily shipment and support the various customer demands in the future. However, the company management realized that transforming their existing large batching production system into continuous flow system can significantly cost them both cost and time. They would like to precisely know what type of investment, changes in process, and the estimation of performance improvement prior committed company resource into this project. In physical experiment, bed liner production line consists of many large machines. Layout will costly to manually adjust and possibly affect other production lines. Batch size reduction possibly affects operators, material handlings, storage area, and so on. Therefore, simulation modeling is used to avoid these problems and generate critical information to support their decision. In addition, the company has set the target of improvement as follows: 1) Average WIP per month decreases to 1,500 pieces and 2) Production lead time per daily order (200 pieces) decreases to one day.

The bed liner production processes are shown in figure 1.

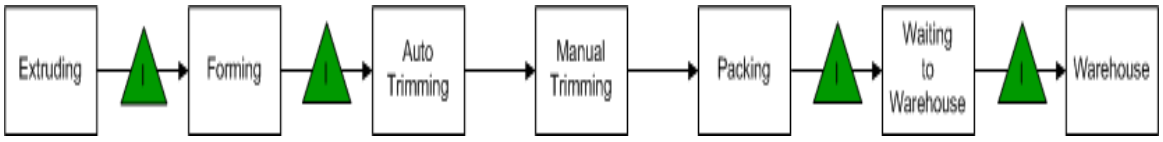


Figure 1 Process flow diagram of bed liner production

The detail of each process show as following:

Extruding Process

Extruding is a process that forms raw materials to plastic sheets. The extruder is a very large machine that produces continuously. In process, the machine will form raw materials to long plastic sheets and then they will move to the cutting point at the end of the machine. Plastic sheets will be cut by specification of each product. After cutting, plastic sheets will be keep in the WIP areas. Machine specifications are as following: 1) Speed: 1.7 meters per second 2) Length: 15 meters. In this study, the extruder will be used to produce many products. The Re-Order Point (ROP) will be used to order the production. For the bed liner product, it has ROP of 500 pieces and production batch size of 2,500 pieces. At present, extruding process define the WIP area for each product. The maximum WIP of the bed liner product is 3,000 pieces. The

batch products will be transfer to the forming process by forklift truck. One batch size is 50 pieces.

Forming Process

Forming is a process that forms sheet to forming product. Forming machine is the Rotary type. In this process, the operator will take in plastic sheet to the machine using jig-fixture. The machine can form one sheet per time. In this study, the forming machine will be only used for bed liner product. Production batch size is 25 pieces. The maximum WIP that can keep are approximately 600 pieces. The products that pass forming process will transfer to the trimming process by forklift truck by batch of 25 pieces.

Trimming & Packing Process

Trimming process is used for cutting the forming product. It separate to two processes. The first one is automatic trimming by robot and the second is manual trimming by operator. Major part of forming product is trimmed by robot. Minor is trimmed by operator. After trimming, the products will be packed. The quantity of packing product is 25 pieces per batch. In this study, this process is sharing operation. It is used for many products (arrival time and quantity of other products will explain in part of "Experimental Designs). Production batch size for this process is 25 pieces. The maximum WIP that can keep are approximately 75 pieces. The products that pass trimming and packing process will transfer to the waiting to warehouse process by forklift truck by batch of 25 pieces.

Waiting to Warehouse Process

Waiting to Warehouse is a process that packing product will be waited for transfer to warehouse by forklift truck. At present, there are two time of transferring. The first one is 8:00 a.m. and the second one is 4:00 p.m. The maximum WIP that keep in this process is 500 pieces.

2. METHODOLOGY

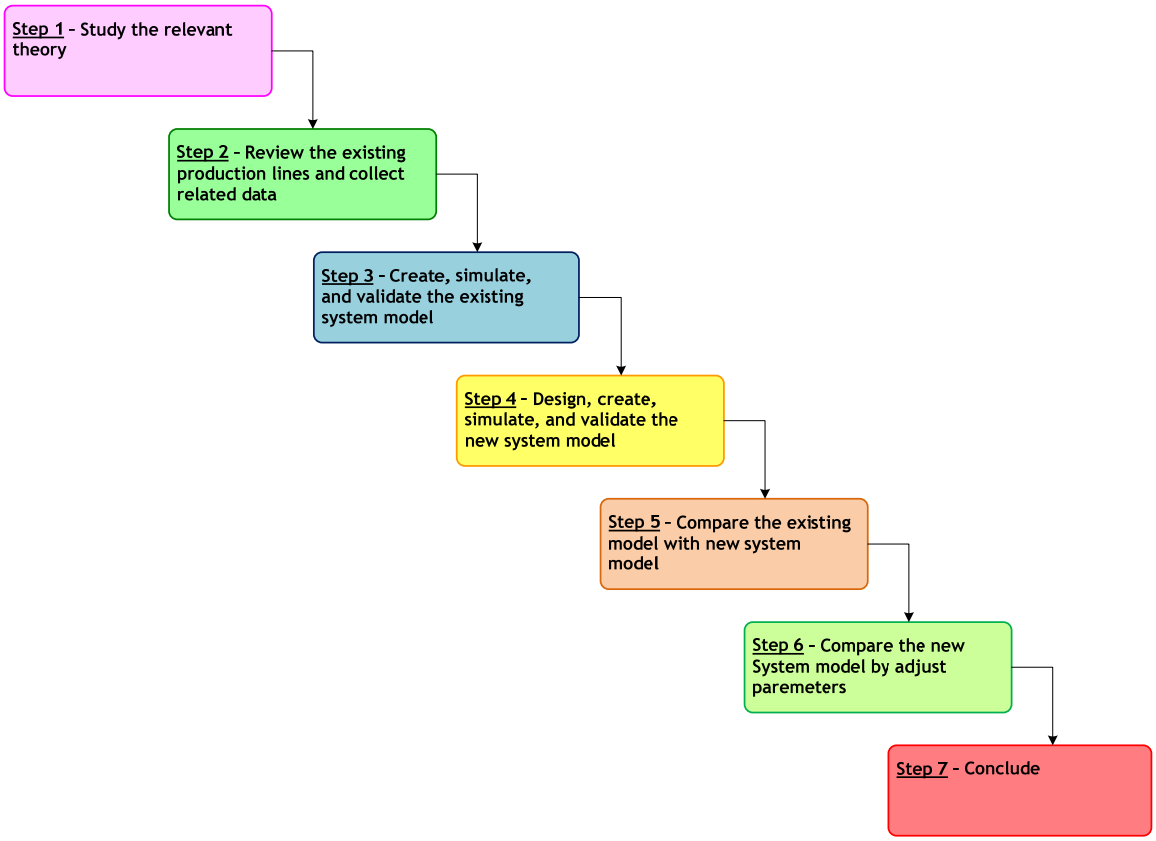


Figure 2 Steps of methodology

The descriptions of each step are as following:

1) **Study the relevant theory**
   - Study the theories; Just-in-Time, Cellular Manufacturing, and Simulation Computer.
2) **Review the existing production line and collect the related data**
   - Understand overall processes of bed liner production and draw the process flow chart.
   - Collect the related data from overall processes to create the existing model such as cycle time, work-in-process, production batch size, transportation distance, customer demands, number of operators, number of material handlings, etc.
3) **Create, simulate, and validate the existing system model**
   - Create the existing model, simulate, and validate the output such as work-in-process and production lead time.
4) **Design, create, simulate, and validate the new system model**

- Design the new system model after completed validating the existing model then simulate and validate the output. Major design focuses on layout design and minor focuses on batch size.

5) **Compare the existing system model with the new system models**
   - Compare the average of work-in-process and production lead time of two systems.
   - Summarize the preliminary results will include the technical benefits such as storage area, material handling, etc.
6) **Compare the new system model by adjust critical parameters**
   - Compare the average WIP and production lead time of each scenario.
7) **Conclude**
   - Summarize the results include the technical benefits such as storage area, material handling, etc.
   - Recommend parameters that should implement in the case factory.

3. EXISTING CONDITION

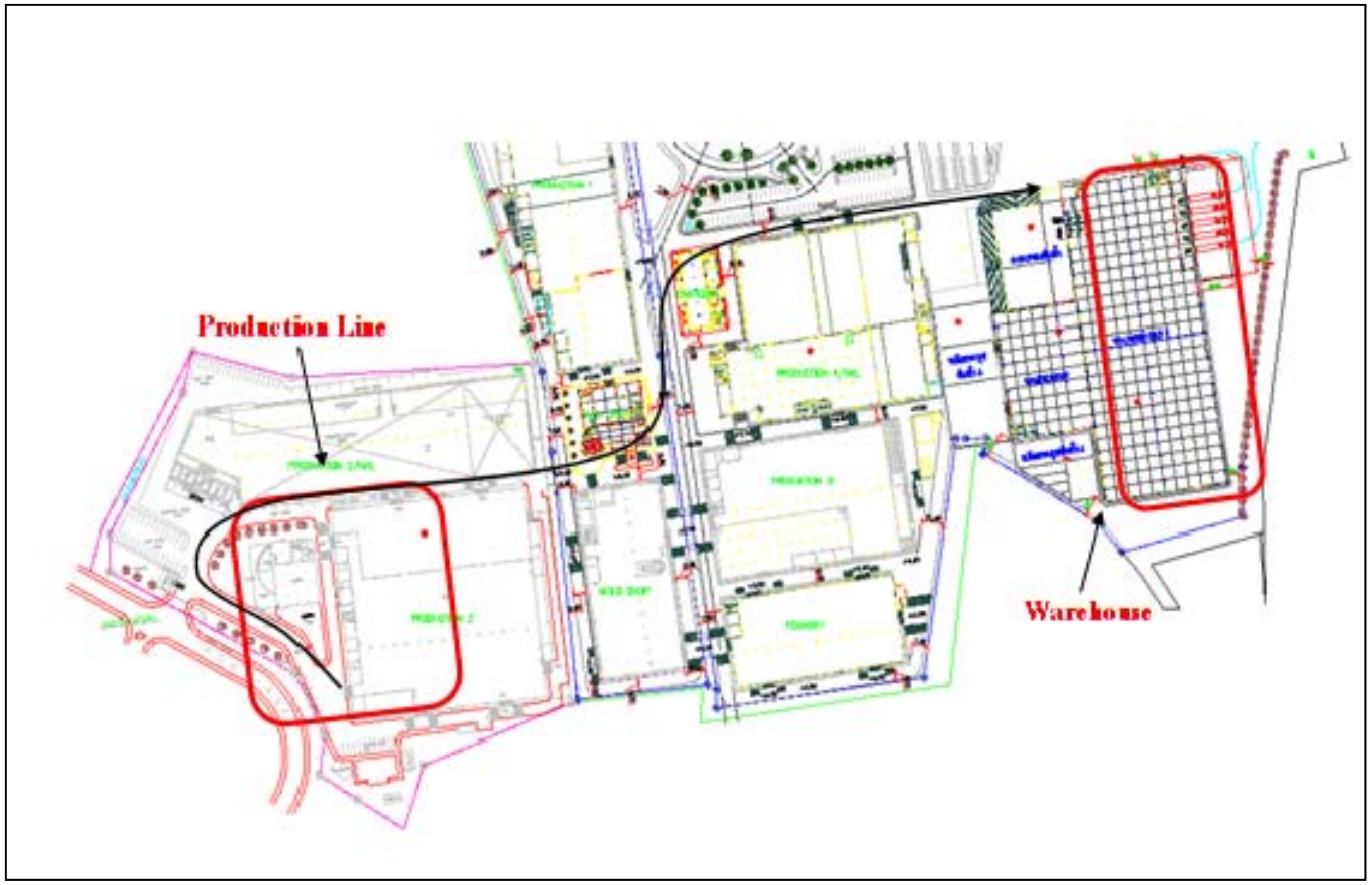
The current data of work-in-process, batch size, transportation distance, number of operators, number of material handlings and customer demands that concern with bed liner production line are shown in table 1.

Table 1 Existing production data of bed liner production line

Data	Quantity
Average WIP per month	2,046 pieces
Batch Size	Extruding: 2,500 for production and 50 for transportation Forming to Packing: 25
ROP	500 pieces
Transportation Distance	1,602 meters
Operator	11 units
Material Handling	11 units
Average Customer Demand	200 pieces per day

The average WIP per month of 2,046 pieces are calculated from the simulation model. Details will show in part of "Experimental Designs". The production batch sizes for extruding process is 2,500 pieces and transferred batch size is 50 pieces. The production batch sizes of 25 pieces for forming, trimming and packing are used for both production and transportation. The ROP of extruding process are 500 pieces.

The transportation distances of 1,602 meters are measured from the production line to the warehouse. The current layout shows in figure 3. The operators and material handlings are only used for bed liner production line. The average customer demands of 200 pieces are daily order. The production order is changed from weekly to daily.



- Waiting to warehouse process elimination

Layout design concerns with transportation distance. For the existing system, the total transportation distances from the production line to the warehouse are approximately 1,602 meters. After design new layout, the total transportation distances decrease to 713 meters. The layout design of the existing system and the new system shows in figure 4.

The new system will provide one piece flow in forming to trimming. Batch size of 25 pieces is reduced to 1 piece. The effect of batch size reduction will reduce WIP. The ROP of extruding process are reduced from 500 to 250 pieces. The numbers of 250 refer from daily order of 200 pieces and safety stock of 50 pieces. The new system can reduce the forklift truck because the distance between each machine is closely.

The Waiting time during transferring to warehouse process can be eliminated because distance between the production line and the warehouse is closely.

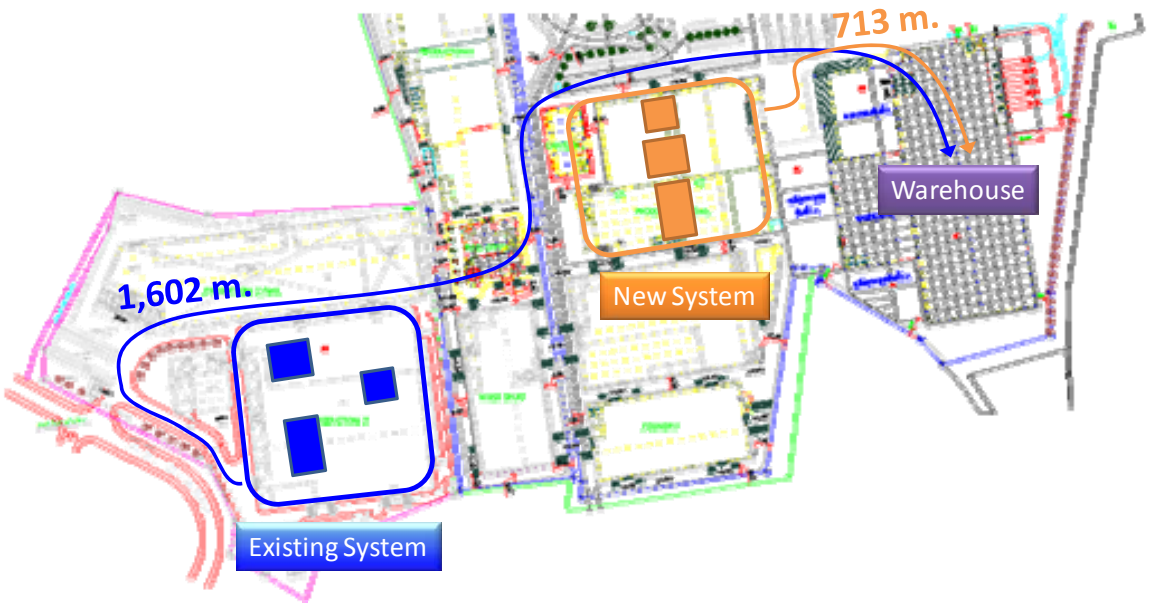


Figure 4 Layout design of the existing and the new system

Figure 5 shows the comparison of adjusted batch size and process of the existing system with the new system.

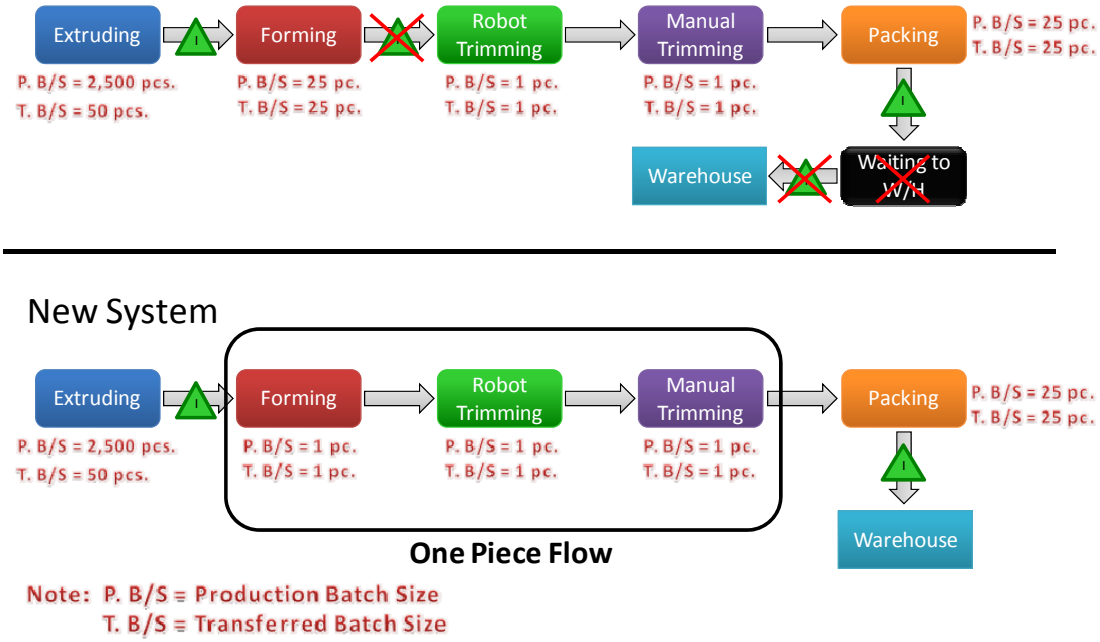


Figure 5 The comparison of batch size and process of the existing with the new system

Each model consists of static and stochastic parameters. Static parameters consist of transportation distance, production batch size, maximum WIP in each process (depend on storage area), number of operators, number of forklift trucks and ROP at extruding. Stochastic parameters consist of cycle time of all processes, arrival time and quantity of other products at trimming process. Summary of comparison are shown in table 3.

Table 3 Summary of the experimental design

Parameter	Existing System	New System
Distance (m.)	1,602	713
Batch Size (pcs.)	Extruding: 2,500 for production and 50 for transportation Forming to Packing: 25	Extruding: 2,500 for production and 50 for transportation Forming to Trimming: 1 Packing: 25
Max. WIP (pcs.)	4,212	3,137
Operator (unit)	11	11
Forklift Truck (unit)	11	9
ROP (pcs.)	500	500 and 250
Cycle Time (type)	Normal Dist.	Normal Dist.
Other Products Arrival Time (type)	Exponential Dist.	Exponential Dist.
Other Products Quantity (type)	Normal Dist.	Normal Dist.

The cycle time of each process is defined by normal distribution (details of cycle time are shown in Appendix A). The other products arrival time is defined by exponential distribution with mean of 21 hours. The other products quantity is defined by normal distribution with mean of 80 pieces and standard deviation of 10 pieces.

For each model, the assumptions and simulation settings are as same as defined. The details are as following:

- Assume no defective in both of existing and new system
- Assume no shortage material for production
- Assume no machine downtime in both of existing and new system

- Number of replication: 30
- Run length: 1 month or 4 weeks or 504 hours (working time 21 hours per day, 6 day per week)

The outputs in this experiment are as following:

1. Average WIP per month (pcs.)
2. Average production lead time (days) per daily order (200 pcs.)

The layout of models construction in ProModel shows in figure 6 and 7.

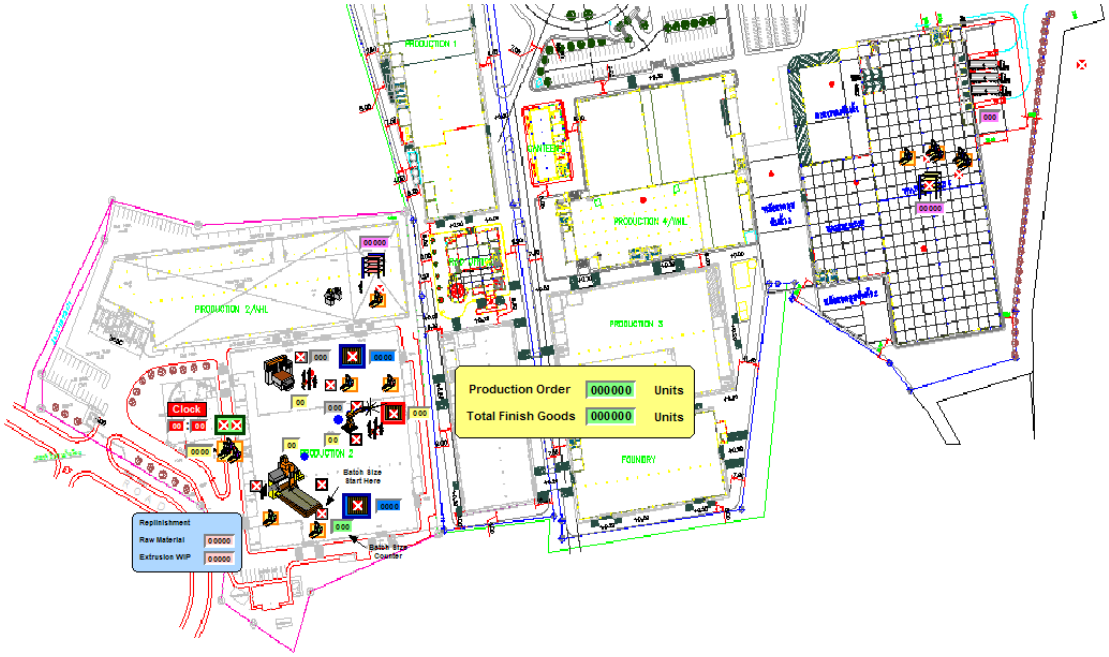


Figure 6 The existing system layout of simulation model in ProModel

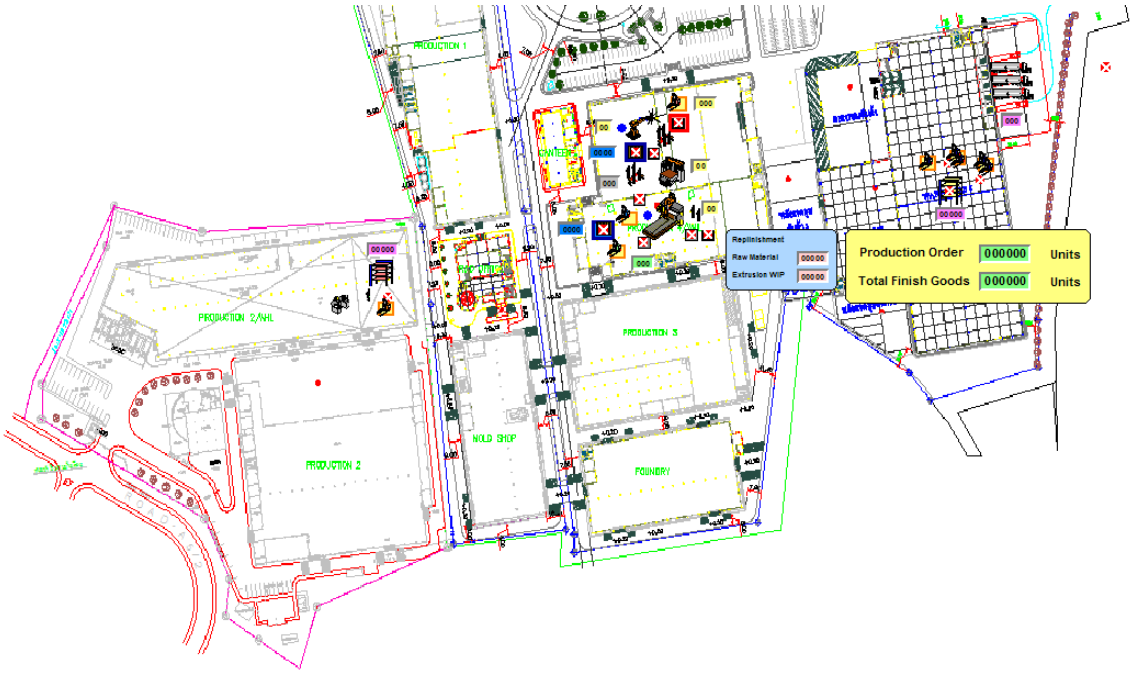


Figure 7 The new system layout of simulation model in ProModel

5. SIMULATION ANALYSIS

Table 6 Analysis of WIP of the existing and the new system

Analysis Category	Existing (ROP 500)	New (ROP 500)	New (ROP 250)
Avg. WIP at Extruding (pcs.)	1,659	1,613	1,534
Avg. WIP at Forming to Waiting to Warehouse (pcs.)	387	277	278
Avg. Total WIP (pcs.)	2,046	1,890	1,812
Max. Total WIP (pcs.)	4,212	3,637	3,637
Standard Deviation (pcs.)	119	140	97
n	30	30	30
alpha	0.05	0.05	0.05
t	2.05	2.05	2.05
Half Width (pcs.)	44	52	36
95% CI - L (pcs.)	2,002	1,838	1,776
95% CI - H (pcs.)	2,090	1,942	1,848

The average of total WIP of the existing system of 2,046 pieces is more the average of total WIP of the new system of 1,890 pieces than 156 pieces. For 95% confidence interval of the average total WIP, the existing system is between 2,002 and 2,090 pieces. The new system is between

1,838 and 1,942 pieces. There are not the same numbers between these two ranges. Therefore, in statistical analysis, that means the average of WIP of the new system is less than the existing system.

The 95% of the average of total WIP of the new system with ROP of 500 are between 1,838 and 1,942 pieces and the 95% of the average of total WIP of new system with ROP of 250 is between 1,776 and 1,848 pieces. There are somewhere numbers that same between two ranges. Therefore, the average of total WIP of the new system with ROP of 500 are similar the average of total WIP of the new system with ROP of 250. The 95% confidence interval plot of WIP analysis shows in figure 8.

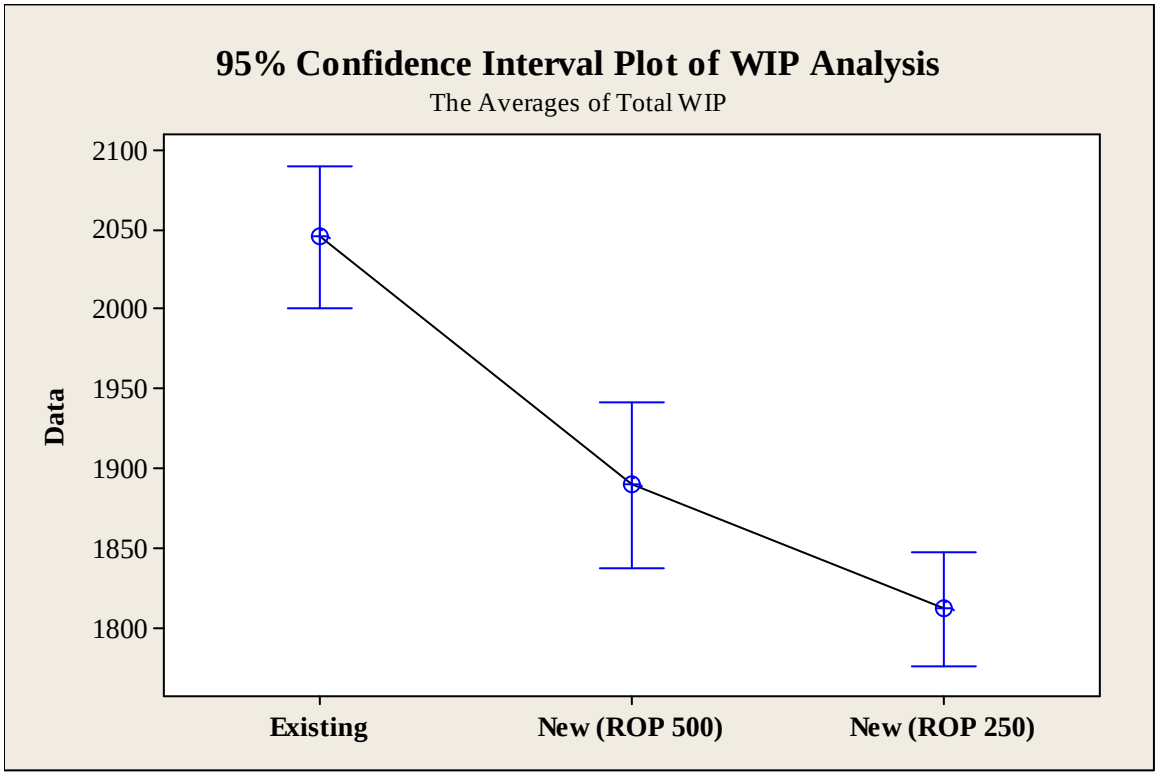


Figure 8 95% confidence interval plot of the average of total WIP

In fact, the average WIP per month of the new system with ROP of 250 should less than the new system with ROP of 500. Therefore the replication is increased in this comparison to reduce range of this interval. Number of replications that use for this comparison is 100.

Table 7 Analysis of WIP of the new system with ROP of 500 and 250

Analysis Category	New (ROP 500)	New (ROP 250)
Avg. WIP at Extruding (pcs.)	1,614	1,544
Avg. WIP at Forming to Waiting to Warehouse (pcs.)	283	282
Avg. Total WIP (pcs.)	1,897	1,826
Max. Total WIP (pcs.)	3,637	3,637
Standard Deviation (pcs.)	132	112
n	100	100
alpha	0.05	0.05
t	1.98	1.98
Half Width (pcs.)	26	22
95% CI - L (pcs.)	1,871	1,804
95% CI - H (pcs.)	1,923	1,848

For this comparison, the 95% of the average of total WIP of the new system with ROP of 500 are between 1,871 and 1,923 pieces and the 95% of the average of total WIP of new system with ROP of 250 is between 1,804 and 1,848 pieces. There are not the same numbers between these two ranges. Therefore, the average of WIP of the new system with ROP of 250 is less than the new system with ROP 0f 500.

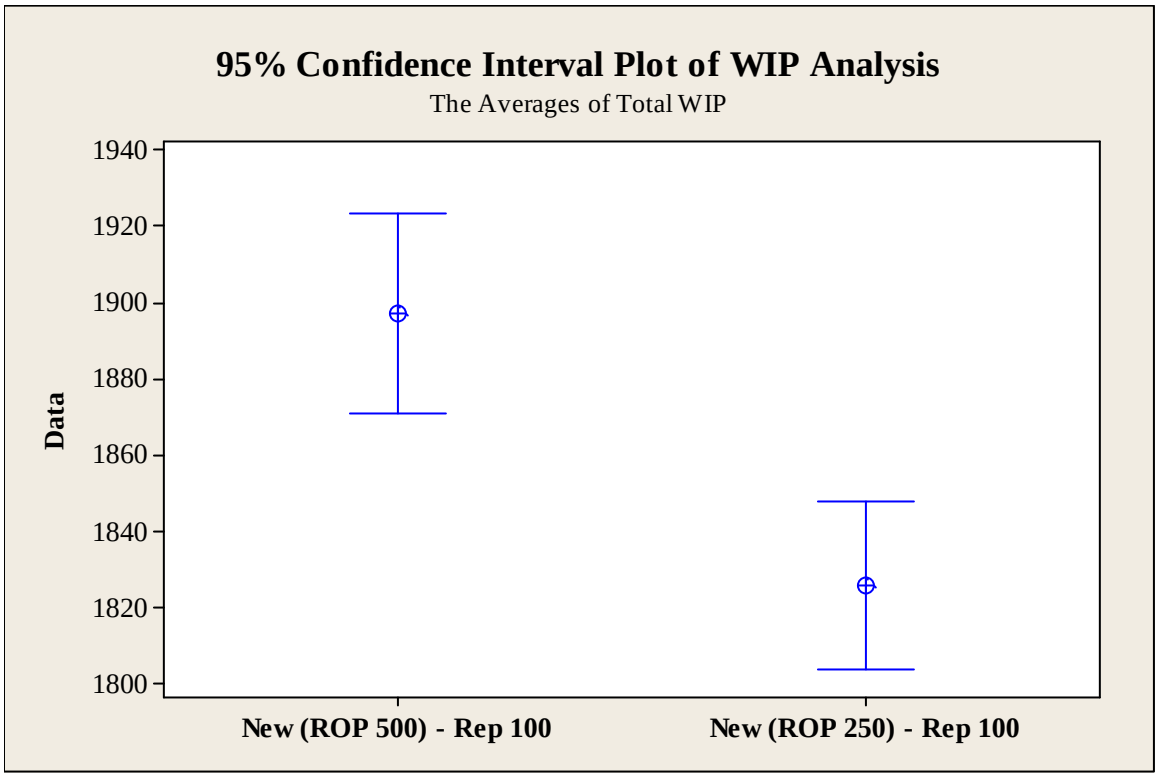


Figure 9 95% confidence interval plot of the average of total WIP for ROP of 500 and 250 pieces comparison

Table 8 Analysis of production lead time of the existing and the new system

Analysis Category	Existing	New (ROP 500)	New (ROP 250)
Avg. Lead Time (min.)	1,666.12	1,487.64	1,459.87
Avg. Lead Time (day)	1.32	1.18	1.16
Standard Deviation (day)	0.10	0.09	0.07
n	30	30	30
alpha	0.05	0.05	0.05
t	2.05	2.05	2.05
Half Width (day)	0.04	0.03	0.03
95% CI - L (day)	1.29	1.15	1.13
95% CI - H (day)	1.36	1.22	1.19

The average of production lead time of the existing system of 1.32 days is more the average of production lead time of the new system of 1.18 days than 0.14 days. For 95% confidence interval of the average of production lead time, the existing system is between 1.29 and 1.36 days. The new system is between 1.15 and 1.22 days. There are not the same numbers between

these two ranges. Therefore, in statistical analysis, that means the average of production lead time of the existing system is less than the new system.

The 95% of the average of production lead time of the new system with ROP of 500 is between 1.15 and 1.22 days and the 95% of the average of production lead time of new system with ROP of 250 is between 1.13 and 1.19 pieces. There are somewhere numbers that same between two ranges. Therefore, the average of production lead time of the new system with ROP of 500 is similar the average of production lead time of the new system with ROP of 250.

The 95% confidence interval plot of production lead time analysis shows in figure 10.

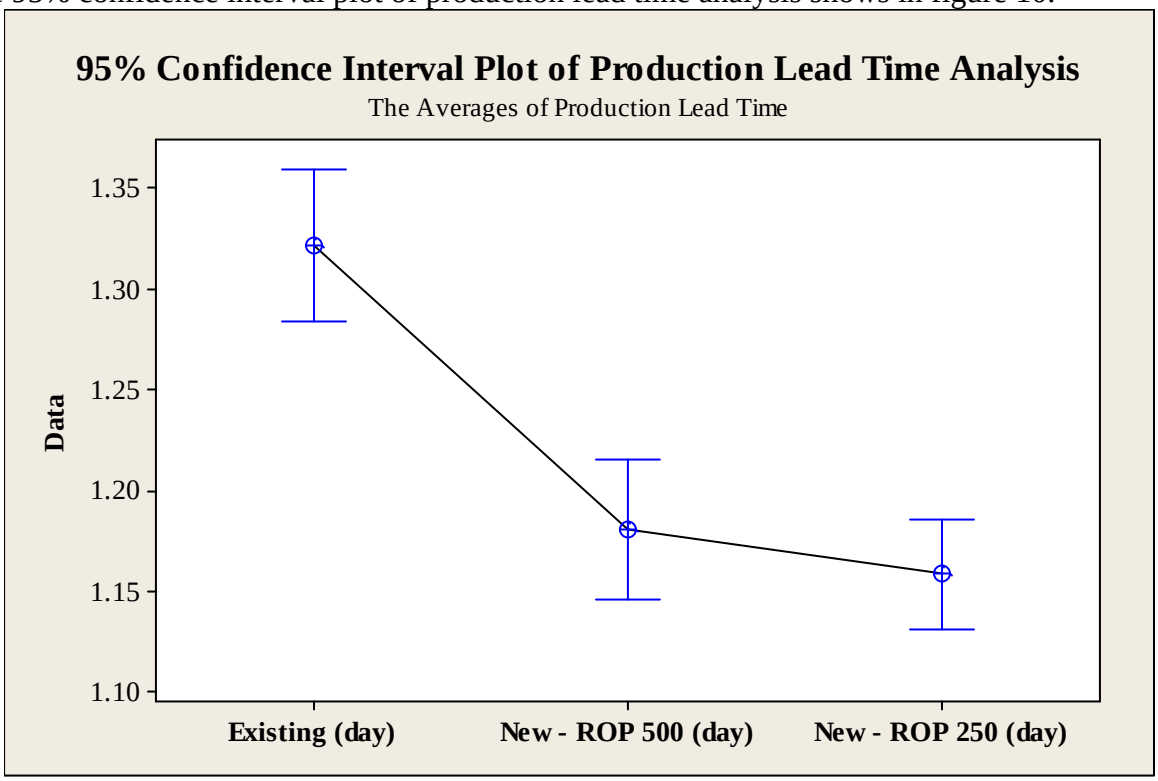


Figure 10 95% confidence interval plot of the average of production lead time

According to the objective of this project, the results from the first experiment still not achieve the targets (average WIP per month of 1,500 pieces and average production lead time per 200 pieces of 1 day). Therefore, the additional experiments are designed for achieving the targets. Additional experiments use all the same assumptions and simulation settings.

These new experiments focus on

- Production batch size reduction after packing process
- Maximum WIP reduction after extruding process
- Arrival of other liners at trimming process

The ROP of 500 and 250 are compared for all of these additional experiments. This comparison bases on arrival of other liners at trimming process (arrival or no arrival). The results are shown in table 9.

Table 9 Analysis of WIP of ROP 500 and 250 for the additional experiments

Analysis Category	ROP 500 (Arrival)	ROP 250 (Arrival)	ROP 500 (No Arrival)	ROP 250 (No Arrival)
Avg. WIP at Extruding (pcs.)	1,614	1,544	1,579	1,525
Avg. WIP at Forming to Waiting to Warehouse (pcs.)	283	282	41	41
Avg. Total WIP (pcs.)	1,897	1,826	1,620	1,566
Max. Total WIP (pcs.)	3,637	3,637	3,637	3,637
Std.Dev (pcs.)	132	112	0	0
N	100	100	30	30
Alpha	0.05	0.05	0.05	0.05
T	1.98	1.98	2.05	2.05
Half Width (pcs.)	26	22	0	0
95% CI - L (pcs.)	1,871	1,804	1,620	1,566
95% CI - H (pcs.)	1,923	1,848	1,620	1,566

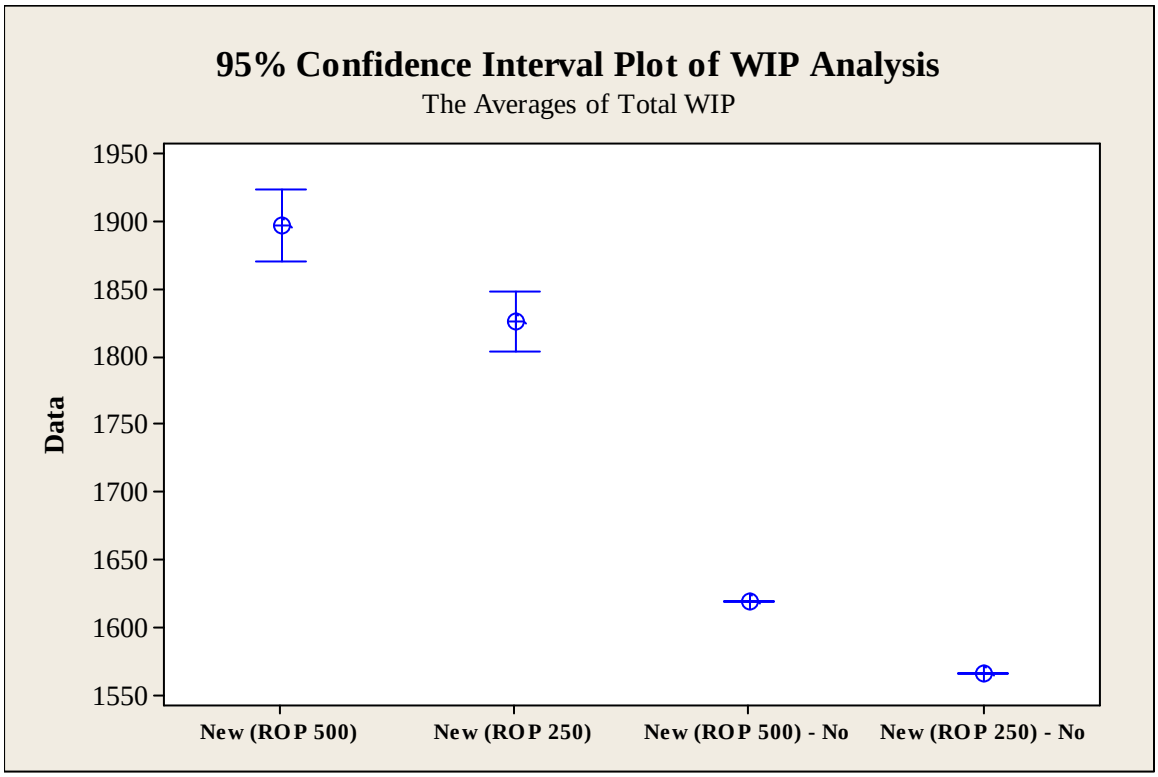


Figure 11 95% confidence interval plot of the average of total WIP of ROP 500 and 250 for the additional experiments

From these results, the ROP of 250 with no arrival of other liners provides the lowest average WIP. Therefore it should be used in the additional experiments is 250 pieces.

The additional experimental design shows in table 10.

Table 10 Additional experimental design

Batch Size		25		20		15		10	
Other Liners		Arr.	No Arr.	Arr.	No Arr.	Arr.	No Arr.	Arr.	No Arr.
Max. WIP after Extruding	3,000	1	21	6	26	11	31	16	36
	2,500	2	22	7	27	12	32	17	37
	2,000	3	23	8	28	13	33	18	38
	1,500	4	24	9	29	14	34	19	39
	1,000	5	25	10	30	15	35	20	40

The numbers of batch size after packing are reduced from 25 to 10 pieces. The numbers of maximum WIP that can keep after extruding process are reduced from 3,000 to 1,000 pieces. When reduce maximum WIP after extruding, the production batch size of extruding will be reduced also. For example, if reduce the maximum WIP to 2,500 pcs. and ROP is 250 pcs.

Therefore, they can produce 2,250 pcs. The other liners at trimming process are arrival or no arrival. The numbers of 1-40 are the scenarios of this experiment.

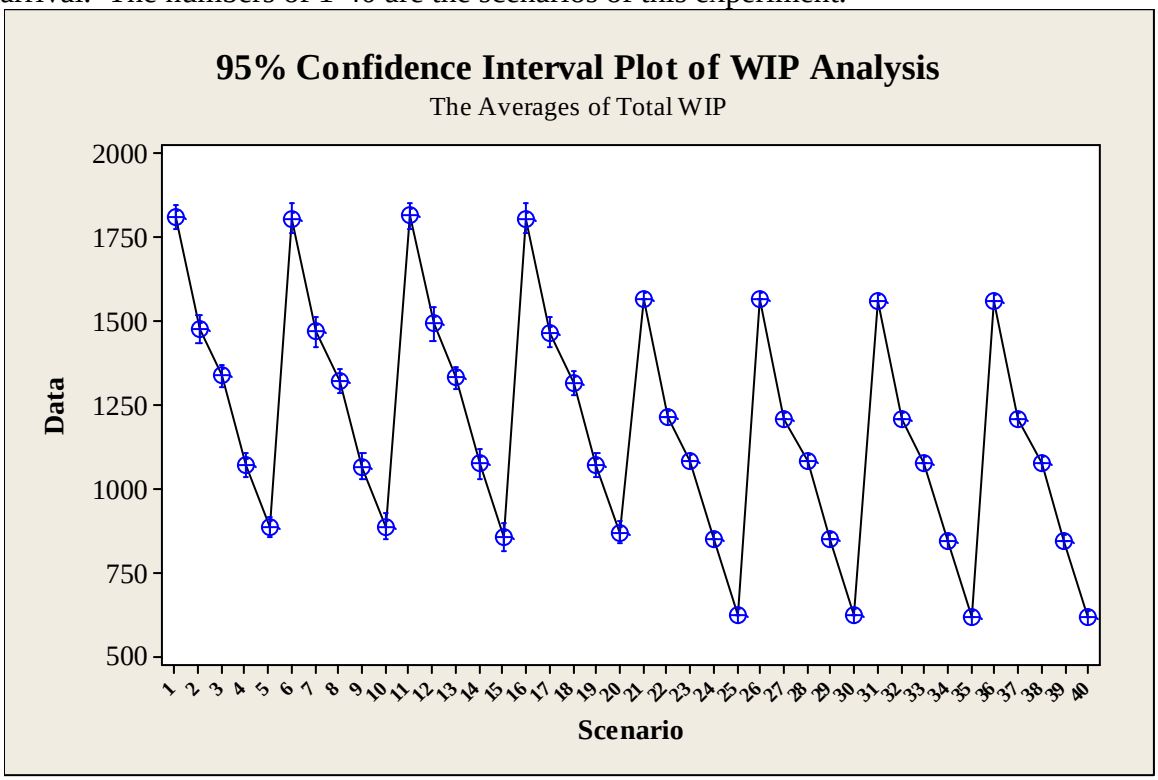


Figure 12 95% confidence interval plot of the average of WIP of additional experiments

From the results, the scenarios that provide the average WIP per month approximately 1,500 pieces are scenario 3, 4, 5, 8, 9, 10, 13, 14, 15, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 30, 32, 33, 34, 35, 37, 38, 39 and 40. For the scenario 2, 7, 12, 17, 21, 26, 31, 36, the average WIP per month have the opportunity to slightly more than 1,500 pieces.

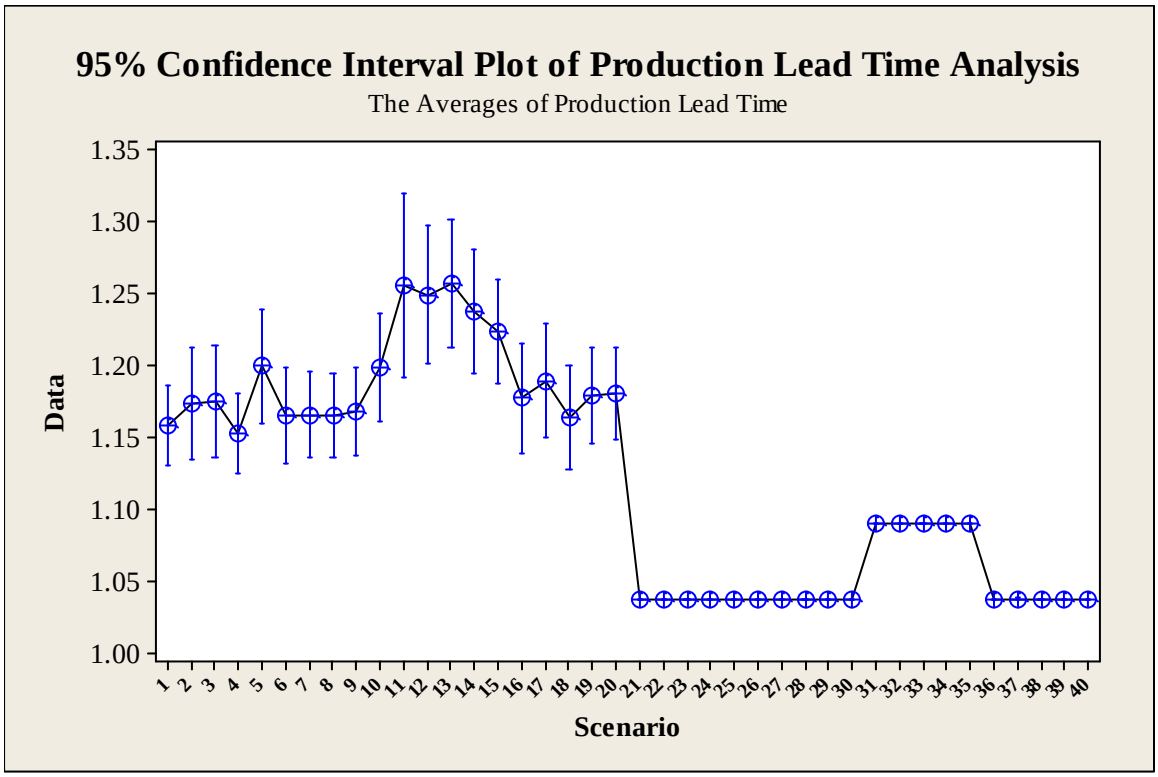


Figure 13 95% confidence interval plot of the average of production lead time of additional experiments

From the results, the scenarios that provide the average production lead time per 200 pieces approximately 1 day are scenario 21-30 and 36-40.

The scenarios that provide the average WIP per month of 1,500 pieces and the average of production lead time of 1 day are 22, 23, 24, 25, 27, 28, 29, 30, 37, 38, 39 and 40. All of these scenarios provide the similar average production lead time of 1.04 day but not similar in average WIP per month. When focuses on average WIP, the scenario 40 is the best scenario because it provides the lowest average WIP of 618 pieces. It is probably not suitable scenario for this case factory. Due to machine downtime and other production factors such as defects and raw materials are not included in the model. Therefore, this study should select the scenarios that provide the high level average WIP per month for starting implementation. The high level average WIP can avoid the effect of these other factors more than the low level average WIP.

6. TECHNICAL BENEFITS

Besides the main benefits from this result such as WIP reduction and production lead time reduction, there are more benefits which are found from this analysis. The benefits involve with techniques. The technical benefits consist of transportation distance, number of forklift truck and WIP storage area.

Transportation distance

After the new layout is adjusted follow the continuous flow system, transportation distance is decreased from 1,602 to 713 meters or 55.5% decreasing (see routes of transportation in figure 4).

Number of forklift truck

The total forklift trucks of 11 units are decreased to 9 units. The first truck is eliminated from two trucks in extruding process. After the layout is adjusted, the extruder are arranged closely the forming machine. Distance between these two machines will also decrease. The second truck is eliminated from the waiting to warehouse process. Because of waiting to warehouse process eliminating, the truck that uses for transfer liners from this process to warehouse no need anymore. Utilization of each truck is shown in table 15

Table 15 Utilization of forklift trucks comparing between the existing and the new (scenario 22) system

Name	Units		% Utilization		
	Existing	Scenario 22	Existing	Scenario 22	Diff.
Mat Warehouse Forklift Truck	1	1	0.04	0.07	0.02
Extruding Forklift Truck 1	1	1	0.74	0.46	-0.28
Extruding Forklift Truck 2	**1**	**0**	**1.75**	**0.00**	**-1.75**
Forming Forklift Truck	1	1	2.49	0.36	-2.13
Trimming & Packing Forklift Truck	1	1	2.11	3.34	1.23
Waiting to Warehouse Forklift Truck	**1**	**0**	**16.83**	**0.00**	**-16.83**
FG Warehouse Forklift Truck 1	1	1	0.64	0.73	0.09
FG Warehouse Forklift Truck 2-1	1	1	0.48	0.73	0.24
FG Warehouse Forklift Truck 2-2	1	1	0.48	0.00	-0.48
FG Warehouse Forklift Truck 3-1	1	1	2.60	3.21	0.61
FG Warehouse Forklift Truck 3-2	1	1	2.59	0.00	-2.59
Total	**11**	**9**			

Due to a decreasing of distance between extruder and forming machine, the utilization of extruding forklift truck no.1 decreases from 0.74% to 0.46% or 0.28% decreasing. The effect of waiting to warehouse forklift truck is the increasing of the utilization of trimming and packing forklift truck. This truck has to transfer liners from packing to warehouse replace the waiting to warehouse truck. The utilization of this truck increases a little that is from 2.11% to 3.34% or 1.23% increasing.

WIP storage area

Benefit from WIP reducing concern with storage area. When WIP is reduced, the storage area will be also reduced. In this study, storage area is calculated from the product dimension, number of sheet per stacking (at extruding process) and number of bed liner per stacking (at forming to waiting to warehouse process).

The storage area calculation details are as following

- Product dimension: 1.65 m. x 1.80 m. x 1.50 mm. (width x length x height)
- Area per 1 piece of bed liner (assume the same dimension of sheet and liner): 2.97 m^2
- No. of sheet per stacking at extruding: 500 pcs. per stacking
- No. of bed liner per stacking at forming to waiting to warehouse: 25 pcs. per stacking

Table 16 WIP storage area comparing between the existing and the new (scenario 22) system

	Existing	New (Scenario 22)
Average WIP per month at Extruding (pcs.)	1,659	1,172
Average WIP per month at Forming to Waiting to Warehouse (pcs.)	387	41
Total storage areas (m^2)	53.46	11.88

Total storage area of the scenario 22 decrease from 53.46 to 11.88 m^2 or 77.8% decreasing.

7. CONCLUSION AND RECOMMENDATION

In bed liner production line improvement follows the continuous flow system of this case factory, average WIP per month and average production lead time per 200 pieces are the main targets that are reduced.

At the beginning, the existing system is compared with the new system that adjusts only layout. The results of the first experiment show that the average WIP per month and average production lead time per 200 pieces still not achieve the targets. Therefore, the additional experiments are designed for achieving the targets.

The additional experiments will focus on

- Production batch size reduction after packing process
- Maximum WIP reduction after extruding process
- Other liners at trimming process

Total additional experiments are 40 scenarios. The results from ProModel simulation software show that scenario 22, 23, 24, 25, 27, 28, 29, 30, 37, 38, 39 and 40 provide average production lead time of 1.04 day but not similar in average WIP per month. The scenario 40 provides the

lowest average WIP of 618 pieces but it is probably not the suitable scenario for this case factory.

In the real production, there are many factors that result in average WIP and average production lead time such as machine downtime, defect and raw material. These other factors will affect average WIP and average production lead time. Moreover, they possibly affect a shortage of finish goods that result in customer satisfaction. In this study, the scenario 22 is the suitable solution that should start implement in the case factory because it provide the highest level of average WIP but still not lower than the target of 1,500 pieces. The high level WIP can help to avoid the effect of other factors more than the low level WIP.

The scenario 22 also provides more benefits such as;

- Transportation distance decrease from 1,602 to 713 meters
- Forklift trucks decrease from 11 to 9 units
- WIP storage area decrease from 53.46 to 11.88 m^2

Table 17 Summary of scenario 22 comparing with existing system

Category	Existing	Scenario 22
Layout Design	Old	New
ROP (pcs.)	500	250
Batch Size after Packing (pcs.)	25	25
Max. WIP after Extruding (pcs.)	3,000	2,500
Other Liners at Trimming Process	Arrival	No Arrival
Avg. Total WIP per month (pcs.)	2,046	1,213
Avg. Lead Time per 200 pcs. (day)	1.32	1.04
Transportation Distance (m.)	1,602	713
Forklift Truck (unit)	11	9
WIP Storage Area (m^2)	53.46	11.88

Recommendation

In this study, all of these scenarios provide the average WIP that is lower than the target but the average production lead time still more than the target slightly. When the other factors such as machine downtime are focused in the system, both of the average WIP and average production lead time have opportunity to increase.

The case factory should start implement from scenario 22 (highest average WIP) and then try to reduce the average WIP per month until get the scenario that provide the lowest average WIP, average production lead time and no effect of other factors. This implementation should be within scenario 22, 23, 24, 25, 27, 28, 29, 30, 37, 38, 39 and 40. Otherwise, it is better to have a

further study before the implementation. A further study should design the better models that include these factors;

- Machine downtime, defects and raw material to get more accurate results
- More capacity at the bottleneck process to reduce average production lead time

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BRAND BENEFITS AND PERCEIVED RISK AS ANTECEDENTS OF QUALITY-VALUE-BEHAVIOR INTENTION OF ONLINE TRAVEL PROUDUCT

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ABSTRACT

Travel products are marked, prior to purchase, by high levels of potential intangible benefits, and this characteristic of intangibility makes it difficult for possible purchasers to assess quality, value and brand image. This paper is based on the premise that brand images imply brand benefits of value to consumers. However, the risk of disappointment is even higher when making purchases on-line. The article reports the findings from a study that explored Taiwanese respondents' perception of quality, value, and behavior intention when making online travel product purchases in Taiwan when brand benefit and perceived risk are involved and posited as antecedents to purchase. An analysis based on SEM indicates some, but not conclusive support for a proposed theoretical framework and as a consequence both theoretical implications and suggestions for the future research are made.
Keywords: Brand benefit; Perceived risk; Quality-Value-Behavior intention (Q-V-B) model

INTRODUCTION

The emergence of information technology (IT), world wide web (WWW) and communications technology have opened up the business of firms (Grewal et al., 2003; Wu & Chang, 2006). E-commerce has significantly changed the distribution channels of business and many enterprises have been set up to establish and join this market of electronic commerce to increase their share of the market (Grewal et al., 2003). From the perspective of consumers, online purchase is convenient and timesaving, consumers can rapidly and easily compare features of travel product such as quality or value (Card, Chen, & Cole, 2003; Chen & Dubinsky, 2003). Like the tourism products that consumers purchase from a physical store, however, consumers hardly evaluate whether the product is good or bad in online travel agencies.

Past studies stated that brand image is an important part of a firm’s marketing program and it can help consumers to recognize and evaluate a firm’s product (Keller, 1993). However, brand image could be a bad image and consumers may have a lesser expectation of the property of product they purchased. On the other hand, though the brand image is good, people may greatly favor one of the brands. For example, some consumers may choose a product that is a little inferior or lower quality, but the brand has matched their basic needs,

thus those consumers may be more aware of the brand benefits of that product.
Generally, an effective marketing communication must be able to distinguish how consumers get the benefits from the product or brand values (Sheth, Newman, & Gross, 1991). Brand image is based on the extent to which individuals believe only the brand in question brings them the benefit (Bullmore, 1984). Other common conceptualizations have been based on non-product related attributes or benefits (Keller, 2003). In this study, we have used a non-product-based definition which refers to what we refer to as "brand benefit". On the other hand, most scholars agree the "perceived risk" of online stores is higher than the traditional stores (Featherman & Pavlou, 2003). Bhatnagar, Misra, and Rao (2000), based on the online shopping risks, have pointed out that the Internet has provided lots of convenience to the shopping, consumers are worried about the transaction security of online shopping.

In the past, consumer behavior research (cognition – attitude - behavior) has always been an important topic in marketing. Traditionally, studies related to this are mostly based on the "Quality-Value-Behavior Intention" (Q-V-B) model and its major connotation is to discuss the causal relationship between quality-value-behavior intentions (Cronin, Brady, & Hult, 2000; Zeithaml, 1988); so do recent studies of hospitality and tourism fields (Gallarza & Saurab, 2006; He & Song, 2009; Petrick, 2004).

However, due to the variations of situational context and subject difference, the results of Q-V-B models have some differences in the path analyses in terms of previous proposed models. In addition, for the evaluation of perceived quality, "when intrinsic information was scarce, or not deemed useful, or there was no opportunity to process it, extrinsic attributions were more likely to be used to assess product quality (Miyazaki, Grewal, & Goodstein, 2005)." These findings are consistent with those of Patterson (2000), who argued that previous studies have not considered these two variables are all the concepts under context-specific situations. This study considers that the possible reasons for inconsistent results of previous studies may lie under seeing perceived quality and perceived value as given variable. Also, brand benefit and perceived risk have never yet received collectively the opportunities of cross-reference they deserved in Q-V-B models.

Because this study discussing online product belongs to the commodity of credence property, the brand external clue (Berry, 2000) and perceived risk (Agarwal & Teas, 2001; 2004) are both important elements that influence perceived quality and perceived value (Chen & Dubinsky, 2003). Given the strong influence brand benefit and perceived risk have in our model, perhaps the presence of brand benefit and perceived risk as antecedents of the Q-V-B model helps explain the lack of the relationships from the simplicity of Q-V-B model. Based on the existing Q-V-B model and to bridge the gap between perceived quality and perceived value, the purpose of this study is to extend the Q-V-B model to the online purchase process, by adding brand benefit and perceived risk as the antecedents for the perceived quality and perceived value, in the hope of making the Q-V-B model more integrated.

LITERATURE REVIEW AND HYPOTHESES

1. Brand benefit

Bullmore (1984) emphasizes that the creation of the brand image is based on individual

psyche and does not agree that the image belongs to the brand itself; in contrast, the brand image is based only on how individuals believe the brand will bring them benefits, similar to the concept of goodwill. In other words, from a consumer's viewpoint, brand image is a concept of benefit (Ambler, 1997; Sheth et al., 1991), referred to in this article as "brand benefit". When a brand's benefit meets what the consumer evaluated and assessed, this brand will meet the consumer demand, and its importance will be even higher than the product itself (Orth & Kahle, 2008; Orth, 2004).

Bhat and Reddy (1998) and Orth et al. (2004) stress that to investigate each kind of brand benefit will motivate consumers to have preference for some specific brands, which has important implications for brand position. Given the above description, this study focuses on consumers' psychological viewpoint, regarding the brand benefit as a subjective or emotional concept of consumers, and for them to develop, to nurture and treat as significant.

2. Perceived risk

Internet shopping or online purchase process, perceived risk refers to when the consumers purchase any kind of products, some uncertainties surround a purchase outcome. When consumers make a wrong purchase decision, there may be some loss for them (Dunn, Murphy, & Skelly, 1986). Cox (1967) defined perceived risk as the function of the following two factors: 1) before consumers make the purchase decision, they are aware of a possible disadvantageous outcome, and the risk becomes reality after the purchase. 2) When a purchase result is disadvantageous, consumers have their individual notion of how severe the loss is. This concept also may extend to online purchasing action, which uses the same subjective perception to define the perceived risk. In the online purchase context, Forsythe and Shi (2003) based on loss concept to define perceived risk as the subjective anticipative loss when online shoppers think about buying things online. Featherman and Pavlou (2003) defined the perceived risk of an online shopper: a possible loss happens around a desire to get an optimal outcome. This study, therefore, refines the notion of perceived risk as: the subjective anticipated loss the consumer has regarding online purchasing. Based on the characteristics of the online risk, this study uses the financial risk and functional risk that are most familiar to consumers' risk perception forward during the online purchase process.

3. Quality-Value-Behavior intention (Q-V-B) model

The Q-V-B model proposed by Zeithaml (1988) mainly discusses the relationship among perceived price, quality, and value, and their relevance to purchase behavior. Zeithaml (1988) defines perceived quality as the consumer's judgment for the superiority or excellence of products. Perceived quality can be assigned to two types of components: intrinsic and extrinsic (Baker & Crompton, 2000; Miyazaki et al., 2005). In this study, perceived quality includes both intrinsic qualities and extrinsic qualities.

Perceived value is a complex, higher order construct (Zeithaml, 1988), and is generated without the products being actually bought or used (Sweeney & Soutar, 2001). The components of perceived value have been empirically identified in the literature (Grewal et al., 1998; Woodruff, 1997). They can be defined as capturing customers' overall value judgment on a statement (Gallarza & Saura, 2006; Kwun & Oh, 2004); alternatively, the

central process of the purchase judgment originates from the trade-off between two components: benefits and sacrifices (Dodds, Monroe, & Grewal, 1991). Essentially, as long as consumers' perception of quality is greater than their perception of sacrifices made to obtain the product, consumers will perceive positive value for the product (Dodds et al., 1991; Grewal et al., 1998). In this study, perceived value is defined as value perceptions derived from the consumer's evaluation of gain and loss in buying a specific product online.
In the literatures of hospitality and tourism, the results revealed that perceived price and/or perceived quality are related to perceived value and all three were related to purchase intention (Ainscough, 2005). Petrick (2004) has found that cruise travelers' perception of quality positively affected perceived value. Empirically, many scholars have shown that a high level of perceived value is linked to behavioral intentions (Baker et al., 2002; Grewal et al., 1998). Research in service quality further suggests that quality has a positive effect on perceived value and that service quality plays a salient role in predicting behavioral intentions (Baker & Crompton, 2000; Cronin et al., 2000). Thus, we propose the following hypotheses:
H_1: The higher the perceived quality, the higher the perceived value.
H_2: The higher the perceived quality, the higher the level of purchase intention.
H_3: The higher the perceived value, the higher the level of purchase intention.

4. Brand benefit and Q-V-B relationships

Service commodities are not concrete entities, so service businesses cannot convey their product quality and related information through packaging or labeling. Consequently, one would expect brand recognition to be more important to service industries (Berry, 2000); service firms can convey service quality and value through brand placement (Berry, Lefkowith, & Clark, 1988). In other words, when consumers are unable to know the intrinsic attributes of products or have inadequate information, brand benefit becomes a major external basis for appraisal. In the Internet context, consumers rely heavily on brand recognition when making a purchase decision. Tthey actually get a fairly limited description of the product and its attributes. Therefore, consumers always rely on external information or generally available details to decide whether to make the purchase (Orth et al, 2004). Brand image literature mentions consumers' recognition of leading brand attributes, benefits, and their attitude towards a firm product. Consumers can retrieve the unique quality of specific brand from firms and high brand loyalty consumers signify having strong and positive emotion for the brand (Chaudhuri & Holbrook, 2001). If consumers are more familiar with some specific brand, they may quickly think of that brand when facing a purchase decision; this benefit stimulates consumers to perceive the quality of a firm's product, and therefore they will be more willing to buy the product of the brand familiar to them.

Brand also has a function in which consumers can project their self-image. From consumer perspective, brand benefit thus bringing consumer's cognition is what the brand has given individual product value (Gabbot & Hogg, 1999). In other words, consumers may perceive the value of a product not only in terms of product quality, it can be through the benefit the product has brought to them to appraise as well (Baker et al., 2002). In this sense, besides knowing the perceived value from the product quality, consumers perceiving value for a product will also be affected by what a product/service or firm's brand benefit has brought to them.

Earlier studies found that when consumers have strong and positive feeling for a brand, there will be loyalty associated with it (Chaudhuri & Holbrook, 2001). Loyalty comes from a kind of pact in which consumers have a particular attitude toward the brand firm named (Chaudhuri & Holbrook, 2001) and consumers perceive the unique value of the brand (Jacoby & Chestnut, 1978). Thus, it may be known that the brand benefit will lead the consumers to think of benefit, profit, and value; and also will affect the consumers' behavior intention. Given these findings, this study offers the following further hypotheses:
H_4: The higher the brand benefit, the higher the perceived quality.
H_5: The higher the brand benefit, the higher the perceived value.
H_6: The higher the brand benefit, the higher the level of purchase intention.

5. Perceived risk and the relationships of Q-V-B

Since the purchase of travel products is a kind of credence property of the commodity, the risk consumers perceived may have had an important influence on their attitude to the purchase, and come along with the appraisal of the consumer purchase (Babin & Kim, 2001). According to the Technology Acceptance Model (TAM; Davis, 1989), it is designed to gather evaluative measures of information system (IS) quality and suitability to IT or internet requirement, and thereby enable predictions of IS acceptance and usage. Thus, the ways in which consumers react to an e-purchase service portal interface are also important as they may be perceived as indicators of overall service performance (Featherman & Pavlou, 2003). A low perceived quality may result from a poor product choice, IT ability, or knowledge due to the shopper's inability to accurately judge, and perceive the risk of the product online. The ability to judge product quality online may be limited by barriers to touching, feeling, inaccurate product perceptions, and insufficient information on quality attributes. Therefore, consumers could have lower perceptions toward the quality of travel product online travel agencies.

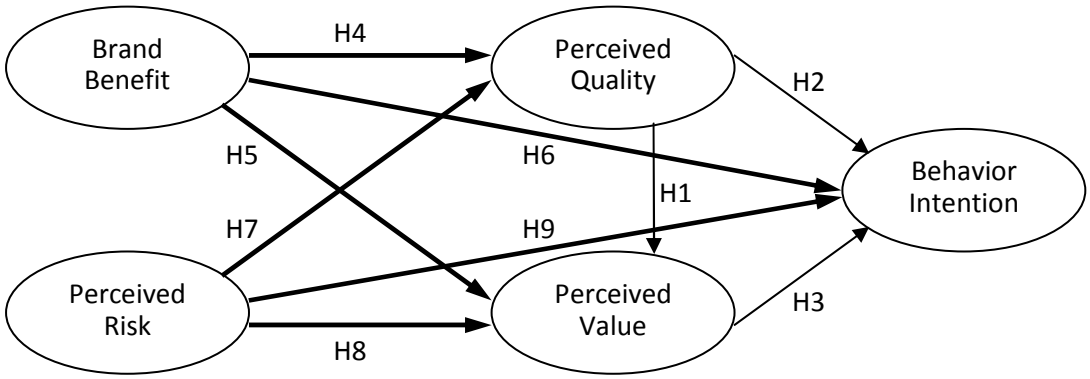
The concept of the give out can be regarded as a risk, including the actual monetary costs during the purchase, and invisible costs (Zeithaml, 1988). Bolton and Drew (1991) state the appraisal of the service value will be affected by those elements including service quality, cognition service, uncertainty, sacrifice, and individual characteristics; uncertainty and sacrifice are related to the concept of the perceived risk described in this study. Salam, Rao, and Pegels (2003) explain that although an online transaction is identical to a cost savings plan, the consumers' perceived risk will reduce their perceived value.

Furthermore, Bhatnagar et al. (2000) argued that although online shopping has many advantages for consumers' purchasing decisions, what mainly making consumers hesitate is the risk perception of online purchasing. Salam et al. (2003) also explained that there are thousands of consumers who go online everyday but could not finish the purchase process, and the most common problem is that consumers are not willing to reveal their credit card number or related personal information due to the consideration of online security. Some scholars have shown that because the consumers have higher perceived risk on online shopping, thus to avoid potential losses from online shopping, they would rather not purchase online; thus, no matter how much perceived value the consumers have, perceived risk has much negative influence and explanation power on online shopping behavior (Forsythe & Shi, 2003). However, the enterprise usually offers a warranty or secure transaction to urge the

consumers to complete a purchase. Combining the above arguments, we hypothesize that:
H_7: The higher the perceived risk, the lower the perceived quality.
H_8: The higher the perceived risk, the lower the perceived value.
H_9: The higher the perceived risk, the lower the level of purchase intention.

METHODOLOGY

Our conceptual model make up for the part which is lacking in the Q-V-B model. This study brings brand benefit and perceived risk into the Q-V-B model, in which we concern these two constructs as the antecedents of perceived quality, perceived value and behavior intention. The conceptual framework is shown in Fig. 1.



* : ⟶ the relationships have been proven by prior literatures
** : ⟶ the relationships will be proven by this study

Fig. 1 Conceptual model

1 Measurement

Earlier work has provided ways of measuring the constructs of the Q-V-B model which were included in the present study. In addition, all measurement items were identified and based on the definitions of each construct. In addition, each construct included its own related considerations (i.e. sub-dimension) in order to precisely complete the analysis of items identified. Measurement dimensions and operationalized variables are shown in Table 1. All measures used in this study were measured on 7-point Likert scales from 1 (strongly disagree) to seven (strongly agree). Finally, consumers' traveling experience variables and socio-demographic variables were also collected and refereed by Heung and Chu (2000). Interrelationships among the study variables, measure items, and references are presented in Table 1.

Table 1
Summary of variables for questionnaire

constructs	Items	reference
Brand benefit	Brand of XYZ represents a good performance (X1) Brand of XYZ has an acceptable standard of quality (X2) Brand of XYZ can display your status symbol (X3) Brand of XYZ would give its owner social approval (X4) Brand of XYZ would improve the way I am perceived (X5)	Aaker and Joachimsthaler (2000) ; Ambler (1997); Orth et al. (2004)
Perceived risk	My estimate of the average price like XYZ is high (X6) Buying XYZ required a lot time to consider (X7) Buying XYZ required a lot effort to buy (X8) In purchasing XYZ, I am uncertain of my choice (X9) It is rather complicated to choose a XYZ (X10)	Cordell (1993); Grewal *et al*., (1994); Kwun and Oh (2004)
Perceived quality	Generally, employees of the XYZ are willing and able to provide service in a timely manner (X11) The XYZ do not possess the reputation (reversed) (X12) The quality of XYZ is very creditable (X13) XYZ is very reliable (X14) Quality in Information Sources is good (X15)	Baker and Crompton (2000); Cronin *et al*. (2000); Zeithaml (1988)
Perceived value	Given the features of the XYZ, it was good value for money (X16) I received a good service quality for a reasonable price (X17) XYZ offers value for money (X18) This XYZ appears to be a bargain (X19) XYZ wouldmake a good impression on other people (20X) XYZ would give me pleasure (X21)	Sweeney and Soutar (2001); Petrick (2004); Sànchez *et al*. (2006)
Behavior intention	At the price shown, I would consider taking this XYZ (X20) If I had to do it over again, I would make the same choice (X21) I encourage friends and relatives to use XYZ (X22) The likelihood that I would recommend this XYZ to others (X23)	Baker and Crompton (2000); Cronin *et al*. (2000); Kwun and Oh (2004)

XYZ: travel product/service provided by online travel agency

2. Sampling

Bettman and Sujan (1987) discovered that consumers with different backgrounds will exhibit different attitudes, willingness to purchase and behavioral patterns. Card et al. (2003) stated that consumers with more online shopping experience will tend to buy things online. In addition, Chang, Cheung, and Lai (2005), reviewing 45 studies of online shopping, discovered that the factors that affect E-purchasing willingness include the consumer's personal characteristics and purchasing background. Further, many studies on online travel show that consumers who are used to shopping online have different consumption patterns than those consumers who do not shop online often (Beldona, Morrison, & O'Leary, 2005). For reasons given above, and to ensure a representative sample, the current study will focus on the Taiwan consumers who have experience of purchasing online travel products. Our survey was administered by purposive sampling.

In addition, based on Tinsley and Tinsley's (1987) criteria, a good sample would be 300. Bentler and Chou (1987) suggested that the ratio of sample size to the observed indicators has to exceed recommended ratio of 5:1 or 10:1. Therefore, given these research criteria, the self-administered questionnaire was obtained from 600 surveys distributed to travelers, of which 487 were returned and usable (The survey response rate was 81.2%). Of all respondents,

males composed 42.50% of the total sample while almost 57.50% were females. The majority were between 25 and 34 years of age (51.4%) and most of respondents resided in the north of Taiwan (56.3%). Among all respondents, more than half (68.6%) hold a bacholar's degree. Most of mean annual incomes of household incomes were NT$ 8,001-$16,000. The occupation distribution was skewed towards the service industries, which represented almost 27.8%. In travel-related experience of the behaviors, it shows that almost half of the respondents (56.9%) had experience of joining an all-inclusive group package tour (GPT) and checked with wholesaler (57.9%). Further, most of purpose of visiting was sightseeing (72.7%). Most of respondents (55.4%) booked a trip abroad with an online travel agency once a year on average. Respondent profiles are summarized in Table 2.

Table 2
Socio-demographic profile and characteristics of traveling experience

Characteristics	Size	%	Characteristics	Size	%
Gender			Occupations		
Male	205	42.5	Traditional industry	1	0.2
Female	277	57.5	Industry	63	13.2
Age			Commerce	95	19.8
Under 18	2	0.4	Public office	37	7.7
19~24	57	11.7	Service industry	133	27.8
25~34	250	51.4	FO industry [a]	28	5.8
35~44	96	19.8	Workless	88	18.4
45~54	55	11.3	Others	34	7.1
55~64	21	4.3	Categories of travel		
65 and over	5	1.0	GPT [b]	276	56.9
Address area in Taiwan			FIT [c]	209	43.1
East	4	0.9	Type of travel agencies		
North	272	56.3	Wholesalers	260	57.9
Midland	71	14.7	Retailers	189	42.1
South	116	24.0	Purpose of visiting		
Off-shore island	2	0.4	Sightseeing	352	72.7
Others	18	3.7	Business	64	13.2
Education			Visiting one's relatives	33	6.8
Under junior	7	1.4	Others	35	7.2
Senior	78	16.1	Average times in online purchasing		
College/Bachelor	332	68.6	One-time	269	55.4
Master and over	67	13.8	Two-times	133	27.4
Annually Income (NT$)			Three-times	45	9.3
Under $8,000	64	13.6	Four-times	12	2.5
$8,001 - $16,000	181	38.3	Five-times above	27	5.6
$16,001 - $24,000	123	26.1			
$24,001 - $32,000	47	10.0			
$32,001 and over	26	12.1			

Note. [a] Freedom-oneself industry
[b] GTP: all-inclusive group package tour.
[c] FIT: foreign individual tour

RESULTS

1. Principal Component and Reliability Analysis

The two antecedents and three endogenous variables of Q-V-B model were subjected to a principal component analysis (PCA) using varimax rotation. The appropriate factor solutions were based upon the generally accepted rule of selecting a factor solution with eigenvalues greater than one and disregarding values less than one (Hair et al., 1998). Reliability analysis, using Cronbach's alpha, was conducted to check the internal consistency of estimated items within each factor's structure. Cortina (1993) has indicated that with scales possessing a reduced number of items (e.g., six or less), a Cronbach's alpha value of .60 and above may be acceptable. The result from PCA indicates that brand benefit (BB) has five items with the reliability of 0.72; perceived risk (PR) has five items with the reliability of 0.61; perceived quality (PQ) has five items with the reliability of 0.88; perceived value (PV) has six items with the Cronbach's alpha reliability of 0.91; behavior intention (BI) has four items with the reliability of 0.86.The cumulative percentage of variance explained is 61.01 %.

2 .Confirmatory factor analysis (Measurement model)

As a further check on the PCA results, a two-step approach was chosen to ensure both the measurement model and the structural model were adequate. The confirmatory factor analysis is performed to examine the validity and reliability of this measurement model. Reliability is assessed by composite reliability (CR) and squared multiple correlations (SMC) of items within each construct (Hair et al., 1998). As shown in Table 3, the 25 scale items load on each expected construct and all t-values are statistically significant (p-value < 0.05). Moreover, the CR values range from 0.81 to 0.89 and the SMC values are acceptable. Taken together, these results indicate acceptable scale reliabilities.

Convergent validity tests were conducted to determine and to form a single construct, where all t-values must be statistically significant whether all the indicators measuring a construct clustered together or not (Bagozzi, Yi, & Phillips, 1991). Hair et al. (1998) also recommended that within-method convergent validity of the constructs is provided by inspection of each construct's average variance extracted (AVE). As argued by Fornell and Larcker (1981), convergent validity is achieved if the AVE in items by their respective constructs is greater than the unexplained variance (i.e., AVE> 0.5). As a result, AVE of each is almost larger than 0.5 except for the construct of perceived risk (AVE=0.49). Thus, the present study concludes that the involvement measure exhibits adequate convergence validity.

Discriminant validity is assessed by means of Fornell and Larcker's (1981) test of average trait variance extracted (see Table 4). It is recommended that square root of AVE should be greater than the variance shared between the latent construct and other latent constructs in the model. All construct pairs the square root of the AVE from the traits almost exceed the correlation between the two respective constructs, evidence for the presence of discriminant validity is provided. The overall fitness indices are adequate ($\chi 2$ (265) = 760.61, chi-square/degree of freedom = 2.87, RMSEA = 0.063, GFI = 0.89, IFI = 0.91, CFI = 0.91, and NNFI = 0.90), thus indicating that the final measurement model fits the data reasonably well.

Table 4 also presents means, standard deviations, and correlations among the constructs.

Table 3
Confirmatory factor analysis of measurement model

Construct	Item	Alpha	CFA					
			SFL	USFL	t value	SMC	AVE	CR
Brand benefit (BB)		0.72					0.57	0.87
	X1		0.90	1.00		0.81		
	X2		0.85	0.94	10.37	0.72		
	X3		0.64	0.71	8.71	0.41		
	X4		0.65	0.72	8.42	0.42		
	X5		0.70	0.78	9.66	0.49		
Perceived risk (PR)		0.61					0.49	0.81
	X6		0.94	1.00		0.88		
	X7		0.48	0.52	5.08	0.23		
	X8		0.39	0.42	5.03	0.15		
	X9		0.65	0.70	8.17	0.42		
	X10		0.86	0.92	8.73	0.74		
Perceived quality (PQ)		0.88					0.74	0.93
	X11		0.89	1.00		0.79		
	X12		0.92	1.03	19.73	0.85		
	X13		0.84	0.94	18.23	0.71		
	X14		0.80	0.90	16.65	0.64		
	X15		0.83	0.94	16.01	0.69		
Perceived value (PV)		0.91					0.72	0.94
	X16		0.77	1.00		0.59		
	X17		0.88	1.15	17.44	0.77		
	X18		0.85	1.11	16.19	0.72		
	X19		0.90	1.18	17.34	0.81		
	X20		0.91	1.18	17.46	0.83		
	X21		0.79	1.03	15.33	0.62		
Behavior Intention (BI)		0.86					0.82	0.95
	X22		0.99	1.00		0.98		
	X23		0.93	0.93	18.96	0.86		
	X24		0.76	0.76	15.61	0.58		
	X25		0.93	0.92	18.79	0.86		

Table 4
Discriminant validity and correlations for integrative model

Construct	Mean	S.D	BB	PR	PQ	PV	BI
BB	4.89	0.88	*1 (0.75)*				
PR	3.76	0.83	0.02	*1 (0.70)*			
PQ	4.97	0.92	0.53	-0.13	*1 (0.86)*		
PV	4.76	0.88	0.59	-0.20	0.74	*1 (0.85)*	
BI	4.83	0.98	0.42	-0.20	0.63	0.77	*1 (0.91)*

Note: ( ) reports the square root of AVE

3. Hypotheses Tests

With the results obtained, the hypotheses proposed are almost all significant, but H6 is not supported. As Fig. 2 shows, in three of our hypotheses, the support is provided for H1 as PQ is significantly andpositively correlated to PV (β_{21} = 0.57, t = 10.03). For customers purchasing travel products online, this result implies that the higher quality consumers perceive, the higher the value they have. As expected in H1, both of these constructs, PQ and PV are positively linked to BI (β_{31} = 0.15x, t = 0.15; β_{32} = 0.69, t = 8. 78, respectively); H2 and H3 are therefore supported. These results reveal that when consumers are involved in an online purchase process to buy a travel product, the higher quality and value consumers perceive, the greater the likelihood purchase intention they have. This finding of Q-V-B model is consistent with past studies that revealed similar result to ours (Baker et al., 2002; Cole et al., 2003; Petrick, 2004).

Concerning the links among one antecedents variable of the Q-V-B model, brand benefit, the results indicate that BB is a consistent positive antecedent of PQ (γ_{11} = 0.53, t = 8.48) and PV (γ_{21} = 0.29, t = 5.23), supporting H4 and H5. For consumers of purchasing travel products online process, the results imply that the more consumers are aware of brand benefits, the higher the quality and value they perceive. With regard to the BB-BI relationship, support is not found for H6 (γ_{31} = -0.06, t = -1.02). Based on the results, this study concludes that consumers will have good perceived quality and value from purchasing products online when they are aware of the brand benefits. Nevertheless, regarding the final buying decision, perceptions of quality and value still dominate the determinable position although brand benefit can motivate consumers to have preference for certain brands. In other words, when brand benefit is simultaneously included in the Q-V-B model, the influence of brand benefit is reduced and the predictive strength of the constructs chain is gradually weakened.

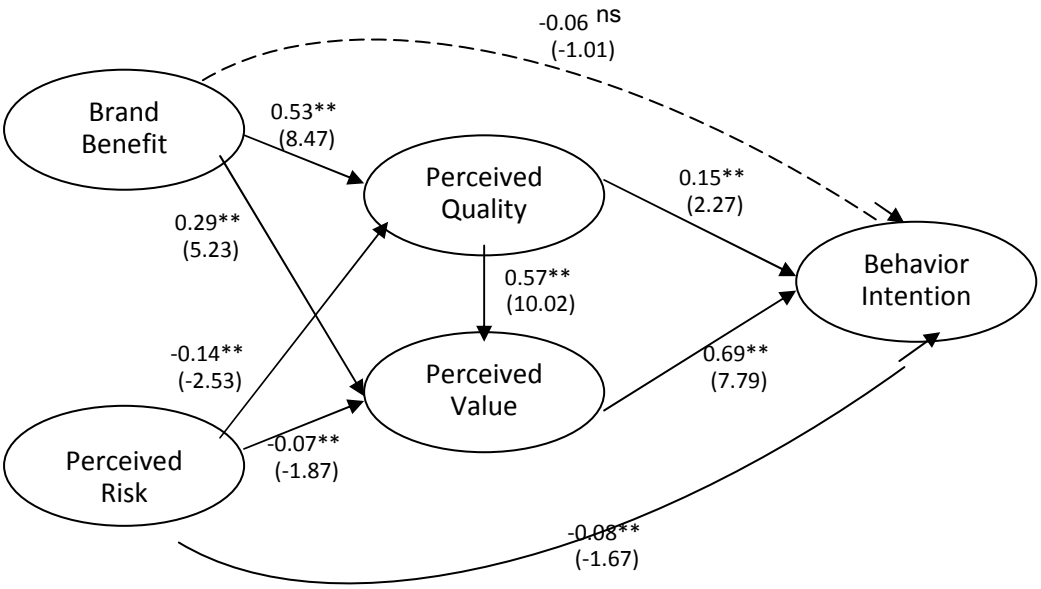


Fig. 2 Final structural model

Turn to other exogenous variable of the Q-V-B model in current study, perceived risk, PR of travel products purchased online is not only found to affect PQ significantly ($\gamma 12 = -0.14$, $t = -2.54$) but also marginally emerges as a significant predictor of PV and BI ($\gamma 22 = -0.08$, $t = -1.88$, and $\gamma 32 = -0.08$, $t = -1.69$, respectively); the results support negative relationships of PR and Q-V-B model for H7, H8, and H9. These results suggest that the more risky consumers perceive purchasing travel online to be, the higher the perceived quality. At the same time, consumers' perceived risk has more or less impact on perceived value and behavior intention in online purchasing.

The overall fitness indices are adequate ($\chi 2$ (265) = 760.61, chi-square/degree of freedom = 2.87, RMSEA = 0.063, GFI = 0.89, IFI = 0.91, CFI = 0.91, and NNFI = 0.90), thus indicating that the final measurement model fits the data reasonably well.

4. Effect analysis

When the analysis of indirect/total effects is taken into account, our conceptual model almost supports the antecedent roles of BB and PR in predicting the Q-V-B model (see Table 5). BB has a strong effect on all constructs, both by direct and indirect means; interestingly, significant support for behavior intention is revealed by indirect and total effects (parameter = 0.49, t = 7.97 and parameter = 0.43, t = 7.03, respectively). The findings reveal that brand benefit consumers awarded may be through the PQ and PV to influence their behavior intention in online purchasing. Besides, BB has significant direct and indirect effects on PV.
Concerning the links among another antecedent: PR has a significant and negative impact on all constructs of the Q-V-B model in total and indirect effects, implying that the higher the perceived risk consumers have, the higher quality and value of travel product they perceive, and the greater the likelihood that they will make a purchase. The indirect and total estimators of PQ to PV and BI are also presented Table 5.

Table 5
Standardized indirect and total effects in integrative model

Independent Variable		dependent Variable	Indirect effect			Total effect		
			SEf	SD	t-value	SEf	SD	t-value
BB	→	PQ	--	--	--	0.53	0.06	8.48
		PV	0.30	0.04	7.13	0.60	0.06	9.05
		BI	0.49	0.07	7.97	0.43	0.07	7.03
PR	→	PQ	--	--	--	-0.14	0.05	-2.54
		PV	-0.08	0.03	-2.50	-0.16	0.04	-3.06
		BI	-0.13	0.05	-3.13	-0.20	0.06	-3.56
PQ	→	PV	--	--	--	0.57	0.05	10.03
		BI	0.39	0.06	7.37	0.54	0.07	8.87

Note: SEf=standard effect; SD= standard deviation; t-value (1.645, one trail, $p<0.05$)

CONCLUSION

1. Theoretical Contribution

Sheth et al. (1991) point out that consumers' purchasing decisions are often motivated by product value driven. Indeed, the current study empirically confirms that perceived value is superordinate to perceived risk and value in its influence on online travel purchase. However, it is not enough if discussing a product's value for determining factor in attitude formation. Attribute information about products and services is usually very limited at the point of purchase, where decisions concerning these products will often be made. Hence it seems reasonable to expect consumers to rely to a large extent on readily available extrinsic cues, such as brand benefits (Orth et al., 2008). For example, an orientation toward quality and performance of product/service is associated with higher preference for a specific brand, while a low price/value for money orientation is associated with lower brand preference. Also, millions of consumers browse thousands of Web vendor sites everyday with the intention of buying products and services. Yet, the majority of these consumers opt for buying the products or services from a brick-and-mortar facility rather than completing the process of online purchase (Salam et al., 2003). Hence, closing this knowledge gap is important because, with respect to many online travel agencies and travel suppliers, consumers seek brand benefits rather than product attributes, and they often act in this way for social psychological reasons.

Although a significant amount of research has examined drivers of perceived quality or perceived value, past studies have almost all focused either on product attributes or exclusively focused on brand name/image and failed to establish links to brand meaning (that is, "brand represents what?") in terms of the benefits desired by individuals in brands (Orth & Kahle, 2008). Through building up of the model structure and hypothesis testing, brand benefit may have a significant and positive influence on customer's perceived quality and value, thus confirming its crucial role in predicting perception the quality and value of the product. The brand benefits that consumers desired can emphasize selected brands, then enhance the assessment of specific products. Therefore, the benefits consumers desired in a

brand are a useful concept for explaining perceptions of quality and value toward online purchasing.
In contrast with previous studies which confirmed the effect of perceived quality on perceived risk, this result may be the objectives of past studies employing tangible consumer goods. Because travel products are intangible, and because travel involves certain risks, the consumer is to some extent taking the provider on trust (Mattila, 2001). Thus, when consumers purchase these kinds of products online, they face uncertainty and perceive some risk at first. Accordingly, it is also found that perceived risk does not only influence consumer's perceptions of value of travel products, but also has an impact on their behavior during online purchasing. This also means although online purchasing behavior is informed by an understanding of quality and value, perceived risk still has a negative effect on buyer behavior when considering travel product purchase. It reveals that perceived risk indeed acts as an important antecedent of the Q-V-B model during online purchasing.

Furthermore, this study also found that the Q-V-B model is proved in the online context; our results demonstrate the model's predictive power regarding the relationship between perceived quality and value and online travel purchase outcome. Given the predictive strength of PV over PQ, the results suggest that in the casual relationships among perceived quality, perceived value and behavior intention, both perceived quality and perceived value can affect consumers' behavior intention. Meanwhile, the perception of values the consumer desires is a fundamental determinant of decision-making in the online purchasing process. This result matches what Zeithmal et al. (1996) emphasized: that perceived quality has a big effect on consumer behavior, and that perceived quality is an important factor.

The goal of our study is to explore the effect of two variables, brand benefit and perceived risk, on the Q-V-B model, because when consumers are aware of both risks and brand benefits, only invoking the Q-V-B model to discuss online purchasing behavior may be over simplified. As well as simply confirming that existing relationships among Q-V-B model discussed either with brand benefit or perceived risk, this study will help online travel agencies understand better how consumers assess the quality and value of their products, in order to strengthen marketing. Based on the results of this study, we provide some management implications and suggestions for future research.

2. Implications for management

This study finds that brand benefit has a significant effect on perceived quality and perceived value; that is, consumers' understanding of product quality and value. Basically, brand can bring consumers many positive association and benefits (Aaker & Joachimsthaler, 2000). We suggest that brand benefit is the application of branding strategies for products that serves to heighten consumers' understanding of the product's quality and value. Since the benefits desired from a product category are evaluated differently than those expected from travel products, brand and product managers should first understand how consumers know the company's brand, what benefits the firm's brand bring, what brand consumers have uppermost in their minds. Thus, branding should be informed by desired consumer ideals, such as youthfulness, adventure, splendent, and sophistication. In addition, the company also should consider how to improve its products, in order to bring consumers functional benefits. As what Keshav (2000) has emphasized, consumers frequently distinguish one hotel from

another by brand; this explains why brand benefit is the major factor that affects consumers' assessment, and is an important tool for the corporation to build up its competitive advantage. In addition, the evidence presented strongly argues for the importance of examining relations between perceived risk and the Q-V-B model. In other words, perceived risk is another important factor that affects consumers' behaviors, especially when the consumers' purchasing decision is subject to a high degree of uncertainty (as with online travel agencies). Since perceived risk is a negative factor, the management should understand when the company markets its products or services to consumers, what kinds of risk will occur to consumers; also, they should reflect on how to reduce consumers' perceived risks. Moreover, perceived risk has a close relationship with uncertainty; generally speaking, the higher the uncertainty on a purchase decision, the higher the consumers' perceived risk. Thus, if online travel agencies can reduce the uncertainty of purchase decision in online process (e.g. secure system of credit card payment, money-back guarantee, confirmed reservations), consumers' perceived risk will be diminished.

This study has proven the Q-V-B model, as well as stressed the importance of perceived quality and perceived value; they both have a positive effect on consumers' behavior intention. Furthermore, from indirect and total effect analysis, this study found that perceived quality and perceived value mediate the way in which brand benefit and perceived risk affect consumers' behavior intention. The results conclude that raising brand benefit or reducing perceived risk may not be sufficient to increase the consumers' behavior intention (BB to BI is non-significant and the effect of PR to BI is weaker though the connection is significant); managers should also cause consumers to have a positive assessment on perceived quality and perceived value towards online travel purchase, and towards the firm's performance. In this way, consumers with high value consciousness will be more likely to return to the firm's site, and make a purchase. Thus, travel agencies should not only work on improving their products, they must reflect on ways to create the biggest perceived value for consumers.

3. Limitation and suggestion of future research

Taking brand benefit and perceived risk as antecedents of Q-V-B model, and the characteristics of travel product we discussed, this study combines brand and perceived risk theory and Q-V-B model to build up a more integrated structure for the tourism domain. However, other factors of a firm's perspective and composition, such as consumers' characteristics and company's marketing strategy may affect the assessment the consumers make of products or services. Typical consumer personality is particularly important here. For this to happen, future studies need to conceptualize and measure additional observations from these areas. In addition, the major participants of studies like this one would ideally have practical online purchase experiences. It is also important that participants make their purchasing decision through the Internet and without reference to others. Besides, since we had no participant pool making online travel purchases, our study was confined to purposive sampling. Future research should attempt to overcome those problems.

Since the purchase behavior of online shopping is different from the behavior found in bricks and mortar stores, we suggest that future research might focus on the investigation of the consumers with both physical and E-purchasing experience, and further distinguish and compare the spending patterns for both online and non-online contexts to generate more

insights and contributions. Furthermore, this study only undertook a cross-sectional investigation. The results cannot resulted in a greater impact on the endurance of the process of consumers' purchasing decision making and behavioral changes. Future longitudinal studies should therefore assess consumers' cognition strength and valence at several points in time to strengthen the outcome of dynamic purchasing behaviors Finally, there are many studies focusing on the online context that mostly point out technology has played an important role on purchasing decisions in the past; for example, TAM shows that the degree to which consumers can accept the latest technology will affect their purchasing attitudes and decisions. Thus, if future studies could investigate this topic from the perspective of the TAM model in combination with the Q-V-B model, interesting findings would likely result.

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THE RELATIONSHIP OF THE THEORY OF THE MANAGERIAL PHILOSOPHY OF PEACE CULTURE AND BUSINESS PERFORMANCE IN MNES

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ABSTRACT

This research considers the influence of peace culture and cross-cultural management to MNEs business performance. The empirical result this research gets is that the peace culture is a positive relationship to MNEs business performance, in which cross-cultural management as intervention. The methodology adapts survey method and collects samples from MNEs subsidiaries of U.S and Japan in Taiwan. We find U.S and Japan both agree that peace culture practices in their management system will get established performance. The practice of peace culture in Japan is higher than U.S.. Two countries have the difference in the moral quality of managers and the consumer conviction, whether the other factors are the same.

Keywords: P-theory, cross-cultural management, business performance

INTRODUCTION

The part faces of the managers of multinational enterprises (MNEs) are the trends of business operation globalization and the quickly changing of the global environment. BMW is Germany company, but it products it's own car at North Carolina; McDonald's sells it's hamburger in the whole world; Japan company TOYOTA manufactures it's car at Kentucky state in U.S.; FORD manufactures it's car chair, windscreen and fuel tank in Mexico, shock absorber in Japan, electronic engine control in Spain, anti-lock break system in Germany, and parts of wheel axle in British. These examples show this world is becoming the global village, and MNEs are forging ahead international management.

To work efficiently in no national boundaries, MNEs have to adapt into versatility of nationality, culture and environment. In the past, MNEs manage subsidiaries with parochialism. It is ethnocentric view. The manager only regards globalization as the best, but not the different working way of different people in different countries. This kind of viewpoint could not be agreed in the modern international management. This is because different countries are with different value, moral, custom, politics, economy system and law. It is the most challenge operating in the various environments. MNEs have to face the different cultures and look for the appropriate system for multicultural to achieve the goal of MNEs.

In 2001, there are about 60 thousand MNEs and they employee over 45 millions staffs. Meanwhile, they create over 1,600,000 millions turnover and 80% of them are developed countries. By 2010, it will be estimated that the number of MNEs will increase to 90 thousands, own 15millions subsidiaries, employ over 75millions staff and 2,500,000 millions turnover (Briscoe and Schuler, 2004). JETRO (2007) shows that by 2005, the total global investment is 1,700,000 millions, about 4.5 times of 1993, 27.5 times of 1985. U.S. is the most investment amount 361060 millions; British is the second amount 200,522 millions and Japan is the sixth. Meanwhile, the statistic data from Taiwan Investment Commission shows that through 1952 to 2008, the foreign investment volume to Taiwan, whatever the case or amount, U.S. is the first number one (18,176millions, 19.33%) and Japan the second (15,373 millions, 16.35%), and the data shows the global investment of development countries to Taiwan is quite energetic.

The trend of business internationalization pushes that when MNEs conduct foreign direct investment (FDI) in various regions, managers should consider the difference of culture at the same time and its effect to MNEs performance (Dunning, 1993). The concept of MNEs' taking multicultural management system is known, but only with that to heighten MNEs' performance seems not enough. It still has many problems. In the past, the performance measure of MNEs centre on promotion of technique, human resource, finance capital and market share. But it neglects the significance of business ethics and moral and draws out fraudulence such as the crash of Lehman Brothers, U.S. subprime lending brining about depression of U.S. economy and causes the misfortune of human welfare.

21th Century, in depth development of business globalization, region economy and high technology prosperity, "peace development" is the main objective for people to pursue. But because of different values in different nations, races, colors and religion beliefs, this phenomenon causes some tragedies like U.S. 911 terrorist attack in 2001, France riot in 2005, the Ghazzah war of Israel and Pakistan in 2008, and structured note crash of U.S. Lehman Brothers causing finance meltdown, the worldwide stock market fatigue, business grave loss, the rising of unemployed rate, and the worldwide economy depression. These all show that it is the lack of cognition on peaceful coexistence among nations, intelligence, and business ethic, and only pursue "profit or benefit". On these grounds, the nations recognize the importance of "peaceful coexistence". Eastern Europe-European Union (EU) peace treaty, promoting the common consensus, agreeing "solving the discrepancy and argument, objecting the menace of military might" in the region; Association of Southeast Asian Nations (ASEAN), establishing ASEAN peace treaty in 2005 shows the production of the spirit of coexistence.

The conflict, confronting position, disunity, and war in civilization is not caused by the difference of nations, races and religion belief, but the "human heart". Lacking of the concept "human coexistence" will confront many difficulties and challenges on MNEs development, world peace, and nation economy prosperity.To promote the harmony and have good interaction among nations, MNEs should possess the managerial philosophy of peace culture (p theory; peace culture) (Lin, 2006). Here we bring up three questions: first, the relation of the peace culture and cross-cultural management system; second, the relation of cross-cultural management system and MNEs business performance; third, the relation of the peace culture and MNEs business performance.

THEORY AND HYPOTHESIS

The theory of the managerial philosophy of peace culture (p theory; peace culture)

The management philosophy of MNEs' manager is the root of business operation. It is the belief, principle, and ideal that the manager holds, and great influences to the object of business. The activity content of business will effect to the employee, stockholder, stakeholder, and business performance (Dunning, 2003; Resick et al., 2006; Lin, 2006). Lin (2004) extends in meaning the peace culture of MNEs from Ikeda (1999) world peace thinking. This theory indicates that except human resource, technology, and skill, MNEs managers should possess the thinking of peace culture management philosophy, the spirit of peace coexistence. With these, MNEs can agglomerate multicultural and multi-races to resolve the problems of the multi-nation, culture, and religions.

The research of Lin (2006) has much specific in peace culture. The contents are: 1 the maximized benefit which is including the employee, customer, and social welfare in the home and local; 2 Business ethic; 3 with charity, intelligence and courage; 4 superior business citizen; 5 taking account of hi-technology product, environment protection and citizen health; 6 the spirit to achieve peace, welfare and coexistence; 7 management in kindly way principle treatment—respecting to the management by virtue, edification, and esteeming humanity; 8 genuine international friendship, partaking peace and prosperity; 9 attentive to other races, human rights and dignity; 10 Bodhisattva business organization—respecting to the benefit of customer, producing the products by ingenuity, and concerning to the after-sales service, satisfaction and trust. Resick, Hanges, Cickson, and Mitchelson (2006) advocate ethic leadership that managers should equip to esteem human rights. Only managers possessing ethic management can influence the other people by social power. Dunning (2003), Mizumoto (2006) claims that MNEs should have the belief of efficiency, fair, participative management, creation, risk adjustment, respecting human rights, and the environment of peace to advocate human welfare.

Past studies indicated that the difference of corporation culture will cause the different management system. The main reason is because of the concept of the manager (Lin, 2006; Dunning, 2003; Resick et. al., 2006). It reveals that whether peace culture has or not is an important issue. MNEs should include social responsibility, ethic, social welfare, peace management into business operation to raise business performance (Lin, 2006; Miroshnik, 2002; Resick et al., 2006; Kambayshi and Scarbrough, 2001).

Cross-cultural management

Hofstede (1908, 1983) is the first one who claims cross-culture. He concretes the difference of multicultural and regards it a predict variable of MNEs business performance (Tihanyi, Griggith, and Ressell, 2005; Tsai, Lu, and Lee, 2006; Slangen, 2006). In his study he indicates that between manager and employee, there are five different aspects in national culture: power distance, individualism versus collectivism, quantity versus quality of life, uncertainty avoidance. In 1993, he continued to advocate global leadership and organizational behavior effectiveness (GLOBE) and nine different aspects in national culture:

assertiveness, future orientation, gender differentiation, uncertainty avoidance, power distance, individualism versus collectivism, in-group collectivism, performance orientation, human orientation.

But Lin (2006) brings up the different view for cross-culture. The study indicates that to enhance MNEs business performance, MNEs manager should realize the difference of human resource and employee welfare between parent and subsidiary. The study discriminate the culture management into three categories: the first culture management—the manager belongs to the parent company and facilitates the management system in the subsidiary followed by the home society culture; the second culture management—the manager belongs to the subsidiary and facilitate the management system followed by the local society culture; the third culture management—the management system in subsidiary is facilitated by the culture combined the advantages of the first and second cultures. Resick et. al., (2006)、Miroshnik (2002) and Chikudate (1991) indicate that understanding the difference and similarity among multicultural can come at the appropriate business style and raise the business performance.

The culture aspect is the different viewpoint between Hofstede (1980, 1983) and Lin (2006), but similar between Chakrabarthy and Perlmutter (1985) and Lin (2006). Chakrabarthy and Perlmutter (1985) indicates that for MNEs, facing multicultural, the management tendency reacting to the local culture includes ethnocentric, polycentric, regioncentric and geocentric, called EPRG model. MNEs adopting ethnocentric tends to home country culture and the management is controlled by parent company. This is similar with the first culture of the study of Lin (2006).

MNEs adopting polycentric tends to host country culture and management is controlled by the subsidiary. This is similar with the second culture of the study of Lin (2006). Regioncentric and geocentric emphasize the integration of home and host culture. The management way of the subsidiary complies with parent company way and adjust it by the host situation. It is similar with the third culture of the study of Lin (2006). Because of multicultural environments, if the management system of MNEs includes the thinking of peace, we think it will help the manager to have more respect and tolerance and adapt the cross-culture management system. Based above, we infer:

H1 the management system with peace culture is the positive relation with adaptation of the cross-culture

MNEs managers should understand the difference of human resource
system and employee welfare system among the first, second
and third culture. Meanwhile they should understand the local environment to decide the appropriate management system. There are some common points in prior studies: Hofstede (1980, 1983) stresses quantity versus quality of life; GLOBE stresses on encouraging rewarding, beneficent and human orientation. Here we can understand that the modern corporations can be not only pursuing the maximized profit, but also considering the volunteer activities such as charity business, resource and environment protection, concerning customer and employee, and social welfare. But the thinking of peace culture has to be facilitated through management system to raise MNEs business performance. Prior studies

indicate that the third culture can raise MNEs performance efficiently (Lin, 2006; Li, 2008; Lin, 2008). Lin and Chung (2006) empirical that subsidiaries of U.S. and Japan in Taiwan consider that it is more important to adopt the third culture. Whatever the stock turnover, account receive turnover rate, fixed asset turnover, and profit ability, their business performance always exceeds to Taiwan companies. Based above, we infer that the relation of the management system with peace culture and MNEs business performance should have cross-cultural as intervention.

H2 The more adaptation of the third culture, the higher business performance of MNEs subsidiary

H3 The relation of the management system with peace culture and MNEs subsidiary business performance is positive

H3a The higher using level of the management system with peace culture, the higher MNEs subsidiary business performance

H3b MNEs subsidiary adapting cross-culture has the intervention effect to the relation the management system with peace culture and business performance

Business performance

Performance is the outcome of control (Geringer and Hebert, 1989). Dugrette and Stowe (1993) think that performance is the indicator of achieving planned goals or object. Hitt (1998) indicates that the research of management policy uses finance indicator as measurment, and organization research uses non-finance. Vendatraman and Ramanujam (1986) indicate three aspects of measurement of performance: 1 the most representative operation performance: return of assets (ROA), return of equity (ROE), and return of sale (ROS); 2 business performance: market share, new product sale, product quality, marketing efficiency, business position; 3 organization efficiency: resolving of conflict, satisfaction of goal of stockholder, and quality of social responsibility. Carpano, Chrisman and Roth (1994), Taggart and Hood (1994) think that the achievement of performance includes the target of subsidiary sale, new product, market share, sale growth. Kirchoff (1997) indicates the non-finance performance indicators include organization stability, labour turnover rate, labour satisfaction and working efficiency. Based above studies, we generalize the MNEs business performance indicators in our study to fit our research purpose.

RESEARCH DESIGN

Variable measurement

Independent variable peace culture, based on prior studies, we uses Lin (2006) operational definition. The peace culture divides into four aspects: moral quality of MNEs manager (integrity, virtue, fair, charity); business ethic cognition (respect, welfare maximized, going concern business); consumer conviction (people orientation, distance of mind, truth friendship, ingenuity); practicable organization behavior (degree of authority, amicability). Dependence variable the business performance indicators are subsidiary sale target, goal of

new product development, market share, sale growth rate, production, and investment return. Intervention variable the third culture management system, we continue using the measurement developed by Chakravarthy and Perlmutter (1985), Lin (2006), and Teng (2007). Control variable, to practice the peace culture philosophy into management activities, the manager have to fit to the local environment for a long time. For this consideration, we take the samplings from subsidiaries in Taiwan for at least five years, and focus on manufacture industry to exclude the interfering of the industry characters.

Sampling and methodology

The sampling is from U.S. and Japan subsidiaries in Taiwan and can be compared with the results. The collecting of sampling method is by questionnaire survey and 5-point Likert measurement (1 strong disagree; 5 strong agree). Meanwhile, the samples are randomly sampling from the roster of Taiwan Investment Commission. For the reliability and validity, the independent variable the Cronbach's α is 0.9669, and the validity GFI is 0.7958; The intervention variable the Cronbach's α is 0.912, and the validity GFI is 0.6119; The dependent variable the Cronbach's α is 0.861, and the validity GFI is 0.692.

Results

Table 1 the correlation analysis of peace culture, cross-culture, and business performance

variable	VIF	Ave.	Std.β	1	2	3	4	5	6
1	1.23	3.86	0.59	1					
2	1.28	3.89	0.71	0.234**	1				
3	1.23	3.89	0.76	0.388**	0.212*	1			
4	1.03	3.92	0.69	0.07	0.042	-0.066	1		
5	1.31	3.80	0.44	0.245**	0.447**	0.233**	0.112	1	
6		3.92	0.49	0.367**	0.289**	0.217**	-0.038	0.384**	1

Note：***p<0.01；**p<0.05；*p<0.1

When MNEs operate at overseas, whether the management system is work or not will influence the subsidiary's business performance. Peace culture should be considered into one of the factor of the management system when the subsidiaries face the multicultural. We send out 180 questionnaires and 160 are returned, which 15 are invalid. Return rate is 80.5%. Meanwhile, U.S has 62, occupied 42.75%; Japan has 82, occupied 57.25%. Table 1 shows the correlation analysis of the peace culture, cross-culture, and business performance. 1 is moral quality of manager; 2 is business ethic cognition; 3 is customer conviction; 4 is organization behavior; 5 is cross-culture; 6 is business performance. In table 1, it shows that the correlation among variables and VIF is low. It means no multicollinearity problem. Thus, we continue to use step regression to empirical the intervention effect, and ANOVA to U.S. and Japan.

The result of descriptive statistics of U.S. and Japanese subsidiaries

Table 2 the peace culture agreement Comparison of U.S. and Japanese subsidiaries

Contents	Overall	U.S.	Japan
1. Maximized social welfare	3.84	3.69	3.97
2. Holding business ethic	4.03	3.96	4.10
3. Courage of charity	3.36	3.38	3.33
4. Superior business citizen	3.83	3.65	3.97
5. Taking account of hi-technology product, environment protection	3.78	3.77	3.79
6. The spirit of MNEs to achieve peace	3.98	3.96	4.00
7. Management in kindly way principle treatment	4.29	4.31	4.27
8. Genuine international friendship	4.02	3.89	4.12
9. Attentive to other races, human rights and dignity	3.90	3.65	4.10
10. Bodhisattva business organization	3.85	3.81	3.88

Table 3 the business performance comparison of U.S. and Japanese subsidiaries

Contents	Overall	U.S.	Japan
New product sale achievement	3.85	3.62	4.03
Market share achievement	3.90	3.65	4.09
New product development achievement	3.80	3.85	3.76
Sale growth rate achievement	4.00	3.92	4.06
Production achievement	3.95	4.04	3.88
Sale target achievement	3.88	4.03	3.76
Investment return achievement	4.02	4.15	3.91

Table 2 shows the peace culture agreement comparison of U.S. and Japanese subsidiaries. In table 2 we find that in the 10 indicators, the level of agreement score of Japan all are higher that of U.S., only courage of charity lower. Table 3 shows the outcome of business performance. In table 3 we find that in the score of new product sale achievement, market share achievement, and sale growth rate achievement, Japan is higher than U.S.; in the score of new product development achievement, production achievement, sale target achievement, and investment return achievement, U.S. is higher than Japan.

Results of hypothesis test

Table 4 H1 the regression model of peace culture and cross-culture

	Overall				U.S.			
	Std. err.	Std.β	t-value	Sig.	Std .err.	Std.β	t-value	Sig.
Constant	.314		6.586	.000***	.551		4.901	.000***
Moral quality of manager	.060	.101	1.234	.219	.122	-.014	-.100	.921
Business ethic cognition	.047	.395	5.517	.000***	.079	.360	2.596	.012*
Customer conviction	.047	.116	1.434	.154	.074	.163	1.288	.224
Organization behavior	.047	.096	1.288	.200	.084	.008	0.067	.947
Adj. R^2	0.239				0.188			
					Japan			
					Std .err.	Std.β	t-value	Sig.
Constant					.393		4.37	.000***
Moral quality of manager					.073	.175	1.643	.104
Business ethic cognition					.065	.430	4.417	.000***
Customer conviction					.064	.081	.754	.453
Organization behavior					.059	.135	1.397	.166
Adj. R^2					.299			

Note：***p<0.01；**p<0.05；*p<0.1

Table 5 H2 the regression model of cross-culture and business performance

	Overall				U.S.			
	Std. err.	Std.β	t-value	Sig.	Std .err.	Std.β	t-value	Sig.
Constant	0.328		7.022	.000***	0.562		4.938	.000***
Cross-culture	0.086	0.384	4.975	.000***	0.146	0.243	1.940	.057*
Adj. R^2	0.148							
					Japan			
					Std .err.	Std.β	t-value	Sig.
Constant					0.386		5.058	.000***
Cross-culture					0.101	0.504	5.257	.000***
Adj. R^2					0.254			

Note：***p<0.01；**p<0.05；*p<0.1

Table 6 H3 overall the intervention effect of peace culture, cross-culture and business performance

Variables	Step1	Step2	Step1	Step2	Step1	Step2	Step1	Step2
Moral quality of manager		0.237						
Business ethic cognition				0.289				
Customer conviction						0.135		
Organization behavior								-0.082
Cross-culture		0.348		0.348		0.353		0.393
R^2	0.142	0.227	0.077	0.148	0.04	0.165	0.038	0.154
ΔR^2		0.085		0.071		0.125		0.116
F	24.748***	20.827***	13.077***	13.992***	7.708***	14.007***	0.207	12.941***

Note：***p<0.01；**p<0.05；*p<0.1

Table 7 H3 U.S. the intervention effect of peace culture, cross-culture and business performance

Variables	Step1	Step2	Step1	Step2	Step1	Step2	Step1	Step2
Moral quality of manager		0.270						
Business ethic cognition				0.086				
Customer conviction						0.244		
Organization behavior								0.082
Cross-culture		0.186		0.387		0.175		0.249
R^2	0.081	0.129	0.164	0.184	0.071	0.114	0.004	0.066
ΔR^2		0.048		0.02		0.043		0.062
F	6.354**	2.951**	12.963***	6.642**	5.268*	3.801*	0.246	2.074

Note：***p<0.01；**p<0.05；*p<0.1

Table 8 H3 Japan the intervention effect of peace culture, cross-culture and business performance

Variables	Step1	Step2	Step1	Step2	Step1	Step2	Step1	Step2
Moral quality of manager		0.343						
Business ethic cognition				-0.071				
Customer conviction						0.020		
Organization behavior								-0.226
Cross-culture		0.416		0.538		0.500		0.555
R^2	0.245	0.364	0.023	0.258	0.004	0.255	0.01	0.303
ΔR^2		0.119		0.235		0.251		0.293
F	27.634***	22.904***	2.947	13.926***	1.352	13.674***	0.246	2.074***

Note：***p<0.01；**p<0.05；*p<0.1

This study presents three hypothesises and the empirical results are showed on table 4 to table 8. Table 4 is the empirical result of H1. From the aspects of overall (F-value=10.997, P-value=0.000***), U.S. (F-value=3.303, P-value=0.017**), Japan (F-value=8.336, P-value=0.000***), each of the whole model is significant and the regression model Business ethic cognition too. This result supports H1 peace culture and cross-culture is positive relation.

Table 5 is the empirical result of H2. From the aspects of overall (F-value=29.748, P-value=0.000***), U.S. (F-value=3.763, P-value=0.057*), Japan (F-value=2.763, P-value=0.000***), each of the whole models is significant and the regression model too. This result supports H2 the cross-culture and business performance is positive relation.

Table6-Table 8 is the empirical result of H3、H3a、H3b. Table 6 shows the overall step regression analysis, moral quality of manager becomes significant through the third culture (F-value=20.827***), $\triangle R^2$ also raises 0.085. The intervention effect of peace culture through

the cross-culture is supported. Business ethic cognition becomes significant through the cross-culture (F-value=13.992***), $\triangle R^2$ also raises 0.071. The intervention effect of peace culture through the third culture is supported. Customer conviction becomes through the third culture (F-value=14.007***), $\triangle R^2$ also raises 0.125. The intervention effect of peace culture through the third culture is supported. Organization behavior becomes significant through the third culture (F-value=12.941***), $\triangle R^2$ also raises 0.116. The intervention effect of peace culture through the third culture is supported.

Table 7 shows the intervention effect of the third culture in U.S. subsidiary. From table 7 we can find moral quality of manager becomes significant through the third culture (F-value=2.951**), $\triangle R^2$ also raise 0.048. The intervention effect of peace culture through the third culture is supported. Business ethic cognition becomes significant through the third culture (F-value=6.642***), $\triangle R^2$ also raises 0.02. The intervention effect of peace culture through the third culture is supported. Customer conviction becomes significant through the third culture (F-value=3.801*) , $\triangle R^2$ also raises 0.043. The intervention effect of peace culture through the third culture is supported. But organization behavior is not significant through the third culture (F-value=2.074) , $\triangle R^2$ is 0.062. The original model is not significant (F-value=0.246). And then the intervention effect is not supported.

Table 8 shows the intervention effect of the third culture in Japan subsidiaries. From table 8 we can find moral quality of manager becomes significant through the third culture (F-value=22.904***) , $\triangle R^2$ also raises 0.119. The intervention effect of peace culture through the third culture is supported. Business ethic cognition is not significant (F-value=2.947). But it becomes significant through the third culture (F-value=13.926***) , $\triangle R^2$ also raises 0.235. The intervention effect of peace culture through the third culture is supported. Customer conviction is not significant (F-value=1.352). But it becomes significant through the third culture (F-value=13.674***), $\triangle R^2$ also raises 0.251. Organization behavior is not significant (F-value=0.246). But it becomes significant through the third culture (F-value=2.074***), $\triangle R^2$ also raises 0.293.

U.S. and Japan variance test of peace culture, cross-culture and business performance

Table 9 U.S. and Japan variance test of peace culture, cross-culture and business performance

Variables	DF	R^2	Adj. R^2	F-value	Sig.
Moral quality of manager	1	0.022	0.016	3.267	0.073*
Business ethic cognition	1	0.004	-0.003	0.563	0.454
Customer conviction	1	0.022	0.015	3.257	0.073*
Organization behavior	1	0.001	-0.006	0.172	0.679
Cross-culture	1	0.001	-0.006	0.192	0.662
Business performance	1	0.013	0.006	1.925	0.167

Note：***p<0.01；**p<0.05；*p<0.1

Table 9 shows the empirical result of variance of peace culture, cross-culture, and business performance between U.S. and Japan. We find that moral quality of manager and customer conviction has difference, the other not.

Although two nations have different management philosophy, their subsidiaries still can achieve the business performance through the cross-culture.

CONCLUSIONS AND DISCUSSIONS

The purpose of this study is to empirical the relation of peace culture and business performance, and the mediate effect of cross-culture management system. We survey U.S. and Japan subsidiaries in Taiwan and compare it. The result shows that whatever U.S. or Japan. Both of them have highly agreement to peace culture. Meanwhile, the degree of the third culture management system is highly facilitated. With the third culture as the intervention, the effect to the business performance of the subsidiaries of U.S. and Japan is significant. The empirical results are presented in table 3- table 8. H1, H2 and H3 are all supported. Meanwhile, the agreement of peace culture, Japan is higher than U.S.. This may the causes of nation value and the philosophy of management system. Japan business always regards their employee as leaves. The employment system inclines to employee whole life and gives every effort to cultivate. Based on this kind of value, the business and employee can coexist and grow peacefully. Through the third culture, peace culture conveys to employee, and then they are encouraged and devoted themselves into the achievement of business goal. On the other hand, U.S. focuses on individual's performance, the speed of reaching the goal, and high production. Although the level of implementing peace culture in U.S. is lower than Japan, there are still four performances higher than Japan: new product development achievement, production achievement, sale target achievement and investment return achievement. Meanwhile, whatever the overall, U.S. or Japan, all have high agreement on peace culture. It shows that practicing peace culture in business will help to accomplish to business performance goal.

Moreover, this study empirical the ANOVA test on peace culture, the third culture, and business performance between U.S. and Japan. The result shows that moral quality of manager and business ethic cognition has significant difference in the two countries. Based on this result, we infer that Japan business combines the management philosophy and corporation together, and cultivates "family common consensus" and "trust". Japan business manufactures high quality products by spirit of ingenuity and offers the higher convenient life quality. The management philosophy of U.S. business focuses individual performance, and stresses financial numbers and profit. The business only concerns about the benefit of stockholder and not considers the need of employee and customer. From this study, it presents that the facilitation of the third culture Japan is higher than U.S.. But there is no significant difference in the performance of the two country subsidiaries. The empirical shows that it responses to the different management philosophy characters of the two MNEs.

Thus, with the different management philosophy, MNEs should have the view of peace culture, and make the social welfare. MNEs should consider the benefit of the labour, customer in home and host, and social benefit. It can reach the business performance goal,

and based on the peaceful and prosperous environment, MNEs can enhance the organizational cohesion and team spirit, and then shorten the distance of human's heart and conquer the difference of cross-culture to get the global goal and enhance human welfare. This study first explores the agreement of peace culture in U.S. and Japan and gets significant result. The suggestion for further study can empirical the other countries and make comparison, and then lift peace culture in management system generalization.

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MANAGEMENT SYSTEM DEVELOPMENT FOR THE PUBLIC SECTOR ORGANISATIONS

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ABSTRACT

Globalisation, demographic changes and growing utilization of ICT is a great challenge to management of public sector organisations. People Capability Maturity Model (P-CMM) is a fairly new approach to the management issues. The main objective of this research was to get a view of the management practices of various types of Finnish organisations in terms of the P-CMM model. The research was based on the P-CMM model, which was localized to the Finnish organizational culture. The measurements were made using mainly group interviews.
The public sector organisations studied here do not have mature enough management processes and practices to execute the strategic objectives and change. Even the strategic management has been widely accepted in those organisations, the likelihood to achieve any objectives is not related to the management performance. The studied private sector companies in average do slightly better, but there is a lot of room for improvement as well. The best organisations in the group of private companies have implemented very extensively management practices that are defined in the P-CMM model in all levels. The recommendation to the public sector organisations based on the P-CMM model and the results of this research can be summarized that the only productive strategic goal would be to take the necessary steps to make the organisation more mature.

Keywords: maturity, strategy, capability, P-CMM model, change management

INTRODUCTION

The public sector is facing new challenges. Financial crisis, demographic changes, globalisation with international competition of business locations, economical integration in different parts of the world, technological innovation, expectation of citizens and changing values - all these changes have brought new demands to the public sector organisations. The public sector has to redefine its mission statement as an enabler and catalyst for local, regional, national and European competitiveness. Public organisations have to cost less and perform better. (Pröhl, 2005.)

The challenges faced needs the modernisation of the management systems in public sector, where

1. The quality of the management systems has to be improved.
2. The bureaucracy and some old organizational structures have to be reduced.

3. The management processes, the effectiveness of the organizations and use of resources have to be optimized.
4. The management skills to manage the capability of the organization have to be promoted.
5. The productivity of the organizations has to be increased.
6. The eManagement systems have to be utilized more efficiency.
7. The focus on the transparency and on the citizens' and businesses' needs have to be improved.

These changes are faced in some private sector companies and the results have been good in increased productivity . The public sector has not been so successful in improving productivity. Actually in Finland sectors like education, health and social services have reduced the productivity in the past years. (Lipponen & Viitamo 2003, s. 9 - 11, Rehn 2004, s. 21 – 30.)

Likewise, the utilization of ICT has not brought in the public sector the same benefits as it has done in some industries of the private sector. It seems that the ICT investments are utilized only by individuals, not the whole organization, because the organizational management systems are not mature enough in public sector to take advantage of the information integration. The low utilization of ICT in some cases has actually decreased the organizational productivity. (Rehn, 2004)

This research is about the management challenges of the public sector organizations in Finland. The approach and some of the results should be applicable also globally.

THE FRAMEWORK

The work is based on the People CMM (Curtis & et al. 2001, 2002) framework, which is a roadmap for implementing management processes and practices in order to continuously improve the capability, the productivity of the organization and to execute the strategic objectives.

The People CMM model measures an organization's:

1. the management system's (processes, practices, methods and tools) maturity and capability to execute the organisational strategy and change,
2. the strategic readiness for executing its strategic objectives
3. the likelihood to achieve the strategic objectives in the long term
4. the potential for benefiting from investments in management process improvement and advanced ICT-technologies

The model consists of five maturity levels, or evolutionary stages, with an integrated system of management processes and practices. At each maturity level, a new system of practices is overlaid on those implemented at earlier levels increasing the human and organizational resources in use. The principle of the model is described in Fig 1.

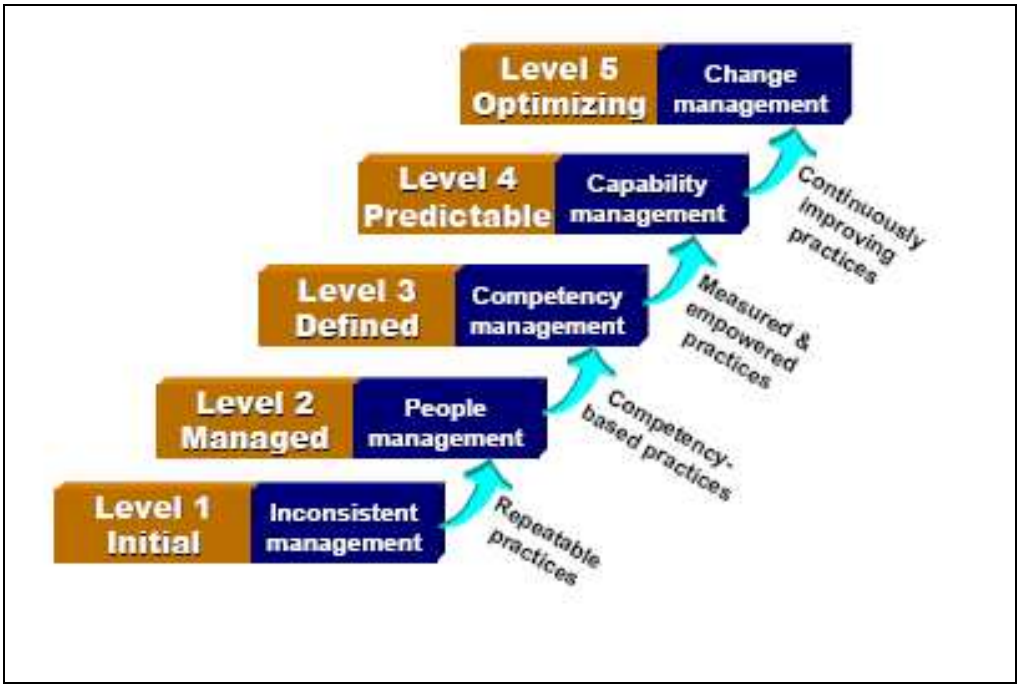

Fig 1: The five maturity levels of the People CMM (Curtis et al 2001)

In mature organizations (Curtis et al 2002):

1. The capability is inseparability a part of organisational performance
2. The capability is a competitive issue and a source of strategic advantage
3. The capability must be defined in relation to the organization's strategic objectives
4. Knowledge-intense work shifts the focus from individuals jobs and tasks to workforce competencies
5. The capability is measured and improved at all levels, including individuals, workgroups, units and organization
6. An organization invests in improving the capability of those competencies that are critical to its core competency as a business
7. Operational management is responsible for the capability
8. The improvement of the capability is managed as a process composed from proven practices and procedures
9. The organization is responsible for providing improvement opportunities, and individuals are responsible for advantage of them.
10. Because technologies and business environments chance rapidly, organizations must continually improve their management practices and develop new competencies.

THE EMPIRICAL RESEARCH

The objectives of the empirical research were:

1. To test the P-CMM model in Finnish private and public sector organisations and to find out what kind of adjustments should be made in order to maintain international comparability and to fit into the Finnish culture and legislations.

2. To get a view of the management practices of various types of Finnish organisations in terms of the P-CMM model.
3. To produce a framework, which could be used as a consulting service to those organisations willing to improve their management practices.

The work was carried out in close collaboration between POHTO Management Institute and the Department of Industrial Engineering and Management of the University of Oulu. From the perspective of this model, organisation's maturity of 14 private companies and 6 public sector organisations was derived.

The evaluation was carried out through interviews. The number of interviewed people varied between 3 and 20 in each of the organisations. In average the evaluation visit took two full work days. In some cases part of the data was collected as self evaluation. The data collection was organized in teams, where 2-5 researchers and research assistants carried out each of the interviews.

THE RESULTS

The results from the evaluation are summarized in table 1 (Appendix 1). The table shows that

1. The public sector organisations studied here do not have mature enough management processes and practices to execute the strategic objectives and change.
2. The studies private sector companies in average do slightly better, but there is a lot of room for improvement as well
3. The best organisations in this group have implemented very extensively management practices that are defined in the P-CMM model in all levels.

In this research group only 2 global companies were evaluated at a mature level (Level 5).

All of the public sector organisations evaluated were placed at the very lowest level of maturity. It seems that the public sector organisations do not manage in a systematic way their capability in order to face their challenges and fulfil their strategic objectives and change. They do not have shared and institutionalized management processes and practices enough. The most common and widely used practices deal with the recruiting and the physical environment, because both of the processes are defined rather extensively by the Finnish law. On the other hand, for instance organisations do not make sure that the resources available are fit for the strategy and that all of the operations are in line with the strategic objectives. There are no shared practices to evaluate the performance, productivity and achievements. The reporting and practices are therefore all missing.

The overall results show that public sector organisations have adopted management processes and practices mainly from level 2. Therefore this concentrates here only on the level 2. The table 2 (Appendix 2) shows in more detail the processes and practices on that level. It shows that:

1. The difference between the best and the rest is significant. The difference between the best private company and the worst public sector organisation is over 90 % measured by the number of implemented processes and practices.

2. There is a difference of about 30 % between the private and the public sector organisations.
3. The public sector organisational structure, roles and tasks are not defined by the strategy.
4. The performance objectives of units and individuals are not defined and therefore not managed.
5. Performance improvement is 'unknown topic' in public organisations.
6. Problems in performance are not discussed and removed.

The research took also a look into the level of implementation. The question was: how extensively the processes and practices have been institutionalised. The details are described in diagram (Appendix 3).

Even when the public sector organisations do have some processes and practices – in some cases defined by the laws – the integration of them as a part of the management system of the whole organization is weak. The responsibilities of the practices might be defined and the tools with templates are available, but they are not part of the management process, there are no measurements to analyse and improve the practices. There are no review practices to these.

CONCLUSIONS

The research showed that:

1. The management systems of organizations can be evaluated and measured.
2. The strategic readiness for executing the strategic objectives and change is measurable.
3. The strategic challenges and the capability of the organization have to be in balance.
4. When the strategy hasn't realized, the solution is not always to define a new strategy. To bridge the gap between strategic objectives and the capability to execute it, is important.
5. In public organizations in Finland, the management systems are not mature enough to face the future challenges.
6. ICT serves the productivity improvement only when the management processes are defined. If not, the implementation of the new advanced technology may even decrease the productivity.
7. In public sector in Finland, the individuals are qualified, but overload. The potential to improve the productivity is to manage the capability of the whole organization and the organizational performance alignment.
8. The productivity improvements in public sector need the development of management processes and practices.
9. There seems to be a positive correlation between the maturity level and the productivity of the organizations.
10. When compared the most mature organisations to the most immature public organisations, there is a great improvement potential which leads to better working atmosphere, higher working motivation, better utilization of the ICT and overall: better perform with less costs.

11. The P-CMM Model seemed to be a very usable framework to analyze the current status in public sector in terms of mature management systems and productivity.

SUMMARY

A study based on P-CMM was carried out in 14 private companies and 6 public sector organisations. The research objective was to test the usability of the model especially in Finland in private and public sector organisations. The other objective was to find out the maturity level of the selected organisations.

The results show that successful global companies have developed their management processes and practices to the highest level while some companies and public sector organisations are very underdeveloped in this scale.

Public sector organisations in general do not have sufficient and mature enough management systems in use in order to face the challenges they have in Finland.

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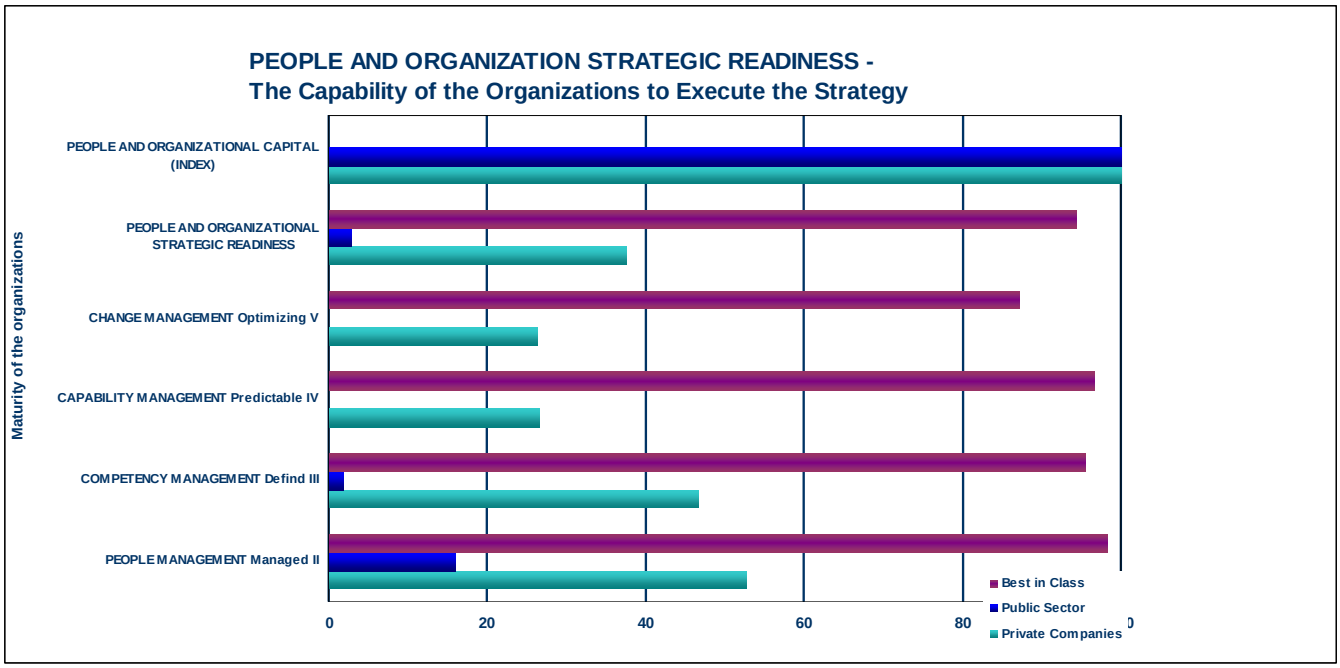
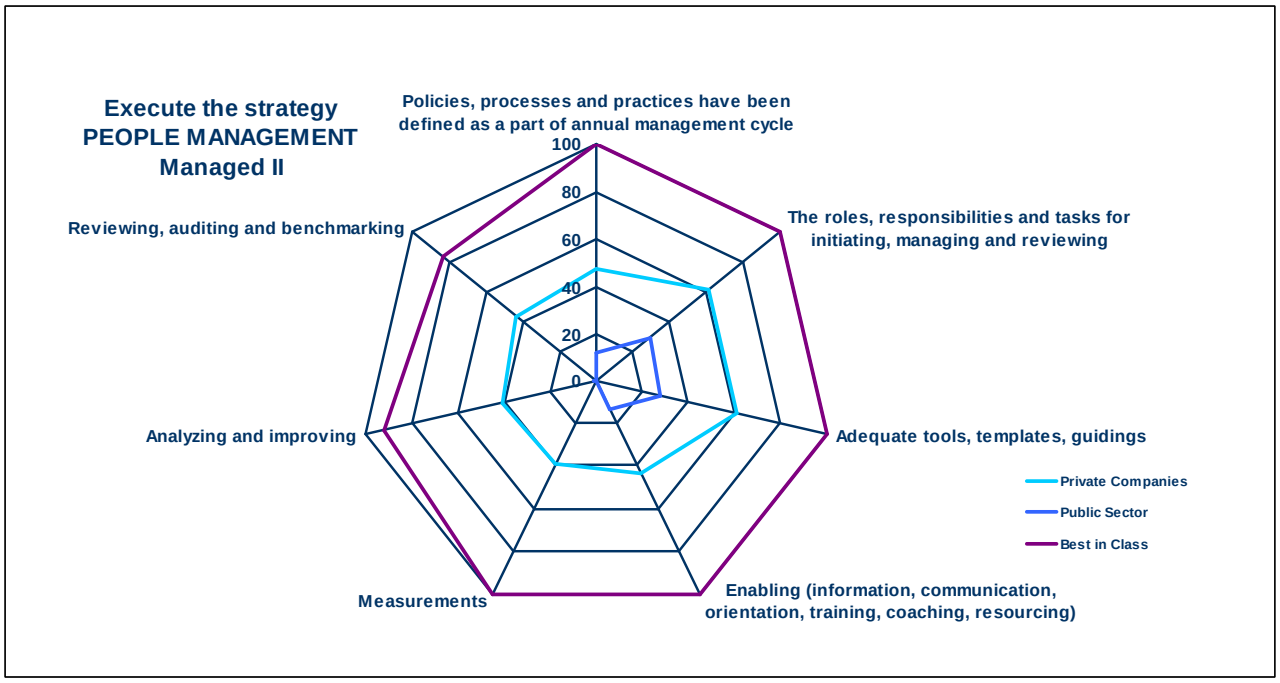
Appendix 1: Overall results from the evaluation



Appendix 2: Processes and practices at Level 2 - Managed

MANAGEMENT PROCESSES Maturity Levels	Private Sector	Public Sector	The Best
Organisation, roles and job descriptions are in line with the strategy	42	13	100
Annual and daily resourcing are managed	55	30	100
Recruiting strengthen the strategy execution	65	50	100
Transitioning into and out of positions in an orderly way	41	22	100
Institutionalizing	39	15	100
RESOURCING	49	26	100
Information is shared across the organization	56	11	100
The views of individuals and groups are valued to improve the performance	49	11	100
Coordination and smooth operations are managed	38	13	100
Institutionalizing	38	17	100
COMMUNICATION AND COORDINATION	46	13	100
The physical environment, facilities and resources are made available	62	37	100
Distractions are minimized	38	17	100
Institutionalizing	43	13	100
WORK ENVIRONMENT AND FACILITIES	48	22	100
Performance objectives are defined and reported	62	29	100
Performance is regularly discussed to improve it	52	13	100
Performance problems are managed	26	11	100
Outstanding performance is recognized	35	0	100
Institutionalizing	40	15	100
PERFORMANCE MANAGEMENT	43	14	100
Knowledge, skills and process abilities are ensured	74	17	100
Learning and development are managed	74	22	100
Institutionalizing	58	10	90
KNOWLEDGE MANAGEMENT	69	16	94
Compensation strategy is rewarding	69	3	100
Compensation is in balance with skills, qualifications and performance	54	6	100
Adjustment are made based on defined criteria	74	6	100
Institutionalizing	62	5	90
COMPENSATION	65	5	95
IMPLEMENTATION	47	13	97
PEOPLE MANAGEMENT Managed II	53	16	98

Appendix 3: Processes and practices implementation at Level 2 - Managed



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EVALUATING PRODUCT AND SERVICE QUALITY IN MALAYSIA: CUSTOMERS' PERSPECTIVE

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ABSTRACT

Following the advances in technology and the improving standard of living, customers now are more particular with the products and services they purchase and use. Furthermore, firms try to understand the need of consumers in order to meet their requirements. It is difficult to understand customers' satisfaction thoroughly but through customer evaluation, firms might be able to capture their preferences. The objective of this paper, therefore, is to analyze customers' evaluation on product and service quality in Malaysia. The service quality instrument underpins the theoretical framework of this paper. We distributed the questionnaire to a sample of 385 participants. The analysis was based on 219 valid respones. Analysis indicate that product quality and service quality varaibles will influence customers' evaluation. The findings from this research will be critical in firms' choices and decisions related to custmers' needs and preferences. We also highlighted the theoretical implications of this paper. Firms need maintain or upgrade their product and service quality measure to be able to attract and retain customers as changes in the business environment and the influence of new technology become more pervasive in this 21st century.

Keywords: Product Quality, Service Quality, Customers' Evaluation, Malaysia

RESEARCH BACKGROUND

Quality plays an important role in all industries. Although quality acts as a major factor in both products and services for firms, it also influences customers' perception and buying patterns especially in today's industrial market. This may be because customers' purchasing power is increasing due to availability of varieties of products and services, and this enables customers to choose and select the products and services according to their preferences. In addition, improving standard of living could be another reason for the increase in purchasing power, particularly because customers are becoming more educated, which makes them more informed to make an educated comparison before making any purchasing decision. Moreover, Rikswijk & Frewer (2008) believe that customers tend to favour high quality products. Kahn, Strong & Wong (2002) indicate that quality describes the process from conformance to specification, the purpose of which is to meet or to go beyond meeting customers' expectation. Moreover, the advancement of technology such as Internet has given the opportunity for customers to access more information that are needed and this has increased the knowledge of customers. For example, customers are able to understand the importance of quality based on the information gathered from the Internet and they might be able to differentiate the good and bad quality based on their perception. Therefore, in today's changing global environment, both product and service quality should be taken seriously into

consideration in order to fulfil customers' satisfaction. Furthermore, satisfaction is becoming a central and critical success factor for most firms (Mcatarsney, 1999). In addition, many more companies are continuously searching for additional means to provide satisfaction for their customers (Ofir & Simonson, 2001).

In this research we will focus on the customers' evaluation of product and service quality and the variable that most customers perceived as "quality". According to Ofir & Simonson (2001), customers' evaluation is a critical input for firms to develop their marketing strategies. Understanding customers' evaluation and the variables perceived as quality could help firms to improve their business operations and sustain their core competencies in the global market. Besides firms, customers could also benefit because the products and services they desire would meet their requirements. This not only fulfil the needs and wants but it will also create customers' desirability towards the products and services provided. In other words, customer relationships management (CRM) could be impacted as well, where there is a formation of good relationship between customers and the firms based on the good provision of quality product and service. Thus, the importance of customers' evaluation of product and service quality is of great importance to both customers and firms.

CONCEPTUAL FRAMEWORK

Figure 1 depicts the research framework for this paper and illustrates two independent constructs, which are product quality and service quality. Service quality consists of 5 dimensions, which are tangibles, reliability, responsiveness, assurance and empathy. Product quality consists of 8 dimensions, which are aesthetics, conformance, durability, features, performance, perceived quality, reliability and serviceability. Altogether, there are 13 independent dimensions under product and service quality. In addition, we developed 13 hypotheses, each generated for each dimension of the independent variables against the dependent variable, customer evaluation to determine the perceived influence of the dimensions on the capacity of customers to evaluate products and services.

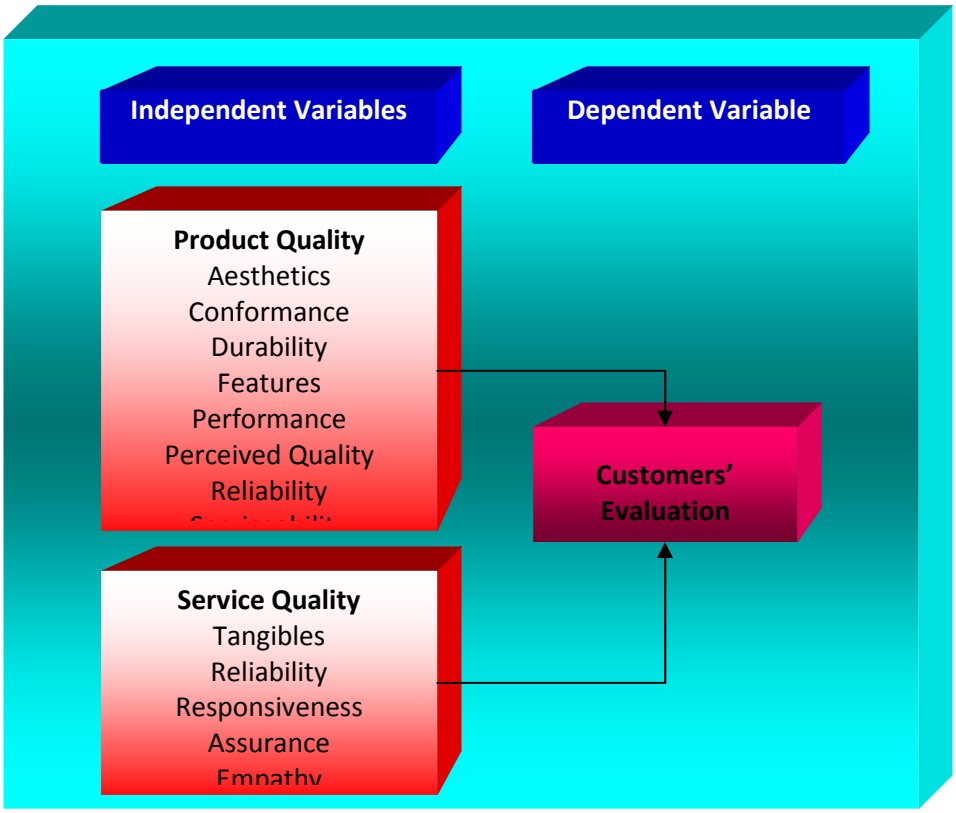

Figure 1: Conceptual Model

HYPOTHESES DEVELOPMENT

Product Quality is the quality of product measured by customers before the purchase transactions take place. According to Garvin (1984), researchers view quality as a precise and measurement variable. Good product quality provides the trust and satisfaction for the customers. In other words, customers are able to assess the perceived value of the product before making any purchase decisions. According to Snoj, Korda & Damijan (2004), the logical and basic rule that applies to each individual customers basic motive of an exchange is that the product is reasonable and include the expected value that brings customers' satisfaction. Based on Garvin (1984), product quality is designated into eight dimensions according to the framework. These dimensions can be measured through customers quality evaluation (Yoon & Kijewski, 1997).

Hypothesis 1: High values of aesthetics wil1 a positive influence on customers' evaluation.
Hypothesis 2: Conformance will have a positive influence on customers' evaluation.
Hypothesis 3: Product durability will have a positive influence on customers' evaluation.
Hypothesis 4: Product features uniqueness will have a positive influence on customers' evaluation.
Hypothesis 5: High product performance will have a positive influence on customers' evaluation.
Hypothesis 6: Perceived quality will have a positive influence on customers' evaluation.

Hypothesis 7: Product reliability will have a positive influence on customers' evaluation.
Hypothesis 8: Service ability will have a positive influence on customers' evaluation.

Service Quality is an important criterion for firms in the industrial market especially among firms involved in service-oriented businesses such as hotels, restaurants, etc. In other words, service quality is a major factor for good business practice (Amy, Dean & White, 1999). Service quality, unlike product quality, cannot be seen or touched and it is fully dependent on the firms providing good experiences and laying down a good impression for the customers. The employees of the firms also play an important role because they are the ones that have the first interaction with the customers. Therefore, service quality is more difficult to measure compared to product quality but there are a few dimensions identified for the purpose of customers' evaluation. Service quality consists of five dimensions: tangibles, reliability, responsiveness, assurance and empathy (Parasuraman, Zeithaml & Berry, 1988). These five dimensions based on the literature have been widely used in previous studies and have been validated as good measure for service quality. Previously, initial literature review revealed ten dimensions, which include tangibles, reliability, responsiveness, communication, credibility, security, competence, courtesy, understanding the customers and access. After the validation process and further testing of the instrument, an instrument called SERVQUAL was developed to represent the five dimensions, which are tangibles, reliability, responsiveness, assurance and empathy. The following are the hypotheses we developed for this paper:
Hypothesis 9: The tangibles of service quality will have a positive influence on customers' evaluation.
Hypothesis 10: Service reliability will have a positive influence on customers' evaluation.
Hypothesis 11: Responsiveness of service quality will have positive on customers' evaluation.
Hypothesis 12: Assurance will have a positive influence on customers' evaluation.
Hypothesis 13: Empathy will have a positive influence on customers' evaluation.

RESEARCH METHODOLOGY

The main focus of the research paper is to examine the influences of both product and service quality on the customers' evaluation. Customers' evaluation is an important resource for organizations in order to compete in the comtemporary competitive marketplace. Firms that are able to acquire customers' evaluation would be better positioned to improve their product or service development. The research questions will be develop based on the outlined hypotheses, with particular attention to previous research in the subject area.

The primary data (from survey questionnaire) and the secondary data (data from journal articles, other form of printed resources and etc) will form the key sources of data for this research. The unit of analysis will be individuals and the survey respondents will be selected by using convenient sampling. The reason for using convenient sampling is to select the respondents that are available and for survey. Three states in Malaysia were chosen for the survey and the three states are Kuala Lumpur, Malacca and Selangor. We chose these three states because they present the best structure with respect experiences and history of places where previous successful survey research are achieveable. Face-to-face interview would also be considered in the data collecting process.The purpose of face-to-face interview is to have a direct interaction with the customers and to provide preliminary and possible post-survey data

to complement the survey data. Furthermore, interviewers are able to read the reaction and body language of the customers through direct interaction, which might be useful in overal analysis.

The data was analyzed using descriptive and inferential statistics. The inferential analysis include regression analysis (which was used to determine the influence of product and service quality on customer's evaluation), correlation analysis (to examine the relationship among the independent and dependent variables) (Babbie, 1990). We also used the descriptive statistical tools to analyze respondents feedback (Sekaran, 2003). The descriptive tools consist of mean and standard deviations. In addition, reliability and validity analysis were conducted to test the strength of the measurement items and whether the items measure what they were supposed to measure as proposed in the conceptual framework. We used statistical package for social sciences (SPSS) for the data analysis.

QUESTIONNAIRE DESIGN

As noted earlier, the questionnaire was developed based on previous research and instruments in the subject area, and the questionnaire was divided into two main parts. The first part of the questionnaire solicited answers and comments from respondents' background such as age, marital status, gender, religion, education level and etc. The second part contained questions and statements on the independent and dependent variables: product quality and service quality. The questions addressed the thirteen dimensions indicated in the conceptual framework. The questionnaire is design according to 7-point Likert scale where '1' stood for "Strongly Disagree" and '7' as "Strongly Agree". Total score of the questionnaire was reviewed and analyzed with the appropriate analytical tools .

We conducted pilot survey to examine the face validity of the questionnaire in order to provide an applicable and reliable result. According to Babbie (1990); Sekaran (2003), the goal of a pilot survey was to measure the validity and reliability of the survey questionnaire in this research paper based on the preliminary review by selected participants. Pilot study was conducted using a group of 20 consumers. All of the feedbacks (suggestions, comments, and critiques) from the respondents were evaluated and incorporated into the survey before generating the final questionnaire. Finally, the adjusted and completed questionnaire was sent to the customers from the selected three states indicated earlier.

DATA ANALYSIS AND FINDINGS

Table 1 shows the demographic profile of the respondents. Female respondents are slightly higher compared to the male respondents. About 70% of the respondents earn RM2000 and above.

Table 1: Respondents Demographic Profile

	Frequency	Percent	Valid Percent	Cumulative Percent
Gender				
Male	102	46.6	46.6	46.6
Female	117	53.4	53.4	100.0
Marital Status				
Married	109	49.8	49.8	49.8
Single	110	50.2	50.2	100.0
Age				
Under 20	20	9.1	9.1	9.1
21-30	90	41.1	41.1	50.2
31-40	48	21.9	21.9	72.1
41-50	30	13.7	13.7	85.8
51-60	26	11.9	11.9	97.7
Above 60	5	2.3	2.3	100.0
Race				
Malay	61	27.9	27.9	27.9
Chinese	123	56.2	56.2	84.0
Indian	33	15.1	15.1	99.1
Others	2	0.9	0.9	100.0
Educational Level				
Standard 6/UPSR	2	0.9	0.9	0.9
PMR/O-Level/SPM	70	32.0	32.0	32.9
A-Level/STPM	21	9.6	9.6	42.5
Diploma/Higher Diploma	44	20.1	20.1	62.6
BA/BS	64	29.2	29.2	91.8
MA/MS/MBA/MPhil	18	8.2	8.2	100.0
DBA/PHD	0	0	0	100.0
Income (Monthly)				
Under RM2,000	67	30.6	30.6	30.6
RM2,000 – RM4,000	106	48.4	48.4	79.0
RM4,001 – RM6,000	30	13.7	13.7	92.7
RM6,001 – RM8,000	9	4.1	4.1	96.8
RM8,001 – RM10,000	5	2.3	2.3	99.1
Above RM10,000	2	0.9	0.9	100.0
Job Status				
Employed	145	66.2	66.2	66.2
Self-Employed	33	15.1	15.1	81.3
Unemployed	2	0.9	0.9	82.2
Retiree	5	2.3	2.3	84.5
Home-maker	6	2.7	2.7	87.2
Student	28	12.8	12.8	100.0

The next table presented the means and standard deviations of the respondents. Generally, all of the independent variables' mean values exceeded 4.0. For product quality, performance

and service ability scores are quite high compared to others. Hence, this indicates that the two variables could be important to the respondents. As for service quality, responsiveness had the highest mean value compared to the other variables. This shows that the responsiveness of employees of the firm are indeed a critical input for the respondents.

Table 2: Mean Analysis for Product Quality (Aesthetic)

Item ID	Item Description	Mean (n=219)	Standard Deviation
AE1	I always experienced the product through product sample before purchase decision.	4.9863	1.14731
AE2	I always purchase product based on my emotional judgement.	4.1735	1.20665
AE3	I don't go for self experiencing if there're number of people using the product.	4.8219	1.14149
AE4	I compare product through smells, tastes, feel or sound before purchase decision.	5.2009	1.00266
AE5	I easily place a judgement on the product upon the first sight.	4.6621	1.23592

Table 2, indicates that the item with the highest score in aesthetics is involves comparing the products before purchase decision (AE4 = 5.2009). Furthermore, respondents would also test the product and experience it before purchase decision (AE1 = 4.9863) but if the product is used by most people, respondents might skip the trial period (AE3 = 4.8219). However, not all respondents would easily place a judgement upon the first sight of the product (AE5 = 4.6621) and this means that consideration would take place before a purchase decision. The lowest score rated by respondents is (AE2 = 4.1735) where the percentage of purchasing based on emotional judgement is low.

Table 3: Mean Analysis for Product Quality (Conformance)

Item ID	Item Description	Mean (n=219)	Standard Deviation
CO1	Product appearance will affect my purchase decision.	5.3014	0.95329
CO2	Product warranty or expiry date is the major factor in my purchase decision.	5.4840	1.14278
CO3	I will be dissatisfied if the product breakdown even though is still under the period of warranty.	5.7945	0.96677
CO4	Warranty should be applicable to all kind of consumer products.	5.6849	1.03441
CO5	Product attributes and specifications that are delivered as promise is persuasive to me.	5.7489	0.80477

Dissatisfaction can easily occur compared to satisfaction and respondents rated highly that they will be dissatisfied if the product breaks down even though it is under warranty (CO3 = 5.7945). The reason may be the inconveniences that respondents faces if the product breakdown. Hence, product attributes and specification that are delivered as promised is persuasive (CO5 = 5.7489). Furthermore, the mean for warranty should be applicable to all kinds of consumer products is (CO4 = 5.6849). The respondents rated warranty or expiry date is a major factor at (CO3 = 5.4840) and product appearance at (CO1 = 5.3014).

Table 4: Mean Analysis for Product Quality (Durability)

Item ID	Item Description	Mean (n=219)	Standard Deviation
DU1	I frequently calculate the product period of usage for repurchase intention.	4.6712	1.47195
DU2	I compare the period of usage for similar products.	4.8037	1.42159
DU3	I will satisfy with the product if it can operate after being repaired.	4.7534	1.37921
DU4	I would have repurchase intention if the product durability meets my expectation.	5.7352	0.84223
DU5	I ensure the product period of usage before purchase decision.	5.2283	1.15454

Table 4 presents the product durability where respondents' feedback on (DU1 = 4.6712, DU2 = 4.8037 and DU3 = 4.7534) tended towards the agreement range. However, DU4 and DU5 is rated slightly higher whereby customers would ensure the product period of usage before purchase decision (DU5 = 5.2283) and the highest score is that product that meets the expectation would incurred repurchase intention (DU4 = 5.7352). This would lead to the satisfaction of respondents.

Table 5: Mean Analysis for Product Quality (Features)

Item ID	Item Description	Mean (n=219)	Standard Deviation
PF1	Products with unique quality attract customers' attention.	5.7580	0.92908
PF2	I will go through the external and internal of the product before purchase decision.	5.3014	1.10485
PF3	I frequently read the product content before purchase decision.	5.2329	1.30827
PF4	I only purchase product that fulfil needs and wants.	5.4749	1.23149
PF5	Product features is the important consideration during purchase decision.	5.6621	1.00228

Table 6: Mean Analysis for Product Quality (Performance)

Item ID	Item Description	Mean (n=219)	Standard Deviation
PE1	I frequently select product that offer good functionality.	5.8082	0.91858
PE2	I compare the product function before purchase decision.	5.7078	0.92691
PE3	Performance is more important than price during decision making.	5.2192	1.22938
PE4	I ensure that I understand the product functions before purchase decision.	5.6301	0.93613
PE5	I would be favourable if the product is user-friendly.	5.8950	0.90001

The uniqueness of the product usually attracts attention according to the respondents point of view (PF1 = 5.7580) and hence, product feature is an important consideration during purchase decision (PF5 = 5.6621). Respondents somewhat agree that they only purchase product that fulfilled their needs and wants (PF4 = 5.4749) and this means that they still

purchase products that they desire occasionally rather than just needs and wants. As for (PF2 = 5.3014 and PF3 = 5.2329) where respondents go through the external and internal of the product and frequently read product content before purchase decision are within the range.

Product performance is important and it would be favourable if the product is user-friendly (PE5 = 5.8950) where it is the highest score rated by the respondents. Furthermore, good functionality also acts as an important factor for respondents to considered during the purchase decision and is rated (PE1 = 5.8082). Respondents' rate on comparing the product functions is (PE2 = 5.7078) and ensure that they understand the product functions is (PE4 = 5.6301). However, performance is more important than price is rated slightly lower compare to others (PE3 = 5.2192). Therefore, price would affect purchase decision whenever respondents compare both especially when respondents' feels that the product performance is not worth the price or the product price is not within their budget.

Table 7: Mean Analysis for Product Quality (Perceived Quality)

Item ID	Item Description	Mean (n=219)	Standard Deviation
PQ1	I perceived the level of quality with a bunch of product attributes.	5.3288	1.00075
PQ2	I would normally relate high price to better quality.	4.9589	1.51541
PQ3	A well-known brand indicates high quality.	4.7489	1.50105
PQ4	I compare the product attributes before purchase decision	5.4658	0.99192
PQ5	I always evaluate the quality of the product before purchase decision	5.5342	0.98729

As mentioned earlier, customers perception is an important factor and from Table 7, respondents agree that they would evaluate the product before purchase decision (PQ5 = 5.5342). Respondents would evaluate by comparing the product attributes (PQ4 = 5.4658), perceived the level of quality with a bunch of product attributes (PQ1 = 5.3288) and etc.

Table 8: Mean Analysis for Product Quality (Reliability)

Item ID	Item Description	Mean (n=219)	Standard Deviation
RE1	I assume that product period of usage reflects the product reliability.	5.1781	1.18487
RE2	Always repurchase product rather than making new purchase decision especially on new product.	4.7626	1.38414
RE3	I assume that every parts of the product are attached to product reliability.	5.2511	1.06484
RE4	I will associate long period of warranty to product reliability.	5.1553	1.28635
RE5	Firms with good reputation will provide reliable product.	5.3836	1.14495

As for (PQ2 = 4.9589), where the score of relating price and product quality is not high and this is followed by (PQ3 = 4.7489) which is the lowest score. Hence, not all the respondents would feel that well-known brand is indicates as high quality.

Table 8 presents that respondents feedback on (RE1 = 5.1781, RE3 = 5.2511, RE4 = 5.1553 and RE5 = 5.3836) are within an agreement range. However, the lowest score is (RE2 = 4.7626), which indicates that the respondents make repurchase intention rather than purchasing new products that are offered in the market. This means that respondents would try out on new products and experience it and if it is a bad experience, respondents would make repurchase intention but if it is a good experience, they would purchase the new products.

Table 9: Mean Analysis for Product Quality (Serviceability)

Item ID	Item Description	Mean (n=219)	Standard Deviation
SA1	I will usually prefer firms that provide after sales service than firms that do not.	5.7671	1.00257
SA2	Assessing customers' advice will help firm gain customers trust.	5.6986	0.91899
SA3	After sales service is the consideration of purchase decision.	5.6530	1.05714
SA4	Continuous updating customers with the latest information are preferable.	5.5114	1.09779
SA5	Able to repair the product immediately is a credit.	5.8721	0.97778

Under product quality, serviceability is one of the dimensions being considered and based on Table 9, SA1, SA2, SA3, SA4 and SA5 are all within the agreement range. The highest score is on the item that firms are able to repair the product immediately is a credit (SA5 = 5.8721) followed by providing after sales service (SA1 = 5.7671). Assessing customers' advice is a competitive advantage to firms (SA2 = 5.6986) and after sales service is a consideration of purchase decision (SA3 = 5.6530). Last but not least is updating customers with the latest information, rated by respondents at (SA4 = 5.5114). Hence, overall score shows that serviceability is an important factor for respondents.

Table 10: Mean Analysis for Service Quality (Tangible)

Item ID	Item Description	Mean (n=219)	Standard Deviation
TA1	Employees or personnel that are clean, tidy and well manner is an expectation.	5.8950	0.99214
TA2	Modern looking equipment is preferable.	5.3379	1.02937
TA3	Appealing physical facilities attracts customers.	5.5525	0.95818
TA4	Firm impression will affect the purchase decision on the service.	5.6712	0.86292
TA5	Materials provided are clear and understandable.	5.8539	0.81083

Based on Table 10, respondents indicate that (TA1 = 5.8950 and TA5 = 5.8539) is important where the score is high compared to others. This indicates that respondents are likely to drop the first impression on the firms' employee. Furthermore, materials provided that are clear and understandable is important because it won't create query for respondents and

respondents do not have to find a way to solve the query. Besides, firm impression will also affect the purchase decision as rated by respondents (TA4 = 5.6712). Others, such as modern looking equipment (TA2 = 5.3379) and appealing physical facilities (TA3 = 5.5525) are rated almost equally.

Table 11: Mean Analysis for Service Quality (Reliability)

Item ID	Item Description	Mean (n=219)	Standard Deviation
SRE1	Service is provided as promise.	5.9041	0.99767
SRE2	Able to solve customers' problem immediately.	5.9909	0.96256
SRE3	Normally insists an error-free record.	5.3014	1.21177
SRE4	Professionalism of etiquette displayed by employees when dealing with customers.	5.7945	0.86139
SRE5	Well recommended firms are reliable.	5.4749	1.05928

Respondents rated SRE2 highly, which is means that firms are able to solve customers' problem immediately. This is because it helps to reduce the inconveniences respondents may face. As for (SRE1 = 5.9041) where service is delivered as promise is also an important factor being considered and the third highest is (SRE4 = 5.7945) where professionalism is needed when employees are dealing with customers. Slightly lower score rated by respondents is (SRE3 = 5.3014), which indicates that respondents normally insist on an error-free record (SRE5 = 5.4749), is well recommended firms are reliable.

Table 12: Mean Analysis for Service Quality (Responsiveness)

Item ID	Item Description	Mean (n=219)	Standard Deviation
RS1	Employees provide a prompt service to the customers.	5.8904	0.91212
RS2	Employees are willing to help customers.	5.9498	0.94444
RS3	Employees will not escape from customers' request.	5.7215	1.14140
RS4	Employees that are able to provide clear and understandable service is preferable.	6.1279	0.71811
RS5	Service accuracy is the most preferable.	6.0868	0.77030

For service quality, employees responsiveness is important where employees indicated they are able to provide clear and understandable service is preferable (RS4 = 6.1279) and advice accuracy (RS5 = 6.0868). Employees are the key factors of a firm especially in the retail

industries, customers usually receive the first impression on the employees. Furthermore, prompt service (RS1 = 5.8904), employees that are willing to help customers (RS2 = 5.9498) and would not escape from customers request (RS3 = 5.7215) are equally high. Table 13 indicates that respondents would insists on safe transactions (AS1 = 5.7854) because safe transaction would instill confidence (AS4 = 5.6575), which is rated highly by respondents. Employees that are well trained would show greater degree of professionalism (AS5 = 5.6621), which could assure respondents that they can depend on the employees in case of any issues related to the firm.

Table 13: Mean Analysis for Service Quality (Assurance)

Item ID	Item Description	Mean (n=219)	Standard Deviation
AS1	Customers feel safe with their transactions.	5.7854	0.94736
AS2	Employees share their knowledge and experience to provide assurance.	5.4429	1.05369
AS3	Employees are consistently courteous with customers.	5.4658	1.00140
AS4	Employees instill confidence in customers.	5.6575	0.82023
AS5	Employees are well trained in particular job functions.	5.6621	0.93521

This would create trust, and possibly satisfaction among the respondents. Besides, employees who are courteous would gain confidence and satisfaction in the work as well (AS3 = 5.4658) and employees that share their knowledge and experience are also preferable by customers.

Table 14: Mean Analysis for Service Quality (Empathy)

Item ID	Item Description	Mean (n=219)	Standard Deviation
EM1	Employees provide customers with individual attention.	5.2055	1.17652
EM2	Operating hours are convenient to customers.	5.5205	1.08505
EM3	Willing to listen to customers' advices or comments and implement them.	5.4658	1.15832
EM4	Firms have customers' best interest of heart.	5.4155	1.10708
EM5	Firms understand the specific needs of their customers.	5.4977	1.15088

On empathy, majority of the respondents agrees that firms should provide operating hours that are convenient (EM2 = 5.5205). Respondents somewhat agree that firms should understand the specific needs of customers (EM5 = 5.4977), and should be willing to listen to

customers advices or comments and implement them (EM3 = 5.4658) and have customers best interest of heart (EM4 = 5.4155). The lowest score is (EM1 = 5.2055) where respondents somewhat agree with the statement.

Table 15: Reliability Test on Independent Variables

Item ID (Product Quality)	Cronbach Alpha (α)	Item ID (Service Quality)	Cronbach Alpha (α)
Aesthetics (AE)	0.759	Tangibles (TA)	0.785
Conformance (CO)	0.790	Reliability (SRE)	0.754
Durability (DU)	0.733	Responsiveness (RS)	0.845
Features (PF)	0.727	Assurance (AS)	0.850
Performance (PE)	0.702	Empathy (EM)	0.892
Perceived Quality (PQ)	0.700		
Reliability (RE)	0.787		
Serviceability (SA)	0.818		

Nunnally (1978) suggested that the minimum acceptable alpha is 0.60 but Hair (2006) recommended that the acceptable alpha should be 0.70. Alhawary and Allisra (2008) conducted the reliability test on independent variables by checking all the items in the questionnaire. We, therefore, conducted a reliability test on the independent variables following the suggestions by Alhawary and Allisra (2008).

Table 15 indicates that all the variables exceeded the cronbach alpha of 0.70. Therefore, this means that all the data collected are reliable and can be used for further analysis. The highest score is empathy (0.892), followed by responsiveness (0.845), assurance (0.850), serviceability (0.818), conformance (0.790), reliability (0.787), tangibles (0.785), aesthetics (0.759), service reliability (0.754), durability (0.733), features (0.727), performance (0.702) and perceived quality (0.700).

Table 16: Correlation Matrix

	CE	AE	CO	DU	PF	PE	PQ	RE	SA	TA	SRE	RS	AS	EM
CE	1													
AE	.286	1												
CO	.554	.168	1											
DU	.587	.211	.231	1										
PF	.610	.072	.324	.423	1									
PE	.655	.014	.292	.303	.525	1								
PQ	.423	.038	.080	.346	.347	.280	1							
RE	.561	.086	.175	.421	.308	.394	.420	1						
SA	.659	.092	.379	.230	.358	.392	.218	.328	1					
TA	.695	.129	.382	.276	.310	.428	.147	.303	.545	1				
SRE	.738	.120	.389	.346	.402	.469	.228	.328	.541	.625	1			
RS	.632	.094	.244	.209	.219	.410	.066	.243	.400	.578	.537	1		
AS	.493	.066	.365	.150	.158	.242	.026	.199	.286	.337	.401	.412	1	
EM	.574	.059	.231	.299	.283	.281	.163	.180	.350	.348	.397	.446	.300	1

Table 16 presented the correlation matrix of all the conceptual variables in this research paper. All the independent variables show significantly positive correlation with the dependent variable (customers' evaluation) as the p-values are < 0.05. From the correlation matrix, all the correlations do not exceed 0.90 and this indicates that there is no colinearity problems with the data collected.

Table 17: Multiple Regression Analysis (R and R^2)

Mode	R	R^2	Std Error of the Estimate	Durbin-Watson
1	.983[a]	.966	.08835	1.990

a. Predictors: (Constant), EM,AE,PQ,CO,AS,PE,DU,SA,RE,RS,PF,TA,SRE
b. Dependent Variable: CE

From the Table 17, R = 0.983 and R^2 = 0.966. This means that 96.6% of the variation of customers' evaluation is explained by product and service quality. Hence, this suggests that the product and service quality have strong relationship with customers' evaluation in making of purchase decisions. Therefore, the importance of product and service quality should be considered seriously by firms.

Table 18: Multiple Regression Analysis (ANOVA Test)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	45.780	13	3.522	451.165	.000[a]
	Residual	1.600	205	.008		
	Total	47.380	218			

c. Predictors: (Constant), EM,AE,PQ,CO,AS,PE,DU,SA,RE,RS,PF,TA,SRE
d. Dependent Variable: CE

For the hypotheses to be supported, p-value should be <0.05. Indeed, the ANOVA test indicated an F test of 451.165, which is significant with a p-value of 0.000. Therefore, this indicates that the conceptual idea is supported as shown by the linear relationship between dependent variable (customers' evaluation) and the predictors' variables (product and service quality). Furthermore, this support shows that product and service quality can be used to predict customers' evaluation. Hence, the results suggest that all the variables used in this paper are useful is designing specific products or services. Firms should consider the results in this paper as they plan their business strategies in order to maximize the possibility of successful business ventures in the contemporary competitive market.

Table 19: Multiple Regression Analysis (Coefficient Equation)

Model	Unstand Coeff		Stand Coef	t	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero Order	Partial	Part	Tolerance	VIF
1 (Constant)	-.008	.079		-.099	.922					
AE	.078	.008	.136	10.215	.000	.286	.581	.131	.926	1.080
CO	.089	.010	.139	9.141	.000	.554	.538	.117	.708	1.413
DU	.078	.008	.148	9.343	.000	.587	.546	.120	.655	1.528
PF	.073	.010	.122	7.305	.000	.610	.454	.094	.589	1.696
PE	.100	.012	.143	8.402	.000	.655	.506	.108	.569	1.757
PQ	.064	.008	.114	7.580	.000	.423	.468	.097	.733	1.365
RE	.064	.008	.123	7.742	.000	.561	.476	.099	.655	1.526
SA	.079	.010	.130	7.727	.000	.659	.475	.099	.581	1.720
TA	.083	.013	.122	6.513	.000	.695	.414	.084	.470	2.128
SRE	.071	.012	.111	5.837	.000	.738	.378	.075	.457	2.190
RS	.092	.012	.141	7.903	.000	.632	.483	.101	.520	1.924
AS	.065	.009	.105	6.921	.000	.493	.435	.089	.722	1.386
EM	.073	.007	.148	9.731	.000	.574	.562	.125	.709	1.410

Based on the results in Table 19, the estimated coefficients indicate that the ß0 (constant) is -0.008, ß (aesthetics) is 0.078, ß (conformance) is 0.089, ß (durability) is 0.078, ß (features) is

0.073, ß (performance) is 0.100, ß (perceived quality) is 0.064, ß (reliability) is 0.064, ß (serviceability) is 0.079, ß (tangibles) is 0.083, ß (service reliability) is 0.071, ß (responsiveness) is 0.092, ß (assurance) is 0.065 and ß (empathy) is 0.073. Therefore, the equation model is as follow:-

Customers' Evaluation = *-0.008 + 0.078 (aesthetics) + 0.089 (conformance) + 0.078 (durability) + 0.073 (features) + 0.100 (performance) + 0.064 (perceived quality) + 0.064 (reliability) + 0.079 (serviceability) + 0.083 (tangibles) + 0.071 (service reliability) + 0.092 (responsiveness) + 0.065 (assurance) + 0.073 (empathy).*

Furthermore, the results indicate that all the hypotheses are significant, whereby (p-value = <0.05). Therefore, this indicates that there is a linear relationship between the dependent variable (customers' evaluation) and the predictor variables (product and service quality dimensions).

CONCLUSION

According to Wicks & Roethlein (2009), quality is defined as the summation of the affective evaluations by each customers of each attitude object that creates customers' satisfaction. From this point of view, these research papers are able to define the importance of customers' evaluation and the variables that is highly expected by the customers. This would lead to satisfaction and once again Wicks & Roethlein (2009) mentioned that satisfaction is achieved by firms that are able to provide products and services that create specific levels of value, with the expectation or beyond the expectation of the customers in order to retain the customers. Customers' loyalty results in profit, growth and sustainability of firms.

Customers are the assets of firms and hence, customers' evaluation is a critical input for firms towards business success. Understanding customers and retaining existing customers is much easier than acquiring new customers. According to Babich (1992) and Sheth (1994), it costs five times more to acquire new customers compare to retaining existing customers. Therefore, able to capture the needs, wants and desire of customers would create satisfaction and loyalty that is associated to competitive advantage. Good customers' relationship with the firms, profit may increase. Thus, satisfaction and loyalty, driven by customers' evaluation on product and service quality, are significant to firms' business success.

Both production and service operation stress the importance of customers' long-term sustainability of the firms (Wicks & Roethlein, 2009). This is stressed to all the industries in the market rather than just retail industries where both product and service are the crucial factor. Furthermore, Wicks and Roethlein (2009) also mentioned a new definition of quality is needed and it shall include a method for recording and evaluating customers' satisfaction. This is where it enables firms to identify the customers' satisfaction and loyalty based on the quality definition which would creates sustainability of customers towards the firms. Sustainability of customers would increase the firms' profits and this shall be realized by all firms. Growth of firms would drive to the growth of a country economy.

In general, customers' evaluation on product and service quality has great impact on customers, firms and even the country. Therefore, clear identification of customers'

evaluation is important. The process of conducting the customers' evaluation should be continuous in order to capture customers' heart from time to time due to the reason that customers perceptions or mindset could change dramatically over time. However, actual implementation of customers' evaluation could be difficult and hence, firms should conduct the survey cautiously and systematically in order to acquire valid, reliable and accurate results.

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THE CONCEPT OF EXPERT SYSTEM FOR EVALUATION AND SELECTION OF WEBSITES

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ABSTRACT

The main aim of this article is analyzing possibilities of applying expert systems' mechanisms in the evaluation and selection of websites. After preliminary considerations related to recent experiments of measuring and selecting the best solutions in websites, the author has presented basic elements of the concept of the system used for evaluating practical aspects of internet systems' representations together with their main functions.

Key words: website, electronic business, e-business evaluation methods.

INTRODUCTION

The basic aim of this article is to analyze possibilities of applying expert systems' mechanisms in the evaluation and selection of websites. In order to realize this objective, we need to create a concept of a system that would automatically choose the website which would be the best from the point of view of a specific user. This way the system would help to find a solution to a recurring research problem: which of the functioning websites demonstrates the greatest usefulness with regard to the applied set of criteria (characteristic features, attributes, indicators, factors)?

It leads to the determination of such a criteria configuration which would be desirable (optimally perceived) from the point of view of an end-customer and one which would allow, on the basis of a rational choice, for maximizing its broadly defined benefits resulting from the perception, analysis or use of a particular website. Simultaneously, the owner of a website obtains knowledge on which set and structure (mutual relations) of website's characteristic features appears to be the most significant for clients. On the basis of the knowledge, the entrepreneur will be able to adjust channels and ways of delivering particular services and products to customers' needs.

We can distinguish the following phases in the research into websites' usefulness and quality conducted by the author so far:

- extensive phase – consisting in identifying characteristic features of websites in subsequent basic e-business sectors. Here, the author used mainly a simple, static scoring evaluation to analyze the directions for the development of websites in a given branch (dynamics has been achieved by repeating the study performed with the same

method at certain time intervals). This phase started in 2001, and its main objective was the description of electronic economy in Poland[1],

- indicative phase – pointing to the possibilities of selected research methods which have been applied when addressing the formulated problem. It consisted in further studies into websites in selected sectors; however, in this case, the author concentrated on searching the best methodology for evaluation and selection of websites. The author has modified the applied scoring method in the direction of limiting its subjectivity and imposing an experts' preference scale, as well as analyzing the possibilities of using relational methods – mainly AHP (Analytic Hierarchy Process - T. Saaty), together with their various possible applications. This phase lasted from 2005 to 2007, and its basic objective was identifying the optimum method of measuring the examined phenomenon[2],
- intensive phase – an active approach towards the formulated problem. It consisted in facilitating the evaluation process by creation and further development of the author's own methodologies for websites' evaluation. At this stage the author has designed his own conversion method (scoring-relational method based on the analysis of distances from the average scores). Next, the author has proceeded to examine its practical application on the basis of various sector analyses. Also, the author has created methodology for the evaluation of substitution between the evaluation criteria, and he performed its verification (since 2008). At present, he has carried out studies into the application of the generalized T. Saaty's method - ANP (*Analytic Network Process)* in the evaluation of websites[3].

The conducted research justifies the claim that in the economy there appears a need to address the problem of evaluation and selection of the best solutions in websites. However, the existing procedures and the methods which are available at present cannot provide us with a univocal and universal answer to the issue presented in the beginning of this article. The proposed model of the system may help to find the desired solution.

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1. Factors influencing the evaluation and selection methodology

During the study the following basic factors influencing methodology, procedure and obtained findings have been identified:

- user category – detailed objectives of each kind of users – the status which, to a large extent, determines our further selection procedure. A website designer, owner – website administrator and client tend to have entirely different aims,
- sector, service branch – a set of evaluation and selection criteria may be completely different depending on the status of each of the specified users,
- scope and accuracy of the study – an opinion of a single expert or a selected group of experts from each sector/branch, opinions of selected group of users or interviews with a randomly selected group of users/potential users,
- a set of basic criteria groups and specific criteria within each group. The number of criteria and their attributes may vary in subsequent studies depending on the objectives specified by a user from a particular sector, and also, as it turned out, they may depend on the economic situation of a country where the research is being conducted,
- a specific method of addressing the problem. It may be a single, simple methodology or a combination of methodologies. These methodologies may be e.g. of a linear, relational, scoring, value or mixed character.
- method's environmental conditionings – taking into consideration a preference scale (expert's opinion or automated calculations) and evaluation (ratios) of the risk connected with realizing the method,
- the quality of data – especially important during a screening process; information should be substantiated and preliminarily prepared for analyses, before it is further processed,
- IT infrastructure – supporting the processing of data which are needed for our decision-making process – software and calculation procedures of particular methodologies,
- the way of interpreting findings – in a tabular or graphic form.

The first element prevails over the remaining ones: the examined problem is being solved for the prospective user. He or she decides what actually should be considered in the research. The underlying research problem in each case remains the same, namely, the evaluation and selection of the best website. However, the point of view as to what should be evaluated changes. An IT system designer has a different approach to the issue of website's usefulness or functionality than an average end user who the system is targeted at. This rule applies irrespective of the line of business where the system operates. An end user, for instance, pays greater attention to those evaluation criteria which are related to the ease of navigation, website's functionality which is close to the real one (usefulness) and, finally, economic aspects which are connected with the content within the technical framework (price relations of goods/services as compared to the real market). In the case of a system's designer, these are mainly technical aspects (proper functioning), visualization (esthetics) and those connected with the website' security (protection measures). Both points of view described above are important for the owner of a website; however, we may observe a tendency to attaching slightly greater weight to the client's point of view – as, ultimately, it is the end user and not the creator of the tool who is the source of income for the virtual organization.

The second important element is a sector, or a narrower category - a line of business. The research showed that one universal, standard set of criteria which would be suitable for all occasions does not exist. Attempts to construct such a measure have been undertaken; however, the experiments were successful only in the case of certain sectors, e.g. banking sector – and still not without certain reservations as to the degree of generalization. The second remark, which appears at this point, is the fact that the differences between sectors (e.g. banking and trade in manufactured goods) are much greater than between branches (computers and cosmetics, cosmetics and clothes/footwear, etc.). As the author has mentioned previously, the set of criteria is strongly correlated with the status of the recipient of the study. From the point of view of a system's designer, it would be recommended to undertake a constructive confrontation of the scores obtained in the study of the established solutions with a properly performed analysis of the user's information needs. The evaluation of websites is treated then as an element of typical research carried out prior to the project, where, additionally, the author needs to take into consideration the specific requirements of the mandator of the task. We should also pay attention to the economic situation in which the study is being performed. Electronic economy is based, to a large extent, on clients' trust. In the situations of economic growth or stability a group of psychological indicators (including those mainly connected with the credibility of operations of a virtual organization) achieve almost identical scores in the analyzed websites, even irrespective of marketing methods which a particular organization uses. Thus, it appears that this group of measures may be disregarded in the conducted analyses. At this point, one should also add that at a time of crisis we may observe considerable diversity. However, as it turned out, it also depends on the group of evaluators, the scope and accuracy of the study.

The latter is the third element influencing the research procedure. There are cases where a mandator is interested only in a general and quickly formed (preliminary, estimate) opinion concerning the quality of websites in a given sector/branch, setting only certain operation models or framework for action. In such a case the entrepreneur consults one expert, formulating his or her own evaluation criteria to be used by the evaluator and preferences concerning their structure. After becoming acquainted with such an opinion - the mandator delegates the task of making further detailed assumptions to a corporate website designer whose task is to construct and launch a website. Such an opinion, even though the expert is a specialist in the field, may be burdened with a large dose of subjectivity. However, as the research proves, subjectivity appears with each group of evaluators and each evaluation method; even though the subjectivity may be averaged or relativized to a certain degree, it cannot be entirely eliminated. Obviously, one of the methods used to limit the abovementioned subjectivity is consulting a whole team of experts who represent a homogeneous group (the same qualifications) or a group which is diversified with regard to their status or skills. We may arrive at a better approximation of the objectified scores by means of averaging (or taking into consideration a median of their responses). However, in the case of more complicated methods there occur problems with training an expert to provide responses (evaluations) to the addressed questions (problems have already appeared when AHP method has been applied). Other problems may emerge during conducting research on a large scale. Firstly, in the case when respondents are chosen at random, the number of responses markedly decreases (in 2001 it amounted to 60%, two years later it oscillated between 10-15%). Secondly, the survey should be as simple as possible (a limited number of questions, of non-complex structure, and the simplest possible methodology of

providing answers). On the one hand, it may lead to flattening of the analyzed issue, on the other hand, after exceeding a certain point of respondent resistance, we may observe a considerable increase in the number of incorrect answers. Such a phenomenon points to the fact that the data collected from interviewees should be processed by means of statistical methods e.g. in order to eliminate extreme scores which are caused by the lack of understanding or lack of skill at filling in a questionnaire (coefficient of concordance (Kendall & Babington-Smith), Cronbach's α (alpha) coefficient, etc.).

The fourth important factor is a set of criteria groups and specific criteria. Basically, at first, the description of criteria should be analyzed with regard to its meaning – the language of an analyst, designer and programmer may be entirely different from the language of an end user (or generally, the language of business). Therefore, the languages should be made as similar as possible, through coordination, simplification and unification. Such practices are not commonly used; instead, established sets of factors with specific terminology are prepared e.g.: organizational, functional, technological, legal, economic, cultural, or the one referring to the level of security. In each of the groups particular subcriteria undergo marked differentiation depending on the sector/branch they relate to or the objective of the study.

To date, the author has placed the greatest emphasis on the research methodology, its conditionings and the issues connected with technical adjustment of data to be processed and a technical calculation method. A commonly applied ranking method, which is easy to use and simple due to its interpretation of scores, has been applied and tested several times. However, the method did not receive recognition in scientific circles. This particular fact is caused by the specific simplicity, linearity of the evaluation, its susceptibility to structural diversity (the more subcriteria of a given group, the greater its weight in the final score) and the aforementioned subjectivity. Therefore, the author initially concentrated on the modifications of the ranking method. The author proceeded to use a survey on a larger scale and calculate average scores, and he went on to undertake preliminary processing of the data. Apart from the abovementioned steps, the author applied: group standardization – each group was assigned a maximum value equal to one and a simulation of preference scale variants. The preference scale was established by the person conducting the study and particular experts taking part in it, and the scale was averaged and assumed on the basis of external arrangements. Calculations have been performed for variants with an established predominance of one group of factors and a uniform structure of the remaining ones. Simultaneously, the author has started tests concerning a possible application of a relational method. The author has chosen T.Saaty's AHP method as the most popular and the simplest one with regard to its ideology. However, later in the course of the study, it turned out that the experts objected to the necessity of filling in a great number of tables: first, relations among particular criteria, then particular websites with regard to the established criterion. Next, together with the increase of the number of criteria and subcriteria, experts faced great difficulty evaluating relations among them: a simple maneuver of changing the order of criteria in the table resulted in marked differences in the obtained scores (experts did not remember their previous estimates, and in the case of repeated assessments, they evaluated mutual relations in a different way). Moreover, in order to make calculations, it was necessary to apply a special software package or engage in laborious calculations performed in spreadsheets. The method itself cannot be quickly acquired by an average user, and its results have not been treated seriously. Therefore, further attempts at methodological research

have been undertaken: the author has combined this method (actually: the preference scale obtained by means of this method) with a scoring method; and also the author has created his own method which simplifies the calculations which are necessary in AHP method. In the first case, the author has not obtained satisfactory results, and in the second case, the author has constructed a special conversion method transforming the results of partial experts' evaluations into relations among criteria, and subsequently, relations of websites in the realization of particular criteria.

The last element is the way of interpreting scores – on the basis of gathered tabular data, the author creates a graphic representation of scores; frequently, additional calculations have to be performed in order to obtain conformity of results.

The factors mentioned above constitute the basic components of the proposed concept of the expert system supporting the evaluation and selection of websites.

2. The concept of the expert system supporting evaluation and selection of websites

As it has become apparent in the above specification, creating an IT system that would support a decision-making process in the examined case is not an easy task due to the quantity of data, increasing exponentially, which (together with their mutual relations) should be processed by the system. Simultaneously, the specification which has been constructed in the second part allows for analyzing the problem and presenting it in the form of an orderly, model research procedure. Also, we should remember that in a given case we use a limited, specified amount of gathered information; also, a number of methods which may be potentially used to process the data increases.

IT system, therefore, should consist of the following necessary modules: analyzer, simulator, solver, interpreter and verifier.

The basic task of an Analyzer mainly consists in allowing the end user to communicate with the system. It is a complex task because it should be made up of a few subsequent steps. In the first step, a user should have a chance to ask a question, which on the one hand, would express his intentions, and on the other, it could serve as a basis for initiating further actions. In order to address the first problem we should deal with the issue of correctness of the categories and the correspondence of the categories known to the user and those which function in the system. It happens that the treatment of the same variables from the point of view of a user and a system designer may be entirely different. Next, we should construct a mechanism which helps to specify the scope of the research either by means of subsequent questions or by selecting available options from the menu. In the third stage, we should ensure internal consistency and integrity of the question which is being asked, from the point of view of limitations which result from the previous selection. The Analyzer will aid with making a choice of a category of a user, branch where he or she wants to operate, and the scope of the actions which are to be undertaken. As we may see, the Analyzer should be supplied with database information concerning:

- a status of a user (a functional user, analyst, designer, website administrator, etc.). A status of a user will be related to defining or selecting criteria groups (from a list)

specifying characteristic features which are important from the point of view of particular categories of users,

- division into sectors and branches within the sectors (e.g. financial services (banking, stock exchange, insurance, customs); trade (computers, clothes, cosmetics, sportswear, etc.); service (tourism, recruitment, property trading etc.)). Each sector/branch will have a maximum set of criteria for detailed evaluation attached to it. This set will be available to specific categories of users to view (only) or to select (from a list); or a user will be able to add his or her own categories,
- a list of experts from particular sectors (to select) and a possibility to generate (enter, import from a given format) one's own list of users evaluating websites,
- sets of criteria groups and specific criteria in a hierarchic, narrowing subdivision with regard to the user's status, sector, branch and range.

A Simulator module will be used to gather basic data for performing calculations. Its role consists in generating tables which would enable an expert (experts, website users) to evaluate the phenomenon (evaluation of specific criteria), and subsequently, the expert would be able to sum up the evaluations and calculate additional indicators which are required for further analyses. Additionally, it should have the following mechanisms:

- selection of a specific method used to solve a research problem, together with an attached software package which enables its application (it is important in the case of complex methods, especially relational, value conversions – basis of solution methods),
- mechanisms of supplying some methods with additional parameters such as preference coefficients, risk coefficients, coefficients of usefulness, etc. which would automatically suggest options or give a chance to add one's own solution,
- mechanism of processing data in the case of selecting general solutions with access to the required statistical packages, or developed, selected (or to be chosen by the user), necessary statistical methods.

A Solver module should be used as an additional, supplementary calculation back-end of the designed system. According to previous comments, it should contain a package of evaluation methods for websites (possibly to be complemented) as well as methods used for preliminary preparation of data to be processed.

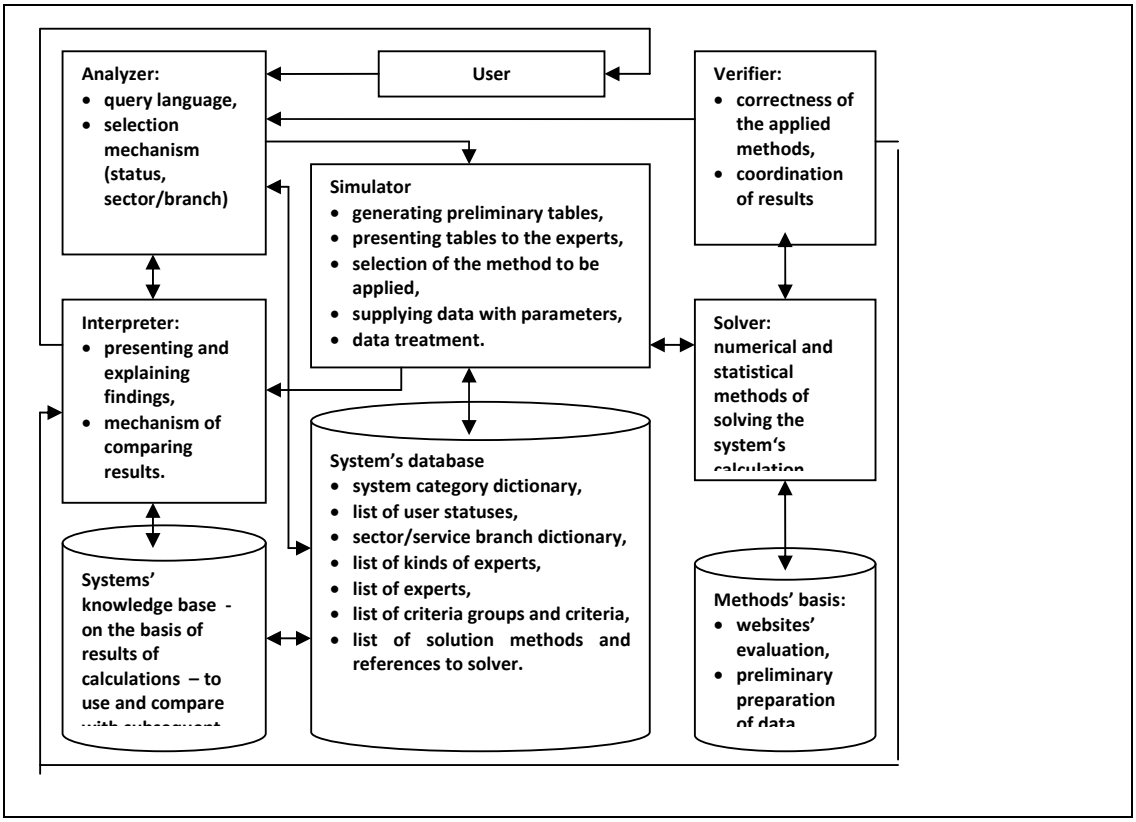

Figure 1. Logical framework structure of expert system supporting evaluation and selection of websites
Source: the author's own work.

Basically, an Interpreter module may be destined to realize two objectives. Firstly, it may be helpful in interpretation of scores and their presentation in a desirable graphic form (the issue of selection of data to be presented and their form: table and a type of a table, graph and a type of a graph, etc.). Its second objective is comparison of results obtained by means of various methods of websites' evaluation (collecting scores obtained from various methods, adjustment to comparability and help in presenting scores).

A Verifier should become an additional module. Its primary tasks are: verifying the correctness of methods used to solve specified problems of a user and coordination of the system's operations.

The framework structure of the system has been presented in Fig. 1.

3. Summary

The presented concept is still being developed. It is a continuation of work concerning evaluation methods of websites' quality and usefulness. On the basis of the concept, after its specification, we can create a logical project of the system that can be systematically developed in order to expand the base of sector/branch criteria and to apply procedures and methods for the evaluation of the examined phenomenon which have not been tested so far.

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APPLYING PROJECT MANAGEMENT TO EVENT PROJECTS - A PRACTICAL STUDY

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ABSTRACT

In this paper, we applied the project management to a university cheerleading competition as a case study. In Taiwan, university cheerleading competitions are one the most popular events and always attract attentions. However, records showed that there are some problems in quality and coordination to be solved for past competition event planning. The success of these event projects mostly rely on the experience of certain individuals. With the complexity of the coordination and interaction needed during the event activities, it is not easy to meet the expectations of the stakeholders, nor to accumulate the knowledge to enhance the management capacity. It is noteworthy that the event management is not the same as general project management due to the characteristics such as the correlation between many of the event activities and there may be many activities executed at the same time. Such characteristics increase the probability of failure of event projects.

General project management approach is adapted to the competition event project in this research. Modification to the project management approach is made to emphasis the interaction and correlation management due to the event project characteristics. A complete case study will be presented to illustrate the differences between event projects and general projects.

Keywords: Project management, Event management.

INTRODUCTION

Cheerleading is a sport that combines gymnastics, stunt, slogan, and dance. In Taiwan, university cheerleading competitions are one the most popular events and always attract attentions. However, records showed that there are some problems in quality and coordination to be solved for past competition event planning.

The increasing number of successful examples in project management shows that the application of proper knowledge, skills, approaches, and technologies have a great impact on the success of projects. According to the definition by U.S. Project Management Institute (PMI), project management means "Application of knowledge, skills, tools and techniques to plan activities to achieve project requirements." Project management is a cross-sectored integration of capabilities. In other words, project management is a systematic way of doing jobs. It can be applied to any industry or enterprise to solve problems and create opportunities, such as process reengineering, organizational consolidation, product development, event organizing, marketing planning, and construction management.

Event projects are one particular category of projects. The government, enterprises, associations, schools, and even performing arts industry, held regularly every year all types of

events. The success of these event projects mostly rely on the experience of certain individuals. With the complexity of the coordination and interaction needed during the event activities, it is not easy to meet the expectations of the stakeholders, nor to accumulate the knowledge to enhance the management capacity.

With the heightened awareness of service quality and customer satisfaction, the requirement of the systematic management framework and methodology for event projects has attracted the attention of researchers. It is noteworthy that the event management is not the same as general project management due to the characteristics such as the correlation between many of the event activities and there may be many activities executed at the same time. Such characteristics increase the probability of failure of event projects.

In this research, general project management approach is adapted to the competition event project. Modification to the project management approach is made to emphasis the interaction and correlation management due to the event project characteristics. A complete case study will be presented to illustrate the differences between event projects and general projects.

PROJECT MANAGEMENT

General projects can be divided into the following stages after the project initialization: the planning process, the executing process, the monitoring and controlling process, and the closing process. To meet the needs in event projects, the event life cycle is modified and divided into analog stages, which are the planning stage, the deployment stage, the implementation stage, and the closing stage. The work in planning stage is to formulate a comprehensive program of proposed activities after the decision to sponsor the event. The work in deployment stage includes the preparation of site layout, facilities leasing plan, procurement and set up of equipments, and the recruitment and training of personnel according to the event plan. The implementation stage is the process to conduct the event activities. The closing stage is the conclusion of the event. In this case study, the management of cheerleading competition project followed the above stages.

PROJECT APPROSCH

Project Planning

The purpose of the project planning stage is to develop a project plan that includes all necessary processes to define the objectives, establish the scope, create the work breakdown structure, and other required activities to achieve the project goal. The required activities in the planning stage are objective planning, scope planning, work breakdown structure creating, schedule planning, budget planning, risk planning, and communication planning.

Objective Planning

The objective of a project should be specific, measurable, achievable, realistic, and time bound (SMART). Following the above principle, the objectives of the project are:

1. The project should be finished in two months.
2. The budget is 150,000 NT dollars.
3. There are more than 1,500 students attending the competition.

Scope Planning

The scope of the project is the description of total amount of works needed to be done in the project. For this project, they are:

1. To get the authorization from the school.
2. To write the proposal for the competition.
3. The rental of all necessary equipments and material.
4. The arrangement, implementation, and monitoring of the activities during the competition time period.
5. The closure and after-work of the competition.

WBS Planning

The whole event must be subdivided into a hierarchical structure of smaller and manageable components which is called Work Breakdown Structure (WBS). The WBS can be obtained according to either process oriented or product oriented. In this project, process oriented principle is applied and the WBS is shown in Figure 1.

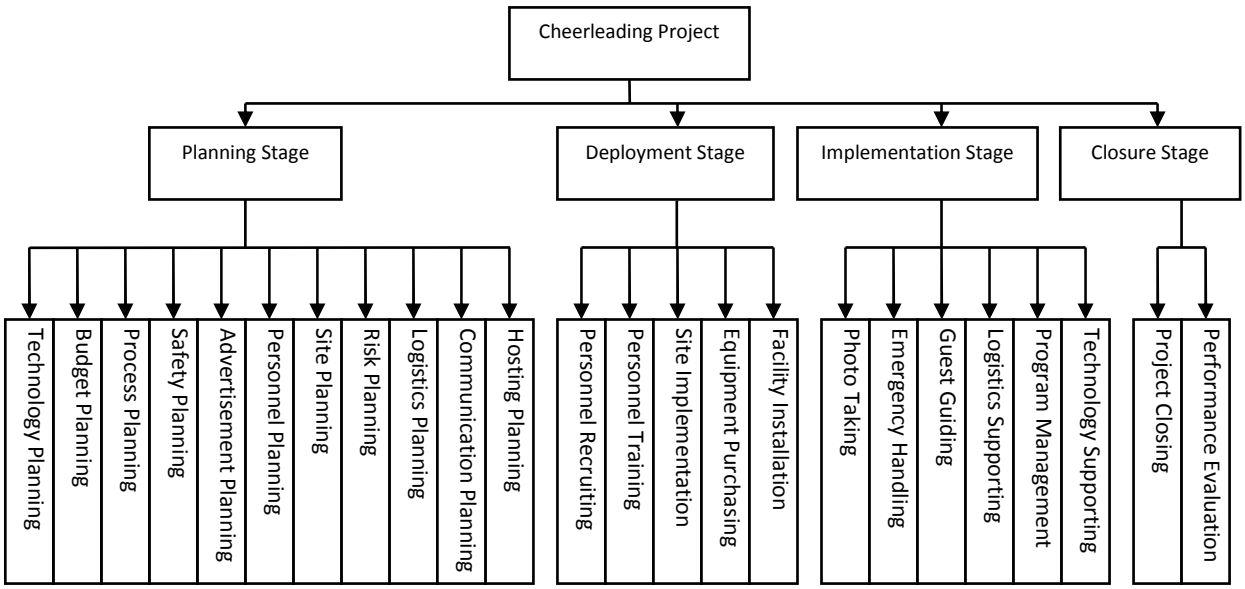

Figure 1. The WBS of the project

The network diagram is then constructed to show the relations between all the activities. The network diagram of the project is shown in Figure 2, 3, and 4. The Gantt Chart of the project is shown in Figure 5.

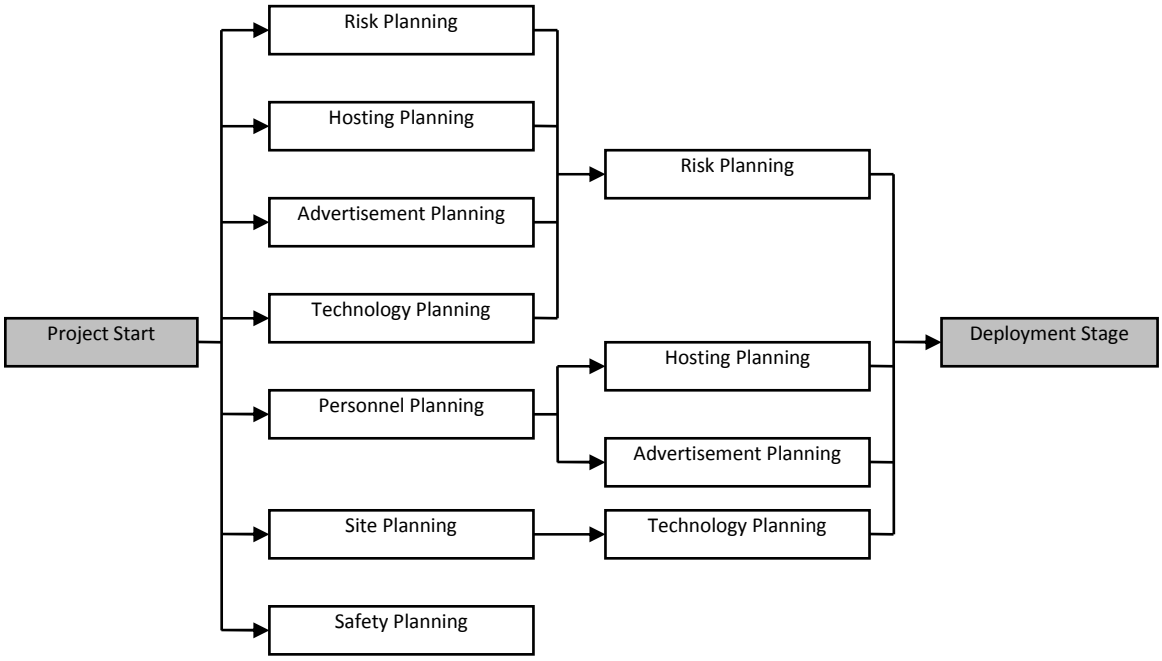

Figure 2. The network diagram of the planning stage

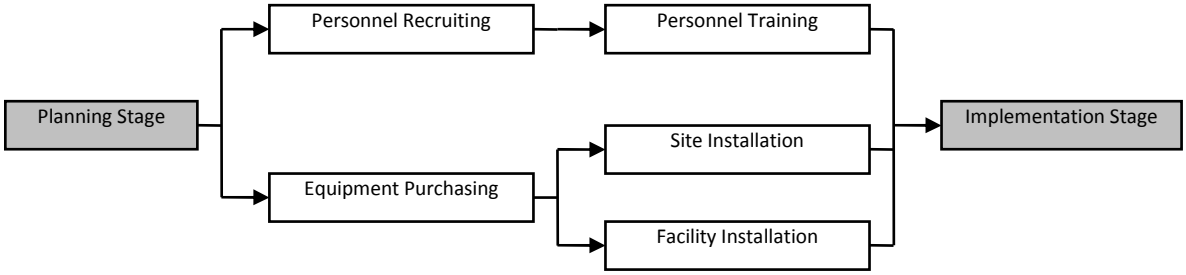

Figure 3. The network diagram of the implementation stage

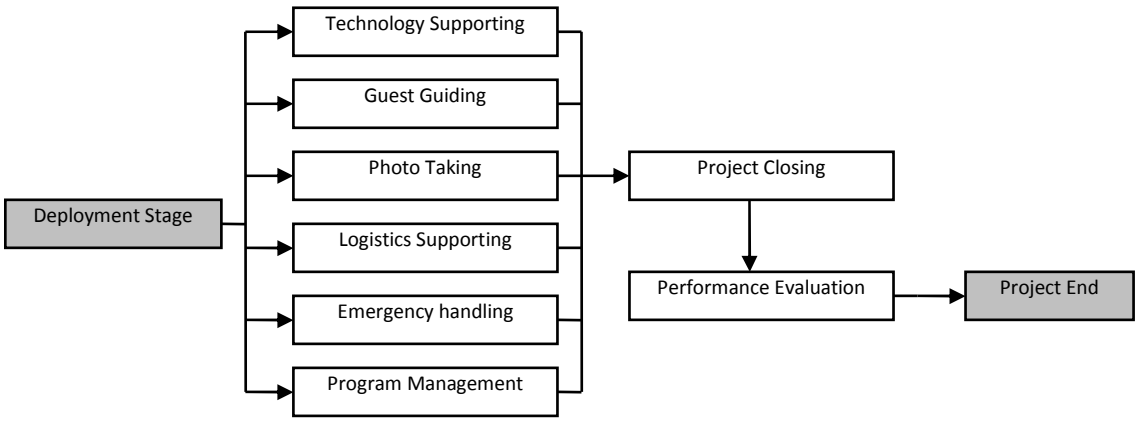

Figure 4. The network diagram of the executing and closing stages

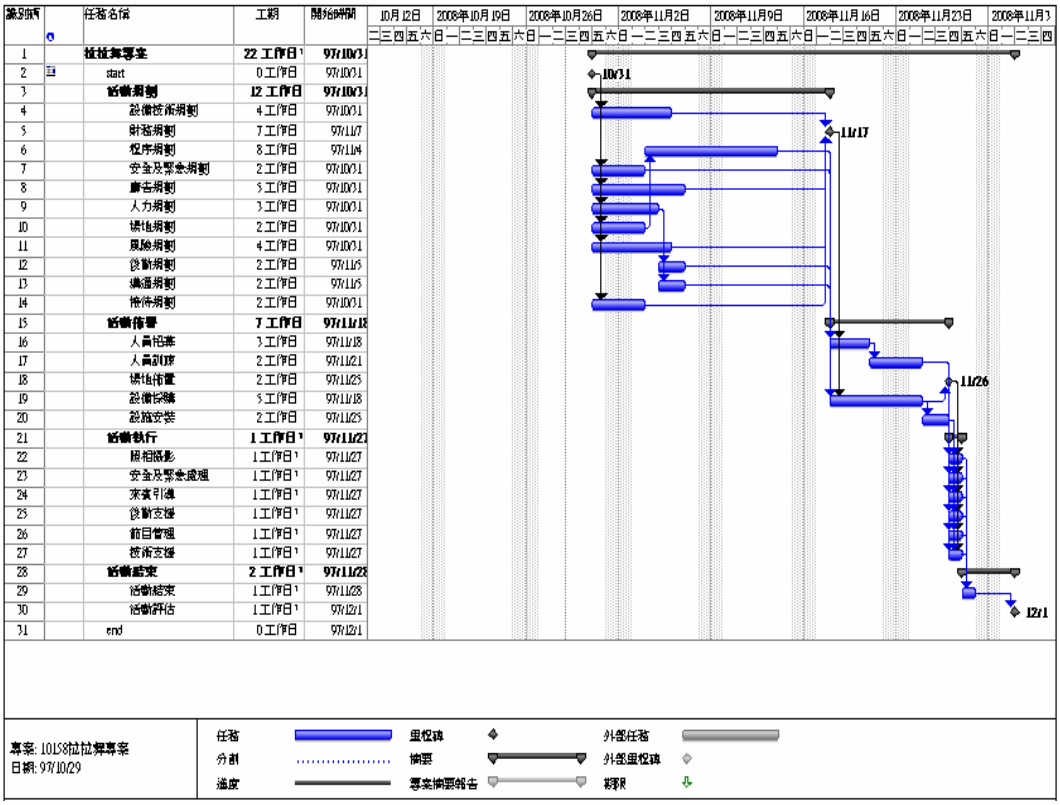

Figure 5. The Gantt chart of the project

Budget Planning

Budget planning is to calculate the amount of funds needed for the project. The budget needed for the project includes the equipments rental expenses, miscellaneous expenses, and personnel expenses.

1. Equipment rental expenses: equipment leasing from the supplier including lighting equipments, special effect equipments, and other audio-visual equipments.
2. Miscellaneous expenses: trophies cost, banners cost, advertising costs, and so on.
3. Personnel expenditure: the fee needed for all the required personnel.

The budget for each time period is calculated and then the figure of budget baseline is drawn as in Figure 6.

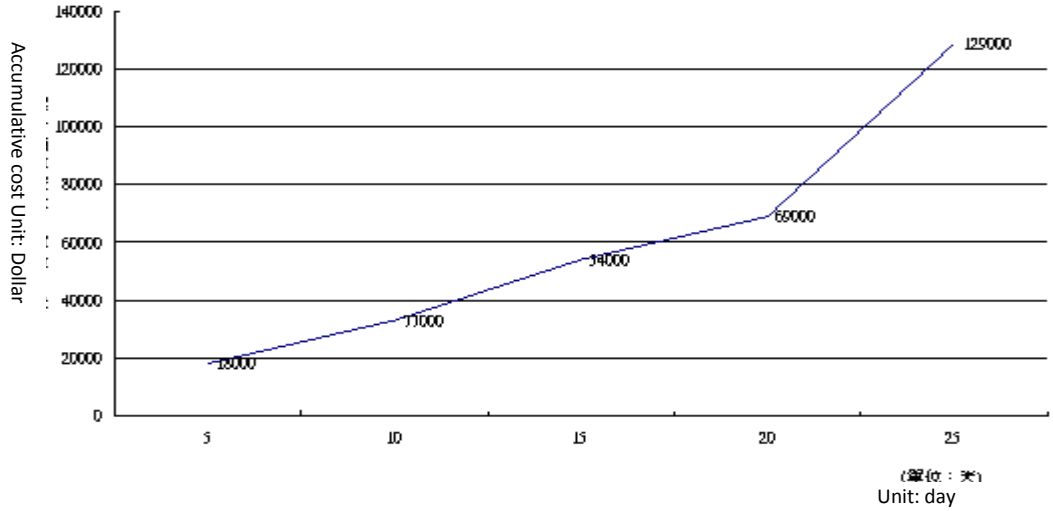

Figure 6. Cost baseline

Risk Planning

The purpose of risk planning is to identify, analyze, and respond to the occurrence of risks. The impact of the risks on the activities can be of positive or negative. One example of positive risks is that the number of participants or the number of visitors is more than expected. Downside risks such as damage to facilities or power failure may affect the quality and cost of the project. The process of risk planning can be divided into risk identification, qualitative analysis, quantitative analysis, and risk response.

Risk Identification:

The first step of risk planning is to identify all the possible risks. Prior to the event the risks must be first identified and the prevention plan must be made. In cheerleading activity, possible risks includes: a participant in the competition being injured, dangers caused by improper use of equipments or props, participants abruptly abandoned the game, the assessment activities or participants being late, power failure so that equipments were not available, or earthquakes, fires and other activities that caused disruption. All identified risk are listed in Table 1.

Qualitative Risk Analysis:

The purpose of qualitative risk analysis is to prioritize risks according to the probability of occurrence and impact of risks. After the possible risks are identified, the probability of occurrence and the impact level for each risk is estimated. In this project, the scale for both probability and impact level is 1-10. Then the Risk Priority Number (RPN) for each risk is calculated by multiplying the probability and impact level. Higher RPN means more serious risk to the project and should be studied more in the next step. The result is shown in Figure 1.

Table 1. Risk Identification and Qualitative Risk Analysis

Work Package	Risk Item	Probability	Impact	Risk Priority Number(RPN)
Personnel Recruiting	Recruiting not completed	2	6	12
Personnel Training	1.Personnel are late	7	3	21
	2.Bad communication	5	3	15
Site Installation	1.Earthquake	2	4	8
	2.Fire	1	8	8
	3.Equipment didn't arrive	3	7	21
Equipment Purchasing	1. Equipment arrives late	2	7	14
	2.Wrong equipment	2	7	14
		2	7	14
Facility Installation	1.Machine malfunction	7	6	42
	2.Personnel accident	3	3	9
Photo Taking	1.Carema malfunction	6	3	18
	2.Out of memory	1	3	3
	3. Personnel accident	1	2	2
Emergency Management	1.Personnel shortage	3	5	15
	2.Equipment not enough	3	5	15
		2	6	12
Guest Guiding	Guests are late or not arriving	2	3	6
Logistics Supporting	1 Personnel shortage	2	3	6
	2. Bad communication	5	2	10
	3. Site out of control	7	6	42
Event Closing	1. Machine malfunction	5	5	25
	2.Missing equipment	3	4	12

Quantitative Risk Analysis

In the quantitative risk analysis step, the effects of the risk on the project schedule, cost, and quality are analyzed numerically. During the implementation of a project, most of the problems come from a small number of reasons. Some risk may cause serious problems to the project. In quantitative risk analysis, the top 20% of risks found in the previous step are taken into consideration to study the type and amount of effect on the time, cost, and quality of the project. The result of quantitative risk analysis is shown in Table 2.

The result shows that the main risks are the facilities delay and failure during the installation step which will result in the delay of the competition and order problems. The second major risk problems are the malfunction of equipments during the process of the competition.

Table 2. Result of quantitative risk analysis

Risk Item	Impact
Facility delay or not arriving	1.Time delay 2.Process interrupted
Facility malfunction	1.Unable to test facility before competetition 2.Cost increase
Camera out of battery or malfunction	Unable to work
Competition process out of control	1.Ouder out of control 2.Time delay 3.Accident
Equipment break down	1.Cost increase 2.Bad credit

Risk responses

Risk responses is the process of developing proper actions and alternative plans to reduce threats in case of risks. Based on the results in the quantitative risk analysis step, appropriate activities should be planned accordingly to reduce the impact of the risks on schedule, cost, or quality of the project. The major risks and the corresponding response activities are listed in Table 3.

Table 3. Risk response

Work Package	Risk Item	Risk Response
Site Installation	Facility delay or not arriving	1.Prepare backup facility
Facility Installation	Facility malfunction	1.Prepare backup facility 2.Prepare technology support
Photo Taking	Camera out of battery or malfunction	1.Prepare backup machine 2.Prepare technology support
Logistics Supporting	Competition process out of control	1.Provide more personnel 2.Improve personnel communication 3.Develop relations
Event Closing	Equipment break down	1.Repaid damage

Communication Planning

Communication planning is the process to identify the stakeholders and to determine the necessary information to be transferred between stakeholders at proper time. The communication issue is more important in event projects than in other types of projects due to the characteristics that usually more people are involved in an event project and the close linkage of the event activities.

In order to achieve the best quality and to avoid the impact of poor communication, the project team will prepare the following related manuals and material in Table 4 to promote

the communication quality so that the activities carried out smoothly. To make sure all the personnel understand their own responsibility, team meeting will be held prior to the event and all the procedures must be double checked.

Table 4. Communication material

Brochure	Purpose
Pass	Guests and personnel passage control
Program Brochure	Provide program flow to guests and personnel
Poster	Promotion to provide event information
Name Tag	To identify guests and personnel
Invitation	To invite guests
Map	Provide site layout and program information
Site Guide	Provide direction from the entrance to the event site
Contact Info	Provide phone number and email for pereonnel

Project Deployment and Implementation

The required activities in the deployment stage are Personnel Recruiting, Equipment Purchasing, Personnel Training, Site Installation, and Facility Installation. The personnel needed for the work of the event are selected and hired in the recruiting step according to the human resource plan developed in the planning stage. These personnel then take necessary training in the personnel training step. The necessary facilities are purchased in the facility purchasing step. Then the facilities and constructions are setup during the site installation step and facility installation step.

The required activities in the implementation stage are Technology Supporting, Guest Guiding, Photo Taking, Logistics Supporting, Emergency handling, and Program Management. They were performed as planned in the project planning stage. The purpose of technology supporting is to provide the required technologies are supported by a specific work group during the event. During the arriving of all guests, project personnel should follow the plan to guide them to proper locations. Photos are taken to record the process. Logistics supporting monitors and supplies necessary drink, food, and material. The program management control the process and order of all event activities.

Project Closure

After the program, the project team carried out site rehabilitation, site cleaning, returning facilities back to the original units. Three days after the event, a meeting was held to evaluate the performance of the project. Experience retention refers to the record of problems, resolving approaches, and best practice during the project. It will be an important reference

for the future projects. Through the review of records of previous projects, the site layout and the linkage of the activities were improved.

Although some improvements have been made through the review of this record from the previous projects, there are still some new problems in this project that are not shown in the previous recode. After reviewing these problems carefully, the related information and data are documented for future references.

CONCLUSION

Cheerleading competitions in university are becoming more and more popular in Taiwan. All types of event projects are also frequently performed by companies and organizations. For most of these companies and organizations, there are not systematic approaches to plan, execute, and monitor the activities in the projects. The success of these event projects mostly rely on the experience of the project manager and the scale of the event. Although the knowledge for project management is well established, it still needs adoptions to meet the characteristics of event projects. The major differences between regular projects and event projects are the complexity of the coordination and interaction needed during the event activities. In this case study, we adopted the general project management to emphasis the interaction and correlation management due to the event project characteristics. The result showed that event project management increased the project quality and the stakeholder satisfaction.

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A STUDY ON RELATIONSHIPS AMONG SOFTWARE ENGINEERING CAPABILITY, COMPETITIVE ENVIRONMENT AND BUSINESS PERFORMANCE IN JAPANESE SOFTWARE INDUSTRY

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ABSTRACT

We conducted three times surveys on software engineering capabilities of IT vendors in Japan. In the surveys we developed a measurement model, called software engineering excellence (SEE), from the viewpoint of deliverables, project management, quality assurance, process improvement, research and development, human development, and contact with customers. In this paper, we integrated the data of three surveys into a database and identified 151 unique IT vendors consisted of 42 maker-turned vendors, 33 user-turned vendors and 76 independent vendors. And, we conducted path analysis on the basis of SEE. Then, we found the significant causal relationships among the factors of SEE. For example, human development and project management at the upper stream of SEE significantly influence on the overall software engineering capabilities. Also, we found that the factors at the lower stream of SEE, e.g., deliverables, R&D, process improvement, customer contact, needed to be interpreted in relation to the other factors such as business performance and business environment as well as time series data.

Keywords: Software engineering capability, Business environment, Statistical analysis

INTRODUCTION

Many companies that use enterprise software in Japan have not been fully satisfied with the quality, cost, speed and productivity of software that IT vendors deliver. At the same time, IT vendors in Japan are facing drastic changes in their business environment, such as technology innovations and new entrants from China and India. Also, the issues in the IT industry in Japan, such as the multilayer subcontractors and the business model depending on custom-made applications for domestic market orientation, have been pointed out over times (Cusumano, M., 2004; Kadono, Y., 2007).

In order for the IT industry in Japan to meet these challenges, an important step is to understand how software engineering capability is significant as a core competence for achieving medium- and long-term success. Therefore, we designed the research on software engineering excellence and conducted it in 2005, 2006 and 2007 with Ministry of Economy, Trade and Industry, Japan.

The objectives of the research were:

- to assess the achievement of software engineering discipline by IT vendors in Japan, and
- to better understand the mechanism of how software engineering capabilities relate to the business performance of IT vendors.

To achieve these objectives, we developed a measurement tool called Software Engineering Excellence (SEE), which can evaluate the overall software engineering capabilities of IT vendors from the viewpoint of deliverables, project management, quality assurance, process improvement, research and development, human development, and contact with customers. Also, we introduced other indicators: business performance and business environment. We assume that the business environment complements the relationship between SEE and the business performance of the software vendors.

In the SEE2005 survey, we analyzed the relationship among SEE, business performance and business environment based on the data collected from 55 major IT vendors in Japan. As we conducted the path analysis, we found that SEE has a direct positive impact on business performance and that the competitive environment directly as well as indirectly (i.e., via SEE) affects business performance (Kadono et al. 2006).

In the SEE2006 survey, we increased the number of surveyed Japanese IT vendors from 55 to 78 in order to more deeply investigate the impact of software engineering on business performance, as well as the business environment. In particular, in this study we focus on the relationships among factors of SEE, the business environment, and business performance as measured by sales profit ratio (Kadono et al., 2007). By analyzing the data collected from 78 major IT vendors in Japan, we found that superior deliverables and business performance were correlated with the effort expended particularly on human resource development, quality assurance, research and development and process improvement as shown in Figure 1 (5% significance).

In 2007, we analyzed the data collected from 100 major IT vendors in Japan. Then, we reproducibly observed that the effort level on human resource development, quality assurance and project management made better performance of customer contact, research and development and process improvement of the IT vendors in Japan, just as we found the tendency in 2006. However, the causal relationships differ significantly from the origins of the vendors: makers-turned vendors, user-turned vendors and independent vendors.

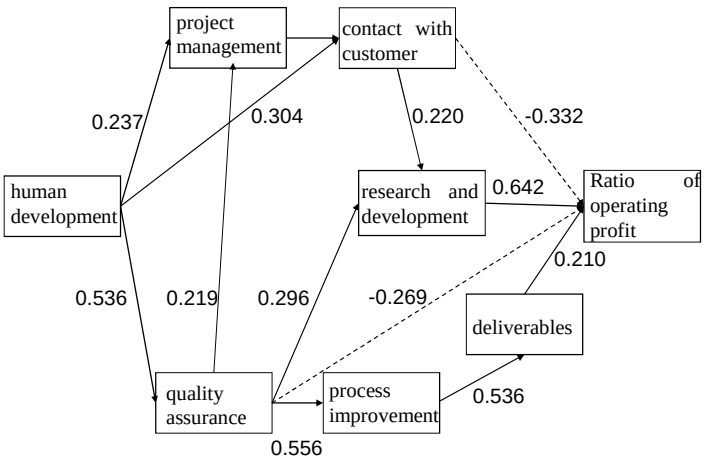


Figure 1. Result of Path Analysis at SEE2006.

In this paper, we integrated the data of three surveys into a database and identified 151 unique companies consisted of 42 maker-turned vendors, 33 user-turned vendors and 76 independent vendors. And we focus on investigating the relationships among the factors of SEE by consolidating data for three years.

RESEARCH MODEL

We introduce the structural model and the measurement model of the research on software engineering excellence (SEE) in this section.

Structural Model

In the original structural model in SEE survey, based on the interviews with successful IT vendors in Japan, we identified three key factors for success: efficient sales force management, effective operational improvement and excellent R&D. In this paper, we begin with the hypothetical structure which is consistent with the empirical results of SEE 2006 (Figure1) and SEE2007.

In Figure 2, we show the structural model in this paper, assuming the following three paths to improve deliverables (quality, cost, delivery etc.):

- marketing innovation (from human development to project management and contact customer),
- product innovation (from human development to R&D), and
- process innovation (from human development to quality assurance and process improvement).

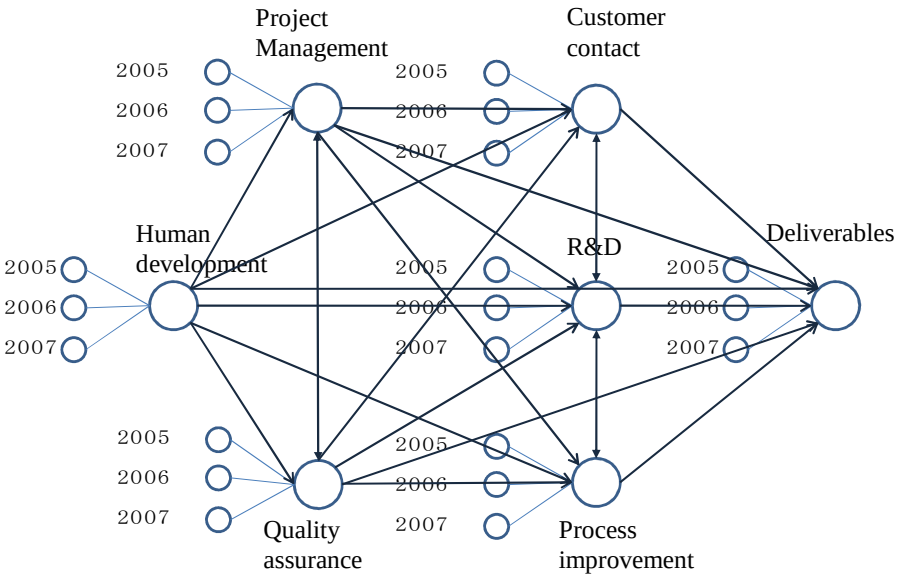


Figure 2. Structural Model.

Measurement Model

Our measurement model of SEE was originally developed through interviews with over 30 experts in the industry in Japan and the U.S. as well as literature searches (Brynjolfsson, E. 2004; Fujimoto, T. 2003; Matsumoto, Y. 2005; Ministry of Economy, Trade and Industry. 2007).

The SEE measurement model has a hierarchical structure with three layers: observed responses, seven detailed concepts, and SEE as a primary indicator. The measurement model at SEE2007 has been modified based on the response rate of each question item and the statistical significance of each observed responses at SEE2005 and SEE2006.
The measurement model of Software engineering excellence (SEE) is as follows:

- deliverables: achievement ratio of quality, cost, speed, and productivity, grip on project information.
- project management: project monitoring, assistance to project managers, project planning capability, ratio of PMP(Project Management Professional).
- quality assurance: organization, method, review, testing, guideline, management of outsourcers .
- process improvement: data collection, improvement of estimation, assessment method, CMM/CMMI (Carnegie Mellon University).
- research and development: strategy, organization, sharing technological skills, learning organization, development methodology, intellectual assets, commoditized software, readiness to state-of-the-art technology.

- human development: training hours, skill development systems, incentive schemes, measure of human development, moral support.
- contact with customers: ratio of prime contracts, scope of service offered, direct communication with customer's top management, deficit prevention, clarification of user specification.

SURVEY ON SOFTWARE ENGINEERING EXCELLENCE

We conducted three surveys, such as SEE2005, SEE2006 and SEE2007, described in INTRODUCTION. After collecting data from vendors in SEE2005, SEE2006 and SEE2007, we conducted factor analysis and calculated the factor loading of seven factors, i.e., deliverables, project management, quality assurance, process improvement, research and development, human development and contact with customers, based on the observed response to the relevant question items of the measurement model described in the previous section.

For example, the score of deliverables of SEE is estimated by observed response to the relevant question items, such as achievement ratio of quality, cost, and delivery (QCD), and productivity, and grip on project information. Regarding the achievement ratio of QCD, the median achievement ratios of QCD are higher than 70% in any types of vendors, i.e., maker-turned, user-turned and independent vendors (Figure 3). Also, the achievement levels of QCD at the user-turned vendors tend to be higher than those of the maker-turned vendors and the independent vendors.

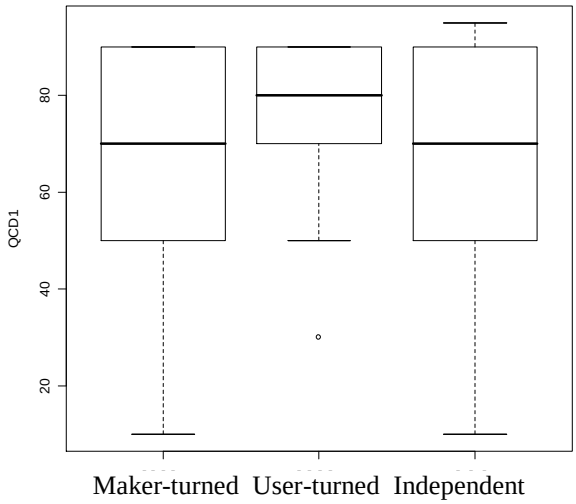


Figure 3. Achievement Ratio of Quality, Cost, and Delivery in SEE2007 (%)

In this paper we integrated the data of three surveys into a database and identified 151 unique companies consisted of 42 maker-turned vendors, 33 user-turned vendors and 76 independent vendors, as shown in Table 1.

Year	2005	2006	2007	2005/06/07
Questionnaires sent	230	537	1000	NA
Valid responses	55	78	100	151
(Maker-turned, User-turned, Independent)	(17,15,23)	(27,15,36)	(27,20,53)	(42,33,76)
Response rate (%)	24	15	10	NA

Table 1. Surveys on Software Engineering Excellence (SEE)

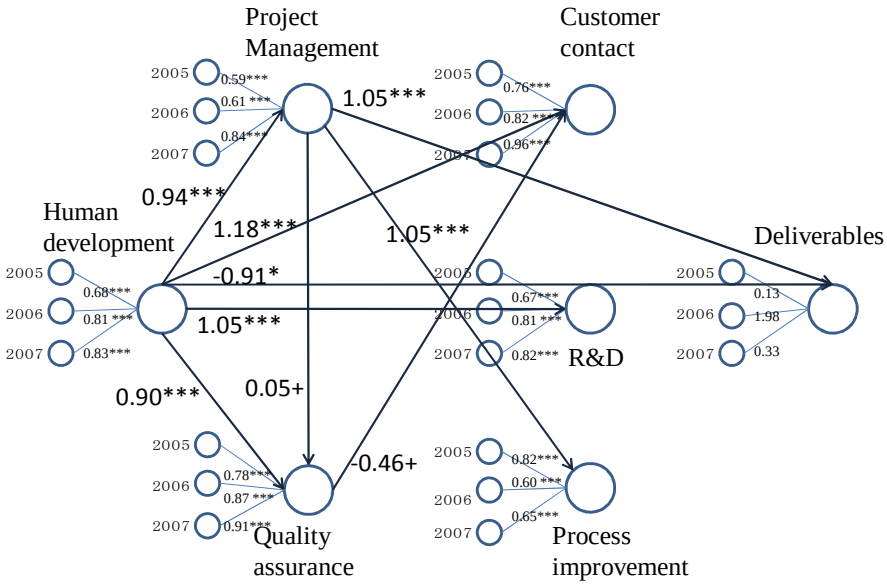
RESULT OF ANALYSIS

We conducted path analysis on the basis of the structural model in Figure 2 and data of three surveys, and found the following causal relationships among the factors of SEE in Figure 4 (Bollen, K. 1989).

- Human development has direct positive significant influence on project management, quality assurance, customer contact and R&D.
- Project management has direct positive significant influence on quality assurance, process improvement and deliverables.
- However, there are some negative paths. i.e., from quality assurance to customer contact, from human development to deliverables.
- Also, deliverables is not significantly composed of deliverables in SEE2005 through SEE2007.

The results implicate the following:

- Human development and project management at the upper stream are significantly influential factors on the overall software engineering capabilities.
- The factors at the lower stream need to be interpreted in relation to the other factors such as business performance as well as business environment.
- Several negative paths, e.g., from quality assurance to customer contact, implicate that the effort on the factor does not pay off at least during the research duration. They might be expected as a long-term effect.
- Furthermore, deliverables needs to be investigated deeply from the viewpoint of time series analysis.



*** 0.1% ** 1% * 5% + 10%

Figure 4. Result of Path Analysis.

CONCLUSION AND DISCUSSION

In this paper, based on the three surveys on software engineering excellence, i.e., SEE2005, SEE2006 and SEE2007, we integrated the data of three surveys into a database and identified 151 unique companies, consisted of 42 maker-turned vendors, 33 user-turned vendors and 76 independent vendors. And, we conducted path analysis on the basis of the structural model and found significant causal relationships among the factors of SEE, e.g., human development and project management at the upper stream are significantly influential factors on the overall software engineering capabilities. Also, we found that the factors at the lower stream, e.g., deliverables, R&D, process improvement, customer contact, needed to be interpreted in relation to the other factors such as business performance and business environment (Kadono et al., 2009) as well as time series data.

Although we focus on the software engineering excellence (SEE) in this paper, the analysis of the relationships among SEE, business performance and business environment (Figure 5) remains to be solved in the future. Business performance expresses the overall business performance of individual IT vendors, such as profitability, growth, and management efficiency. Competitive environment expresses the company profile of IT vendors as well as the business environment in which the vendors work, e.g., number of software engineers, business model, and average age of employees.

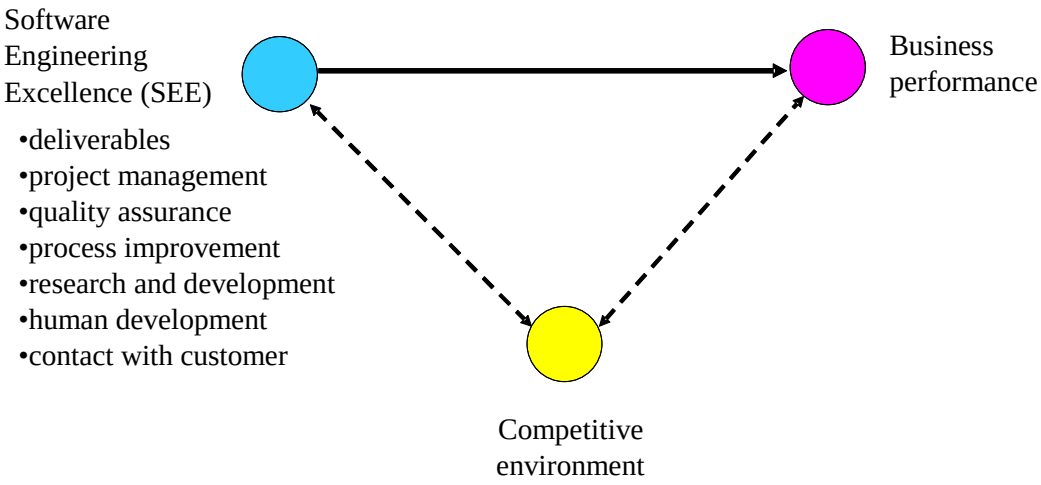


Figure 5. Conceptual Model of Overall SEE Research.

For example, Figure 6 shows that vendors who have a larger number of software engineers tend to score higher SEE in any type of vendors. This tendency was similar to that of the previous study at SEE2005 and SEE2006. We need to further investigate the advantage of scale in terms of capability management of software engineering.

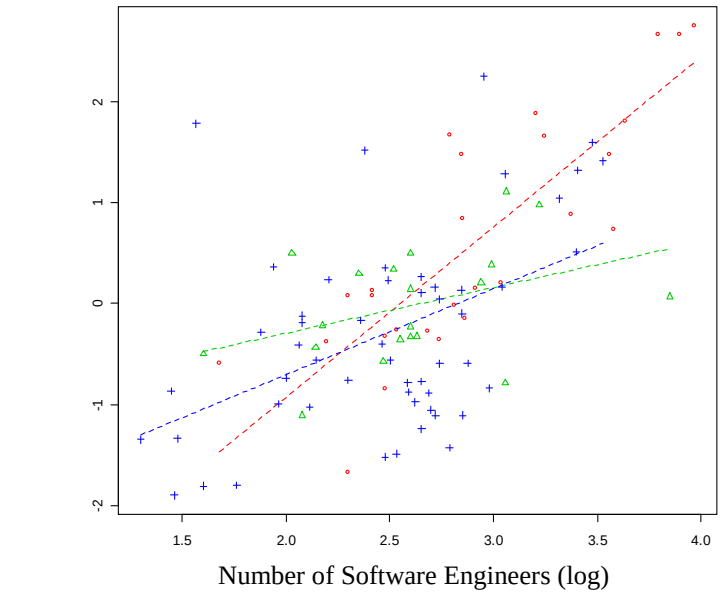


Figure 6. Number of Software Engineers vs. SEE.
(. Maker-turned, △user-turned, +independent)

To expand this paper, we need to connect the relevant IS literature furthermore.
Also, to better understand the reality and issues facing Japan's software industry in the medium- and long-term, we suggest that future studies be conducted as follows:

- stratified analysis by scale of vendors as well as types of vendors, i.e., maker-turned, user-turned and independent vendors,
- time series analysis, and,
- global benchmarking particularly with emerging countries as well as the U.S..

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MOTIVATING FOR INNOVATION

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ABSTRACT

The paper presents personality related and motivational factors which influence innovative activities of employees. The research was run in innovative enterprises IBM in order to obtain a more comprehensive view of the area of motivation and personality related factors.

Keywords : innovation, motivation, personality, HRM,IBM

INTRODUCTION

Development of contemporary business organisations is largely dependent on their proinnovative attitude. Most scholars are in favour of the concept that innovations rank among key factors affecting increasing competition of enterprises (Breen, Hamel 2007).
For this reason, innovation-promoting enterprises should closely link their activities and business with innovative management. Changes in managers' attitudes and operational methods require a continuous mechanism for supporting innovation introduced and operating in an enterprise. Managers should make a significant contribution to unblocking the pro-innovation potential of their staff, inspire them towards new solutions, which ensure free and creative thinking and acceptance for moving away from the standards paths in the company. In addition, introduction of pro-innovative management in enterprises is connected with the need to create procedures for creating incentives and rewarding innovators.

A GROWING IMPORTANCE OF MOTIVATION IN THE PROCESS OF BUILDING EMPLOYEE COMMITTMENT

In the era of knowledge-based economy where the human capital ranks high among crucial competitive factors, a growing importance of personnel motivation and commitment building can be observed. Staff commitment is interpreted as a voluntary effort made in order to perform a task. It is connected with the desire of giving the best possible performance without any additional incentives on the part of the management. It is obvious that employees deliver excellent performance because that it is their intention and, because of that, it is particularly important to release the potential of the staff. An appropriate and well-selected incentive-related impact and building the feeling of employee satisfaction play an important role in the commitment building process. Incentive-related impact includes a whole range of various activities, starting from managers' awareness of needs of their staff, care about personnel development, leaving the area for independent initiatives to building trust and good relations.

Many authors emphasise the necessity of building more permanent employee commitment that the commitment based on external incentives only. In this process, it is crucial that supervisors could infect their staff with the vision of the company, inspire them to take action

and create the feeling that they participate in creating the company's value on the market. In addition, the staff must have the feeling that the work has brought them closer to fulfilment of their own needs and achievement of their own goals. If a person has a feeling of satisfaction and their career is rewarding, feels stimulated to action, such person is able to find their, even hidden, potential, bring it to the light and, this way, contributes to the achievement of goals important to the organisation. Research conducted by the author so far indicates that innovators are truly committed employees.

Innovators in such companies as IBM tend to publish their works more often and, typically, they publish in-house and their publications are helpful in work and addessed at in-company users. The above indicates that they are willing to share their knowledge in the sense that they also like to use internal technical knowledge resources such as community service of software programmers – DeveloperWorks as well as on-line books more often than their colleagues without any innovation-related achievements. In addition, innovators also believe that their work is not monotoneous and are satisfied with what they do.

THE ROLE OF MOTIVATING FACTORS IN CREATING PRE-INNOVATIVE ATTITUDES

In the research conducted by the author, which required respondents to indicate reasons for IBM lab employees to be more innovative, the largest chunk – 51 responses – mentioned lack of time. 19 respondents declared that they were not receiving an adequate support on the part of their company, 33 were not motivated and 14 had their personal reasons and decisions. Several answers illustrated lack of employees' enthusiasm about their work: if employees were given more support and incentives from their employer, if they had less work and responsibilities, if managers themselves supported employees in their pro-innovative work, if software production was more quality-focused. Some responses, such as that IBM simply could not become more innovative, were downright funny. An innovative idea was also suggested: to organise The Thinking Day. Note that some reasons mentioned by respondents were connected with motivation-related definciencies. For this reason, it would be crucial to eliminate or reduce the factors which hinder motivation towards innovation.

In a creative thinking process, more importance is attached to internal motivation, connected with attractiveness of a task and driven by an internal passion or interest. In the process of stimulating the internal motivation, external rewards such as bonuses and promotions do not play the key role.

Certainly, innovators cannot go unrewarded - otherwise their creative energy will be wasted or dispersed. The following elements can be used in rewarding: recognition and appreciation e.g. praises in the public, special awards and rewards, -admission to participating in a decision-making process e.g. running a project, celebrating e.g. celebration of launching a new product to the market, additional time for recreation, holiday stays sponsored by the company. As already mentioned, rewards should be more oriented towards self-fulfilment and cognitive interest and curiosity, interest in work for the sake of work. Certainly, financial motives as well as other stimulants, which support the feeling of self-appreciation should not be neglected. As emphasised by Craig Wynett (2005), Key Development Manager in Procter & Gamble, "Separation of innovation from core business may bring about a dangerous side

result for the culture of the organisation: creativity and leadership start to be perceived as opposites. Such an artificial division means that innovators tend to be insufficiently visible and influential to compete for necessary resources to complete their projects successfully." The policy of favouring and rewarding innovators is a necessary element of working towards supporting innovation in an organisation.

It is crucial that leaders are prepared to support their line personnel in their innovative activities. In his book about being a technology leader, Gerald Weinberg (1986) describes mechanisms of motivating a team, motivating for innovation and points out that leaders are responsible for presenting their vision of work. In addition, he indicates three major obstacles to introducing innovation in a team: self-blindness in the meaning of reaching a deadlock when trying to solve a problem and loosing sight of the problem, not perceiving that problems are problems and blind faith that there is only one right solution. For this reason, when leaders have adequate knowledge on managing people and motivating them and are able to combine the knowledge with their expertise in technical areas, they should be able to offer appropriate support to their personnel in terms of creating innovative ideas. We should also have a closer look at the results of research carried out by Kanter (2005), which show that innovative managers tended to use persuation more than give orders, created teams and sought commitment of other persons and were willing to share their awards and recognition with others. Such activities not only support innovation but also general motivation for work.

THE PURPOSE AND METHOD OF THE RESEARCH

The question whether the capacity to innovate is more a function of the right environment or it is connected with particular predispositions of individuals is analysed by many researchers (Slappendel 1996, Leavy 2002). According to Drucker (1986) and Adair (1990) there is no such thing as "an entrepreneurial personality" and it is actually the organisation that should be flexible enough to create a fruitfull balance between structural restrictions and personal freedom. Therefore, on the one hand, it is necessary to build trust in an organisation and release commitment (Glanz 1998) while, on the other hand, it is required to analyse individual personality determinants of the innovation process. In addition, many researchers indicate that these approaches should not be in opposition

The research was run in innovative enterprises IBM in order to obtain a more comprehensive view of the area of motivation and personality related factors. The article has been written to answer the following questions:

What are the personality characteristics of persons creating innovations[1]?

What aspects of their style of work make it different from the style of work of other employees?

What are preferences of innovators (creators of innovative solutions) when it comes to motivating?

[1] The following characteristics of an innovator have been drawn: the innovator's ideas have been awarded for innovation at least once during the previous year and the innovator has made at least one patent application.

What awards they consider valuable and what awards do they expect?

What aspects make them different from non-innovators?

Are there any differences in commitment of innovators and non-innovators?

What factors block (impede) higher innovation in employees of innovative companies?

What elements in the organisation of work motivate towards innovation or remove the existing barriers?

A questionnaire survey will be run to answer these questions. Respondents will be divided into two groups: the employees who form the innovative core of companies by working in special innovative teams and the employees who are not members of such teams.

EMPIRICAL RESEARCH RESULTS

First, a general profile of innovators employed at IBM[2] was drawn up. All innovators are university graduates and one has started his doctoral studies. Nearly half of them graduated from the University of Science and Technology – in consequence, the University comes first in terms of the number of graduates with innovative achievements (12%) and from the Jagiellonian University and the Technical University of Silesia (3%).

80% of innovators graduated from IT studies. Due to the fact that the research was conducted in a software lab, the result should not come as a surprise. 3 innovators have their educational background in automatics.

Four innovators have 9 to 18 years of work experience in the IT sector. It is worth emphasising that two persons have less than 3 years of work experience in the sector. Work experience of other innovators ranges from 4 to 9 years. Most people have been with the company less than 3 years – 18 persons and between 4 and 9 years – 8 persons.
It is equally interesting to follow the the results of the research in terms of occupied positions. The highest number of innovators – 9 – are heads of team (leaders), 8 innovators occupy non-managerial positions (software engineers) while 6 innovators are consultants.

Four innovators have worked in one project only so far. The other innovators – 22 persons – changed their projects at least once.

42% (eleven persons) of the innovators do not go on business trips at all. This percentage is fairly large; however, when we consider that 56% of the group (101) do not go on business trips, it seems that business trips tend to play a role in supporting innovation of employees.

[2] The research was conducted in a branch of IBM which is a software development lab in Krakow. More than 50% of employees in the lab were covered by the research (101 people working in IBM lab).

A similar comparison emerges from analysing participation in the Innovation Team[3]. It is made up of 4 innovators and 7 people for the entire sample. On this basis, effectiveness of membership in the Innovation Team, which definitely translates into access to knowledge on innovative processes, it 57%. However, only 23% of employees who are not members of the group have innovative achievements to their credit.

Most innovators (23 persons) are between 25 and 35. Five of them are women and 21 – men. Only 1 person is the only child and, out of those with siblings, the youngest children and the oldest children in their families have the most numerous representation (11 persons and 10 persons). When comparing these results with the entire sample, the youngest brothers and sisters represent the highest innovative potential. Is it possible that rearning another child in a family in a way different than the rearing of the first child is more effective in terms of creativity and innovation? In this paper, this conclusion is presented only as a speculation.

PERSONALITY FACTORS AND STYLE OF WORK

Features characteristic for the personality of an innovator include openness, independent thinking and persistence in pursuing goals. Tokarz (2005) points out that, in addition, in order to understand the personality of an innovator, it is crucial to analyse motivation mechanisms as well as dimensions (determinants) of his personality, which, according to him, include: a strong ego, elasticity of cognitive structures, non-conformism, and spontaneity, tolerance, of cognitive incompatibilities, internal steerability, autonomous cognitive motivation, aesthetic attitude, originality and self-fulfillment. A division based on two basic styles of problem solving in innovative and adoptive work situations remains popular (Kirton 1976, Foxall and Hackett 1992, Rilley 1993, Dew 2009)[4]. The adaptator's goal is to improve his actions and, for this reason, he draws from an existing pool of well-proven solutions and procedures on the basis of the existing means and measures, he is disciplined, systematic, sensible, monotony-resistant and meticulous. In social relations he demonstrates conformism, he is dependent, sensible, needs acceptance when going beyond rules, sensitive to others, creates the climate of security, ensures stability and order, upholds collaboration. An innovator acts with an objective of introducing changes and, for this reason; he is in search of new solutions going beyond a given situation. He does not take the existing external limitations or available resources into considerations and he reanalyses a problem in a unique way. He is not capable to taking routine actions in a longer perspective. He often does not accept customs and habits, is independent, break rules and does not need support, is perceived as insensitive to others, increases the dynamics of interactions in a group. In some cases, he threatens group work.

The difference between the above-described styles concerns mostly: perception of problems, methods of their solving, introduction of solutions, the degree of exploration and attitude towards changes. In this case, the assignment axes are: originality, which his higher in the Innovator (reconstruction and change, a high risk of inaccuracy), low in the Adatpator (accuracy, sense and appropriateness), productivity – high in the Adaptator (methodicalness and regularity), incontinuous in the Innovator (lack of regularity, irregular productivity) and

[3] The Innovation Team is a direct innovation-supporting unit. It is responsible for initial assessment of innovative ideas presented by employees, advising and reporting/submitting applications on innovation, subsequently. The Team meets weekly. It is made up of several persons selected on a volunteer basis.
[4] The classification is based on the Kirton Adaption- Innovation Inventory (KAI)

conformism to rules – low in an Innovator and high in the Adaptator. Although they are subject to the same motivating influences in an organisation, their reactions to the influences are slightly different. Adaptator's motivation towards creativity is connected with a combination of external and internal motivating factors which change in connection with the certainty of outcome (Dew 2009). Adaptator's creative motivator, which is relatively low in relation to Innovator's motivation, is the lowest when the result is maximally uncertain or maximally certain. It is exactly the other way round with an Innovator, as his motivation during both maximum outcome uncertainty and certainty is the highest. In addition, the research confirmed a positive correlation of the problem-solving style with the tolerance for ambiguity (Keller and Holland 1978) and locus of control, optimism/ pessimism (Luck 2004, Dew 2009) indicating that, in the business context, Innovators (persons demonstrating an innovative style) are more motivated towards demonstrating creativity.

An important theory of intrinsic motivation is Bandura's (1991) theory of self efficacy, which focuses on the fact that assessment of own abilities and competences is a motivating factor. Strong faith in one's abilities not only affects choices and actions of individuals but also affects their determination and buoyancy shown also as the ability to regain one's strength after failures. In addition, persons with low self-esteem are more motivated by reactive and conservative stimuli than pro-active strive for improvement (Gecas 1982). The above deliberations indicate that motivation towards innovative actions is largely motivated by personality features.

The below-presented results related to personality, self-assessment of preferences and work style of respondents. They also include questions about respondents' attitude towards risk, group work, creativity, entrepreneurship, etc. On the basis of the above-presented theoretical analysis one may presume that innovators tend to be self-assured and remain self-assured when they are not sure what their colleagues think about them, they are not easily discouraged, tend not to prefer team work, are not prone to feel guilty in case of failures, etc.

Table 1. Personality and work style-related results

	Yes	Quite	Don't know	Not really	No
I feel self-confident when presenting a new idea	16%	49%	17%	15%	3%
I feel confident among talented persons	23%	53%	15%	7%	2%
I like to take the initiative	17%	46%	18%	18%	1%
I remain self-assured even when I do not know what my colleagues think about me.	11%	48%	27%	12%	2%
I believe that what I do makes sense.	25%	58%	9%	5%	3%
I believe I am creative.	14%	65%	18%	3%	0%
I believe I am entrepreneurial.	13%	38%	33%	14%	2%
I like taking risk.	18%	44%	22%	15%	1%
When in doubt, I tend to follow common sense rather than rules.	14%	51%	24%	11%	0%
I believe that innovators do well in a group.	14%	40%	30%	14%	2%
I like working in a team.	35%	55%	6%	4%	0%
I feel the best as an ordinary member of a team.	4%	13%	32%	36%	15%
I have leadership skills.	5%	42%	34%	16%	3%
I solve my problems and tasks myself, I do not look for anyone to help me.	5%	47%	19%	27%	2%

	Yes	Quite	Don't know	Not really	No
I feel that I am successful at work.	3%	34%	35%	14%	14%
I believe that my tasks are difficult to perform.	4%	26%	24%	33%	13%
I think I work harder than my colleagues.	5%	10%	37%	36%	12%
I believe that my colleagues could achieve more if they only wanted to	5%	28%	55%	9%	3%
Usually, I succeed in completing in time what I have planned myself	18%	69%	9%	4%	0%
I do not see delays as a problem as long as they help to improve the product	18%	39%	21%	18%	4%
I solve a very difficult problem for a very long time before I give up	20%	61%	14%	5%	0%
I often believe that I could do the things I do better	19%	38%	24%	16%	3%
When my plans do not work out as I think they should, I feel I am a failure	2%	18%	21%	34%	25%
If I do not succeed in doing something it is not my fault	5%	16%	48%	24%	7%
I do not like to follow somebody else's instructions.	3%	12%	34%	47%	4%
In my opinion, my work is monotonous	18%	20%	23%	22%	17%

Source: own study

Questions related to the area of motivation, temper and will were asked in the research. Research results seem to confirm high self-assurance of respondents (48% of respondents said that they rather like to take the initiative and remain self-assured). 58% of respondents can quite see that their work makes sense and 34% believe that they are quite successful in the company. 61% of respondents confirmed that they tend to keep on trying long to solve a problem before they give up and 47% confirmed that they trend to solve their problems themselves instead of looking for someone to help them. 55% answered that they quite like to work in a team; however, the majority (36% replied "not really") do not believe that they could work well as ordinary members of a team and 42% of respondents believe that they have leadership skills.

Statistical analysis did not show any differences between employees in terms of their history of work in the IT sector, while some differences connected with their positions in their company/companies were noticeable. Kruskal-Wallis' test demonstrated a considerable statistical diffference in responses to the question about employees having the feeling of success at work between engineers and leaders (statistically, engineers have less frequent feeling of success p=0.0123). In addition, a difference between leaders and consultants was identified in responses to the question about their feeling that they worked harder than their colleagues (leaders have the feeling that they work harder than their colleagues, p=0,0171), about their colleagues being successful at work if they only wanted to (leaders support this statement more than consultants do, p=00259) and the question about monotony of their work (leaders' responses indicate that, in their perception, their work is more monotonous that consultants' work, p=0.0161).

Mann-Whitney's U statistical test showed differences between innovators and non-innovators. Personality analysis with the U test demonstrated considerable differences between both groups in terms of their perception of their work as monotonous (-=0.0359); statistically, innovators tend to perceive their work as less monotonous and have higher opinion on their creativity and innovation (p=0.0122) and have a different approach to working in teams (p=0.0203) as they tend to prefer working independently. A descriptive statistics profile demonstrated different medians of replies to only one statement about monotony of work. Innovators stated more frequently that they work was not really monotonous while non-innovators had no opinion on this issue.

The same test and a profile of descriptive statistics were also used for comparison of groups of employees who go and do not go on business trips. Some significant statistical differences were noticed in answers given to the statements: I like taking the initiative (more confirmations from business travelers, p=0.0119), I like taking risks (more confirmations from business travelers, p=0.0171), I have leadership skills (more confirmations from business travelers, p=0.0280), and I do not succeed in doing something it is not my fault (more confirmations from business travelers, p=0.0023) and I believe that my work is monotonous (less confirmations from business travelers, p=0.0012),

ANALYSIS OF MOTIVATORS

Motivating and rewarding is a necessary element of strengthening the vision of an innovative enterprise. Although Deci and Ryan (1985), researching internal motivation, indicate that persons, who engage selflessly in some actions had more interest in these actions that the persons who were expecting to be rewarded for their engagement. The researchers formulated a thesis that, if an action is subject to the pressure of external forms of control such as a threat, a deadline, strong competition or assessment, internal motivation is weakened. Forbes and Domm 2004 also indicate that an external control oriented towards increase of productivity (in particular when aimed at swift completion of a task) may reduce creativity or even commitment. On the other hand, though, they also point out that, in special conditions of high employee engagement, external rewards may result in increasing engagement and creativity.

Research (Dew et. al 2009) shows that Adaptators are more sensitive to external motivation than Innovators are, irrespectively of their conviction regarding probable outcome. In turn, Dewett (2004) indicates that the willingness to bear risks is the key factor of individual creativity. The data suggest that external awards should have a lower motivating value to Innovators than to Adaptators.

Below find results of empiricial research conducted in IBM. When asked about a commonly known motivation system which promotes innovative actions, in spite of the fact that most responses were positive, more than 1/3 of respondents does not know nor is not sure whether a motivating system promoting innovative actions exists while 23% doubts whether innovation is rewarded. 5% claim that it is not. The question about the type of rewards to be expected and which would motive each employee to work harder included several response options. Below find their list.

Table 2.Comparison of motivators expected by Innovators and Non-Innovators

	Innovators	Non-innovators
Public praise	89%	92%
Cash rewards	67%	53%
Participation in decision-making process	26%	20%
Project management	7%	17%
Celebrating achievements	33%	47%
Additional time for recreation	0%	7%
Participation in a conference	19%	14%
External training	7%	7%
Financing studies	4%	5%
Visits and stays in other branches/units	11%	22%

Source: own study

The above table shows that the most popular reward given for innovative actions is a public praise and a financial reward while celebration of achievements comes third.

Innovators and non-innovators are largely motivated by the same rewards" cash reward comes first, followed by participation in the decision-making process and a public praise. The results are presented in the table below as a percentage distribution.

Table 3. Comparison of motivators motivating innovators and non-innovators

	Innovators	Non-innovators
Public praise	37%	53%
Cash rewards	67%	86%
Participation in decision-making process	41%	53%
Project management	26%	43%
Celebrating achievements	15%	22%
Additional time for recreation	7%	29%
Participation in a conference	30%	38%
External training	22%	39%
Financing studies	25%	37%
Visits and stays in other branches/units	30%	38%

Source: own study

Mann-Whitney's U test showed a statistically material difference in two answers listed in the table: one is the cash reward (p=0.0470) and the other one is proposed additional time for recreation (p=-.0265). Innovators show lower appreciation of these motivators than non-innovators do. The results confirm the above-presented concept suggesting that innovators are not highly motivated by external rewards. Practically in all categories of rewards, non-innovators indicated that they consider the rewards slightly more attractive than the

innovators. Specific results of the statistical research are presented in the table (2) in the Annex.

CONCLUSIONS

In response to the question how to motivate innovators it should be said that the motivators should be certainly consistent with their expectations and needs. In response to the question about the highest importance that the Innovators attached to cash (financial) rewards note that salaries paid in Poland remain relatively lower than salaries paid in "old" EU member states. When physiological needs according to Maslow are not fully satisfied, they become the priority. Note that the research covered only external motivators which can be influenced by the organisation assuming that innovative employees are motivated to a large degree by factors connected with the attractiveness of the task and the needs of self-determination (Deci, Ryan 1885). In addition, it is important to manage time and tasks so that employees have more opportunities to develop their own ideas. In view of strong competition in the IT sector, it is obvious that the priority is given to planned production and cutting the period before launching of a new product to the market, which limits the freedom of deciding about changes in schedules. However, potentially, innovation is connected with reduced time required for performance of tasks or with the need of finding another, better solution and, certainly, with a higher quality of products and services delivered. The connection is so strong that its strong support and implementation seems the issue of the utmost importance. Nevertheless, note that companies such as e.g. Google give more time to their employees for working on their own projects, which seems to the company's advantage.

Still, as demonstrated in this research, company's innovative potential (Krot, Lewicka 2009) and tools used in IBM deservedly place the company high in innovative companies' ranking and, because of that, IBM is a good example of a success story and makes an excellent example to follow.

The research showed that innovators represent approximately 25% of the lab's community. They have better understanding of the importance of innovation communicated in the company and know better how to report and present new ideas. The latter might result from their experience in reporting and presenting at least one idea. In addition, it is not material whether respondents are or are not innovators in order to call the company innovative, as no dependency was found here.

As employees, innovators are surely more commited. It is proven by the fact that they tend to publish their works more often and, typically, they publish in-house and their publications are helpful in work and addessed at in-company users. They are more willing to use internal technical knowledge resources such as DeveloperWorks programmer community service and books available on-line that their colleagues without any innovative track record.

Innovative employees more than their less innovative colleagues believe in the sens of their work and do not think it is monotonous but they prefer working independently or in a small group. In addition, they know the value of their work, are self-assured and consider themselves creative.

Management intending to support its teams on the basis of behavour and personality patterns of innovators should therefore put more emphasis on promoting a variety of information sources, explanation of innovation proceeses whenever necessary and possible, motivating and rewarding well-performing employees who propose interesting solutions and present new ideas and should care about increasing the variety of work, in particular by giving the opportunity of working for various projects and going on business trips as much as the budget allows. Managers' soft skills should be mostly used for discussions with employees, increasing their self-assessment, presenting a clear vision of their work and increasing the importance of work they do. Whereever possible, teams should be small and their members well selected in accordance with all HRM practices.

Analysing answers to the open question: what would make you more innovative?, suggestions similar to those related to IBM can be listed. More time for inventions, more personal support, availability of new and upgraded technologies and work tools and better understanding of employee's benefits and even increased probability of the benefits which have already been offered – according to respondents, these factors would enhance their ability and potential of creating new and interesting ideas.

Results of the research will increase our understanding of the impact that motivation and personality-related factors, have on innovative attitudes. The attitude oriented towards increasing the competitive edge should continuously emphasise improvement in performance and creation of innovation as well as continuous care for acquiring and retaining the best people in the company. What's more, the key issue is to build their motivation and commitment, which are absolutely necessary for creating innovation.

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Appendix

Table 1.Innovators/ Non-innovators – statistically material differences in the category of personality-related factors

Statement	Sum of ranks - Innovators	Sum of ranks – non-innovators	U	level p
I feel self-confident when presenting a new idea	1222,000	3929,000	871,0000	0,389578
I feel confident among talented persons	1280,500	3870,500	929,5000	0,701542
I like to take the initiative	1187,500	3963,500	836,5000	0,254056
I remain self-assured even when I do not know what my colleagues think about me.	1257,500	3893,500	906,5000	0,571273
I believe that what I do makes sense.	1107,000	4044,000	756,0000	0,056638
I believe I am creative.	1051,000	4100,000	700,0000	**0,012252**
I believe I am entrepreneurial.	1148,000	4003,000	797,0000	0,147014
I like taking risk.	1232,500	3918,500	881,5000	0,445551
When in doubt, I tend to follow common sense rather than rules.	1199,500	3951,500	848,5000	0,287378
I believe that innovators do well in a group.	1487,500	3663,500	813,5000	0,189009
I like working in a team.	1593,000	3558,000	708,0000	**0,020380**
I feel the best as an ordinary member of a team.	1235,000	3916,000	884,0000	0,462088
I have leadership skills.	1162,000	3989,000	811,0000	0,175965
I solve my problems and tasks myself, I do not look for anyone to help me.	1172,000	3979,000	821,0000	0,202019
I feel that I am successful at work.	1196,500	3954,500	845,5000	0,294856
I believe that my tasks are difficult to perform.	1312,500	3838,500	961,5000	0,916698
I think I work harder than my colleagues.	1247,500	3903,500	896,5000	0,523655
I believe that my colleagues could achieve more if they only wanted to	1391,500	3759,500	909,5000	0,576305
Usually, I succeed in completing in time what I have planned myself	1293,000	3858,000	942,0000	0,758564
I do not see delays as a problem as long as they help to improve the product	1360,000	3791,000	941,0000	0,785900
I solve a very difficult problem for a very long time before I give up	1211,500	3939,500	860,5000	0,312299
I often believe that I could do the things I do better	1132,000	4019,000	781,0000	0,117451

Statement	Sum of ranks - Innovators	Sum of ranks – non-innovators	U	level p
When my plans do not work out as I think they should, I feel I am a failure	1304,000	3847,000	953,0000	0,862575
If I do not succeed in doing something it is not my fault	1405,000	3746,000	896,0000	0,514062
I do not like to follow somebody else's instructions.	1190,000	3961,000	839,0000	0,255286
In my opinion, my work is monotoneous	1591,000	3560,000	710,0000	**0,035900**

Source: own study

Table 2.Innovators/ Non-innovators – statistically material differences in the category of Motivators

I am motivated by	Sum of ranks - Innovators	Sum of ranks – non-innovators	U	level p
Public praise	1181,000	3970,000	830,0000	0,194971
Cash rewards	1156,000	3995,000	805,0000	**0,047020**
Participation in decision-making process	1270,500	3880,500	919,5000	0,620983
Project management	1159,500	3991,500	808,5000	0,128000
Celebrating achievements	1255,000	3896,000	904,0000	0,435970
Additional time for recreation	1115,000	4036,000	764,0000	**0,026572**
Participation in a conference	1249,000	3902,000	898,0000	0,476462
External training	1161,000	3990,000	810,0000	0,123518
Financing studies	1175,000	3875,000	850,0000	0,401889
Visits and stays in other branches/units	1249,000	3902,000	898,0000	0,476462
Others	1313,000	3838,000	962,0000	0,571300

Source: own study

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GEOMETRICAL MODELING FOR PRODUCTION MANAGEMENT

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ABSTRACT

The Theory of Connection has been used to solve many problems in engineering, economics, and in management; in this paper, firstly, the theory of connection is introduced. Secondly, a new toolbox of functions for modeling and simulation is presented. Thirdly, the theory is used to solve a production management problem with the help of the toolbox of functions. The scope of this paper is limited to introducing and applying the theory of connection. The major contribution of the paper is the introduction of the toolbox with which mathematical modeling and simulations can be done efficiently on an operating platform like MATLAB.

Keywords: Theory of Connection, Mathematical modeling and simulation, production management

1. INTRODUCTION

In this paper, we present the theory of connection (ToC) based approach for formulation of mathematical models of engineering and management processes. The major advantage in using the theory of connection is that, the same set of functions (or procedures) can be used for formulation of mathematical models of many engineering and management processes: manufacturing processes, electrical circuits, mechanical systems, hydraulics, and control systems (Bjorke, 1995), as well as management processes like e-government startups (Davidrajuh, 2004b), enterprise modeling (Myklebust, 2002) ethical business decision making (Davidrajuh, 2008), and agile supply chain (Davidrajuh, 2004a) too can be modeled with ToC based approach.

1.1. Theory of connection

Theory of connection (ToC), previously known as manufacturing system theory, in the form it is presented here, is due to the work of the Scandinavian School of Systems Theory for the past 30 years (Bjorke, 1995). For detailed study of ToC, interested readers are referred to Bjorke (1995). ToC is based on geometry, which has a history of more than 2300 years, as Euclid formulated Greek geometry in 300 BC (Bjorke, 1995). The mathematical foundation of ToC has grounds from the work by Gabriel Kron (Kron, 1934).

The idea behind ToC is to bring geometry and algebra together; we use geometric modeling to model an physical phenomenon, make a set of algebraic equations out of this geometric model, so that by using a computer these equations could be solved. The usefulness of ToC is

that, different subsystems of different disciplines can be modeled and integrated by performing the same procedure; this is very important for fields like e-commerce as e-commerce involves diverse disciplines like manufacturing, business management, supplier selection, computer hardware and software, control systems etc (Davidrajuh, 2007; Davidrajuh and Melberg, 2008; Hussein, 1997). The modeling approach based on ToC is explained in the next section.

2. MODELING APPROACH BASED ON ToC

2.1. The system model

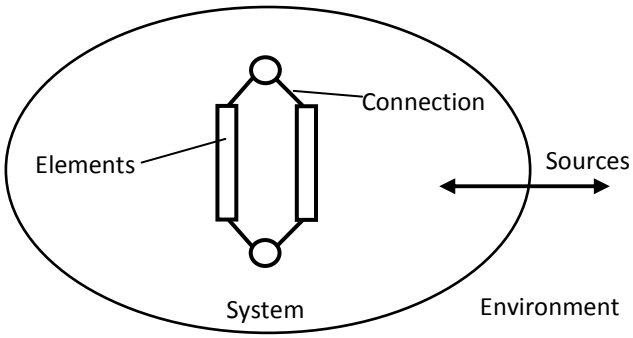


Figure 1: The System model

As shown in figure 1, a system consists of three fundamental components, such as *elements*, *connections*, and *sources*.

The elements carry all the physical or economical *properties* of the system. Elements are the building blocks of the physical system. For example, in a LRC network, the resistors, capacitors and inductors are the elements; the property of a resistor is its admittance, whereas a machine element's property could be its processing time, ratio between input items and output items, scrap percentage etc. Elements can be based on *nominal scale* or *ordinal scale* form (Haavardtun, 1995). Nominal scale element means, like a resistor, the direction of flow through it depends on the potential difference across it. This means, nominal scale elements are bi-directional. For ordinal scale elements, like a production step, the direction of flow through it is given by the element itself, and does not change with applied source or potential across it.

When there is no connection between the elements, the set of isolated elements is called the *primitive system*. The connections reflect how the elements influence each other and it represents the structure of the system. The set of connected elements is called the *connected system*. Finally, the sources reflect the influence between the total system and the environment. Sources are the environment's influence on the system; in an electrical circuit, source s could be current or voltage sources; in production planning, demand of products, startup-setup times, costs involved are some of the sources.

2.2. Geometrical space

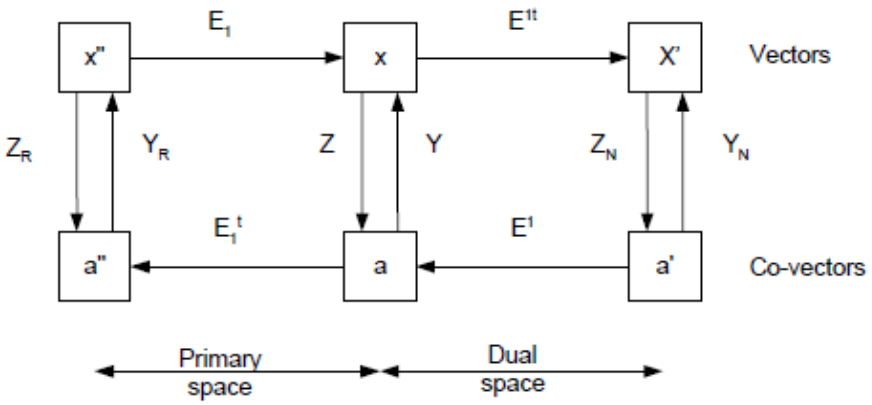


Figure 2: Transformation of vectors and co-vectors (Simplified Roth's diagram)

The Theory of connections is based on the general abstract viewpoint of connection of physical entities into a system. The Theory has geometry as its foundation and is based on the use of continuous geometrical 3-space or more typically an *n*-space volume (a Euclidean space R^n). A *vector* (called a *contravariant vector*) represents a point in the Euclidean space, or *primary space*, from the origin to the point; A vector in a 3-space is represented by:

$$x = x^1\varepsilon_1 + x^2\varepsilon_2 + x^3\varepsilon_3$$

Where $(\varepsilon_1, \varepsilon_2, \varepsilon_3)$ is the basis vector along the three axes.

Whereas, a *point* (called a *covariant vector*) in the corresponding *dual space* of the vector space, defines another vector which can be represented by:

$$a = a_1\varepsilon^1 + a_2\varepsilon^2 + a_3\varepsilon^3$$

Where $(\varepsilon^1, \varepsilon^2, \varepsilon^3)$ is the basis co-vector along the three axes.

Matrices ***Y*** and ***Z*** (and their transformational matrices) are called the *property matrices* that posses properties (or characteristics) of the individual primitive elements. Matrices such as ***E*** are called the *connection matrices* that represent the connections between the primitive elements.

2.3. Formulation methodology

According to ToC, a physical system is made of:

- *elements* (or *primitive* system parts) which determine the behavior of the complex connected system,
- *connections* are the system structure that determine influences of each element on the other elements, and
- *sources* are the external influence on the system (e.g. load).

The formulation methodology for developing mathematical models of physical systems consists of three phases (Davidrajuh, 2000; Hussein, 1997; Myklebust, 2002):

2.3.1 Phase-1: Breaking up a physical system into a set of physical variables

- The system is broken up into its basic parts, i.e. primitive elements; the set of primitive elements is called "the primitive system".
- The governing equations of each element independent of other elements are setup; by that, the variables in the individual elements are isolated.

In this phase, we assemble all the characteristics of the individual elements in the *property matrices* (or objects) such as *Y* and *Z* (see figure 2)

2.3.2 Phase-2: Forming the geometric model

- With the help of the topological structure (meaning, the way the elements are connected together) the variables in the individual primitive elements are combined together. By this, the governing equations of the whole system ("the connected system") are formulated.

In this phase, we create the *connection matrices* such as *V* and *E* as the reference frame for the space that represents the specific connection of the elements in the system (figure 2).

2.3.3 Phase-3: Algebraic computation

- By applying the sources on the governing equations of the connected system, the behavior of the system under the applied sources are studied. In studying the behavior of the system under the applied sources, the traditional methods available in algebra like inversion, iteration, numerical methods and so on will be used.

In this phase, we change the reference frame to the one representing the given connections and calculate by that the properties of the connected system, meaning, we use algebraic matrix manipulations to find the solutions.

3. THE TOOLBOX OF FUNCTIONS

The process of mathematical modeling and simulation approach based on ToC is traditionally done by a toolbox of functions implemented in APL language; APL (A programming Language) was developed by IBM in the sixties.

This paper introduces a toolbox of functions for the industry-standard MATLAB platform. MATLAB platform for implementing ToC toolbox brings many benefits such as ease of use (programming), access to hundreds of functions from other MATLAB toolboxes like fuzzy toolbox, control systems toolbox, statistical analysis toolbox, optimization toolbox, etc., and facilities for high quality graphical outputs.

3.1. Using the Toolbox

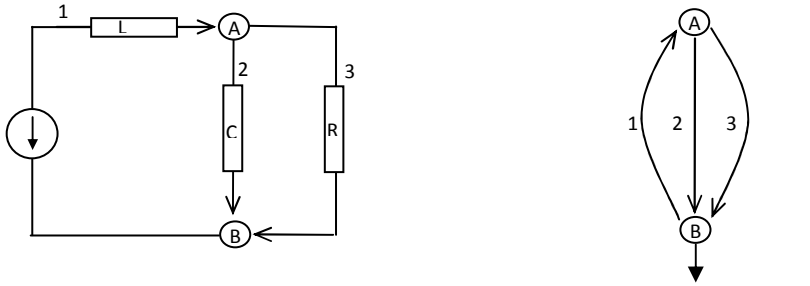
The toolbox of function for ToC based approach is divided into four groups:

1. Creating elements, and grouping of elements (primitive system)
2. Extracting topological structure (connected system)
3. Solving the equations
4. Saving/Loading/Printing System (utility system)

The functions are explained with the help of the following simple example.

3.1.1 Example: a simple LCR network

Figure 3 shows a simple LCR network consisting of three primitive elements – a resistor R, a capacitor C, and an inductor L.



3a. The LCR circuit 3b. Property graph

Figure 3: LCR Alternating Current network consisting three elements connected at two nodes (node B is selected as the reference node in figure-2b)

Conventions used in figure 3: In figre-3a, nodes are identified with block letters 'A' and 'B'; elements with identified with numerals '1' (L), '2' (C), and '3' (R). In figure 3b, there are three branches connecting the nodes 'A' and 'B': the branch-1 consisting of the element '1', the branch-2 consisting of the element '2', and the branch-3 consisting of the element '3'.

Phase 1: Identifying the primitive system

First we create the three elements with the help of the function ***element***.
Function element takes four inputs: element number, name of the element, property value, and comment. Only the first (element number) and the third (property value) are compulsory inputs. For example, for the resistor,
> R = *element*(3, 20)
Meaning, the resistor is the second element and the value is 20 ohms (for other elements, property value is the respective impedance value).

After creating the other elements, all the elements are grouped as a primitive system using the function ***primitive_system***.
> PS1 = *primitive_system*(L, C, R)

Phase 2: making the connected system.

The connection between the three elements through the two nodes has to be established in this phase. This is done with the help of the function ***connect_system*** and the Branin table. The first row of the Branin table consists of the nodes that are tail-end to the branches, and the second row consists of the nodes that are head-end to the branches. For example, considering the three branches 1, 2 and 3 (or elements L, C, and R) the tail-ends are B, A, and A. The head-ends are A, B, and B. Together with these two rows of the Branin table, and with the primitive system, calling the function ***connect_system*** return the matrices VP, Y, and

VN, where Y is the property matrix that includes the property value of all the elements in the primitive system, VP and VN are the incidence matrices for direct connections, the tail part and the head part respectively. The function ***remove_reference*** removes the reference node from the VP, VN matrices and returns the resultant incidence matrix V.

Phase 3: applying the sources, solving the connected system and displaying the results

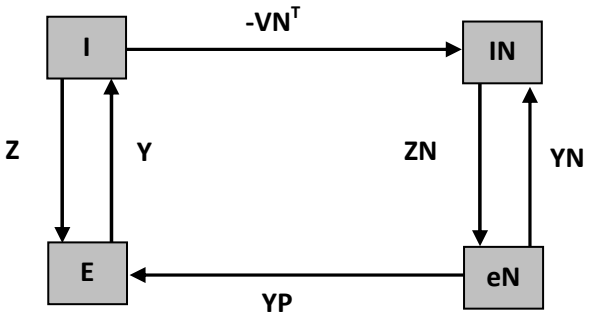


Figure 4: The Roth's diagram (node-solution method)

There is only one source applied to the branch-1, whereas the branches- 2 & 3 do not have applied sources. Thus, in tensor form, the sources are represented by [220; 0; 0], where 220 (volts) is the applied source.
The Roth's diagram (shown in figure 4) is used to solve the system. The Roth's diagram shows the involved matrices and tensors, and how they are connected. Figure 5 shows all the functions used for solving. Figure 5 shows that the data structure for an element contains two obligatory items, element number and the property value; these two items must be given at the element creation time. Also shown in the figure that the data structure for the set of primitive elements (the primitive system) contains multiple primitive elements, and how the vectors and tensors identified in the Roth’s diagram are extracted from the primitive system.

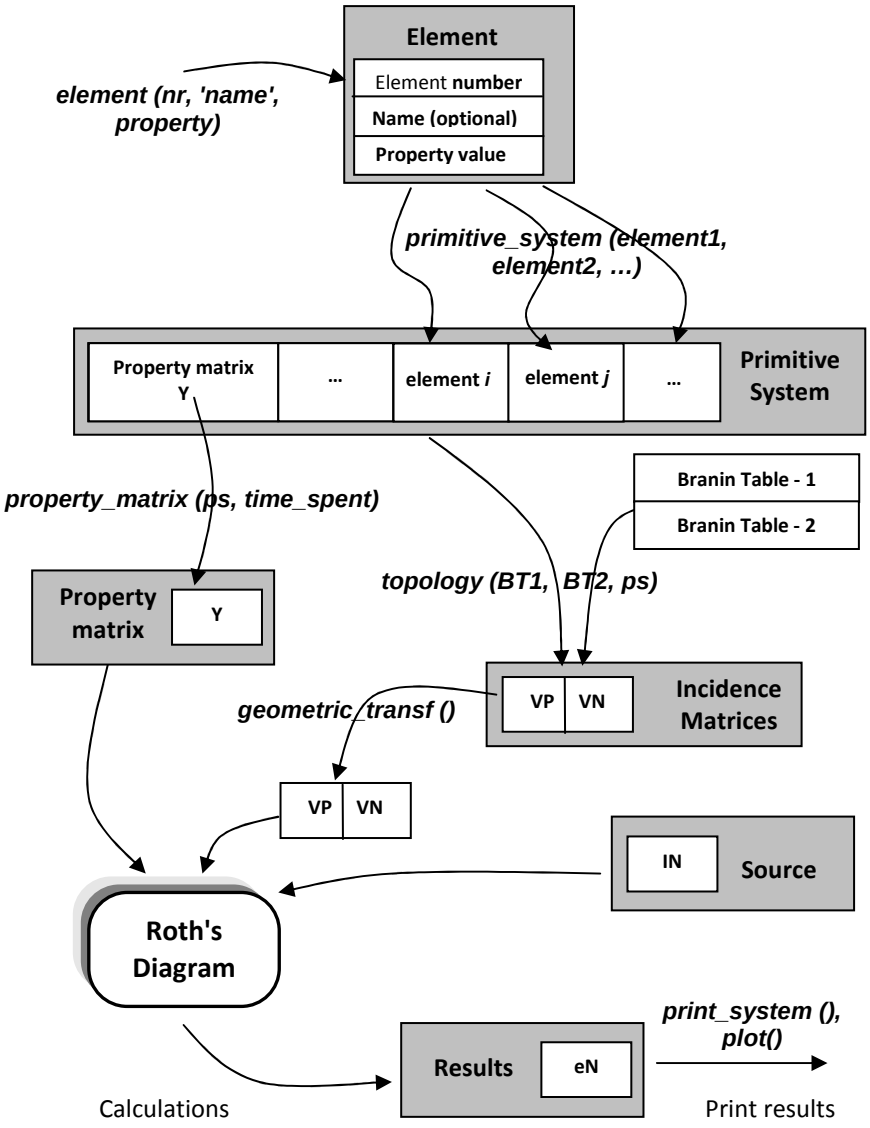


Figure 5: Overview of main functions and data structures used

4. PRODUCTION MANAGEMENT EXAMPLE

In this section, we present an application example as a proof of concept for modeling and simulation using ToC. We like to prove that by using ToC for modeling and simulation of physical systems, we will be aware of the fundamental geometric transformations and algebraic computations all the time; this is unlike modeling and simulations using graphical GUI based software which treats the models as a black box thus hides or abstracts away all the mathematical details. In order to clarify this point, we intentionally keep the application example as simple as possible.

The application example is modeling a production planning and control problem (PPC). The PPC problem is taken from (Bjorke, 1995).

4.1. Problem Formulation

The production planning and control (PPC) system is shown in figure 6. This PPC system represents two production philosophies, "Make to Stock (Push)" and "Make to Order (Pull)". A good production plan should ideally employ both philosophies so that there is no shortage nor accumulated inventory in the system.

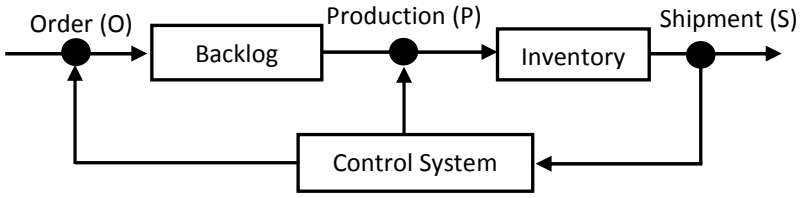


Figure 6: Simplified Production Planning and Control system

The basic equations are:

$$\Delta B(t) = O(t) - P(t)$$
$$\Delta I(t) = P(t) - S(t)$$

Where,

B(t) is the backlog of orders as function of time
O(t) is the incoming orders as function of time
P(t) is the production as function of time
I(t) is the inventory as function of time
S(t) is the shipment as function of time.

4.2. Problem analysis

An analysis of the PPC system is presented in figure 7, showing the four states of the system and the connections between them. The four states in the system are:

x1: the state of the queue of orders in the shop at time t
x2: the state of the stock level at time t
x3: the state of the forecasted shipment at time t
x4: the state of the production schedule at time t.

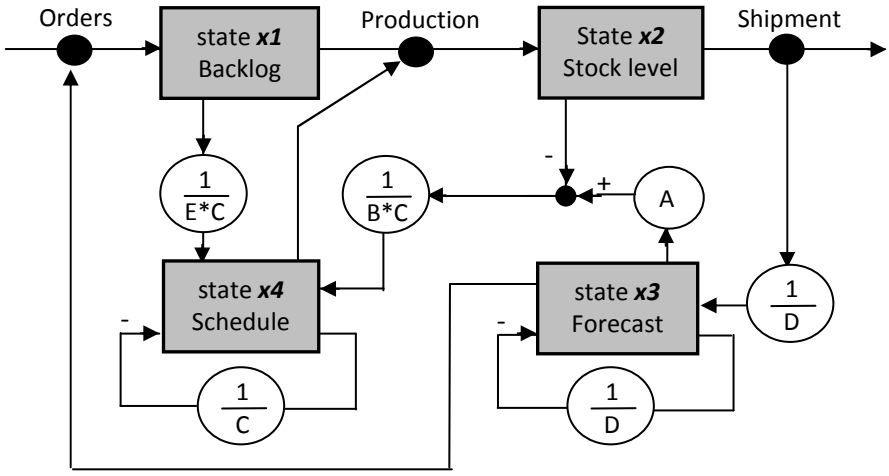


Figure 7: The block diagram of the PPC system

The parameters in figure 7 are:

A: number of periods the stock shall cover
B: number of periods used to build up the stock
C: number of periods used to build up the production
D: number of periods a change in shipment shall be distributed over
E: number of periods the backlog shall be distributed over.

4.3. Problem solving

The block diagram is shown in figure 7, does not show the connections between the different states explicitly. Therefore, from the block diagram (figure 7), we extract the connections between the states and present it as the state diagram (the property graph) in figure 8. Figure 8 shows how the four states (or nodes) are connected by the eight elements.

As shown in the previous example, the eight elements are created first, and they are grouped into the primitive system, and then the solution process is started. Then, as already described in the previous section on formulation methodology, the connection matrices are obtained from the topology structure. From the connection matrices and from the property matrix, the solution is obtained by using the Roth's diagram.

The simulation code for solving the PPC problem is given in the appendix. Simulation results are shown in figures 9 and 10 when two different sources were applied.

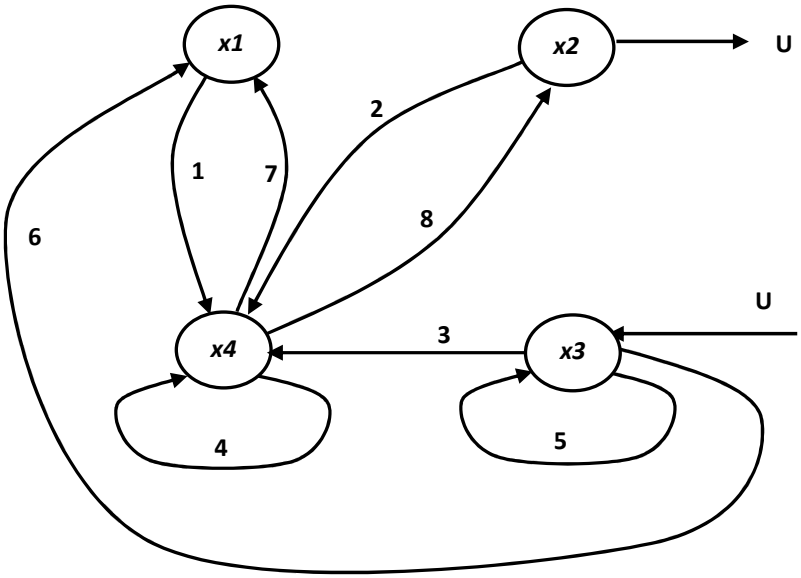


Figure 8: The state diagram of the PPC system

4.4. Discussion

Figure 9 (for case 1) shows the system response when a step function representing 100 units of increase in sale is applied as source; the system responded smoothly and adjusted the shipment level. Figure 10 (for case 2) shows the system response when the step function (as in case 1) was superimposed with a sine function with omega = 0.2. Figure 10 shows that there is a large increase in backlog and stock level where the backlog increased up to 4 times the initial value.

The simulations show that the designed stock control system can handle slow varying disturbances, but it will not properly handle high frequent disturbances.

The fundamental point we want to show through the application example is that ToC combines the intuitive power of geometry with the computational power of algebra. We start with geometry - the connection between the elements of a system, and then move from one reference frame to another in order to simplify solution process. Use of geometry as the foundation makes ToC different from the other graphical modeling techniques such as Petri net, Bond graph, or system dynamics.

The second issue we want to emphasize is that the same set of functions can be used for modeling and simulations of any systems or processes, be engineering, economics or management.

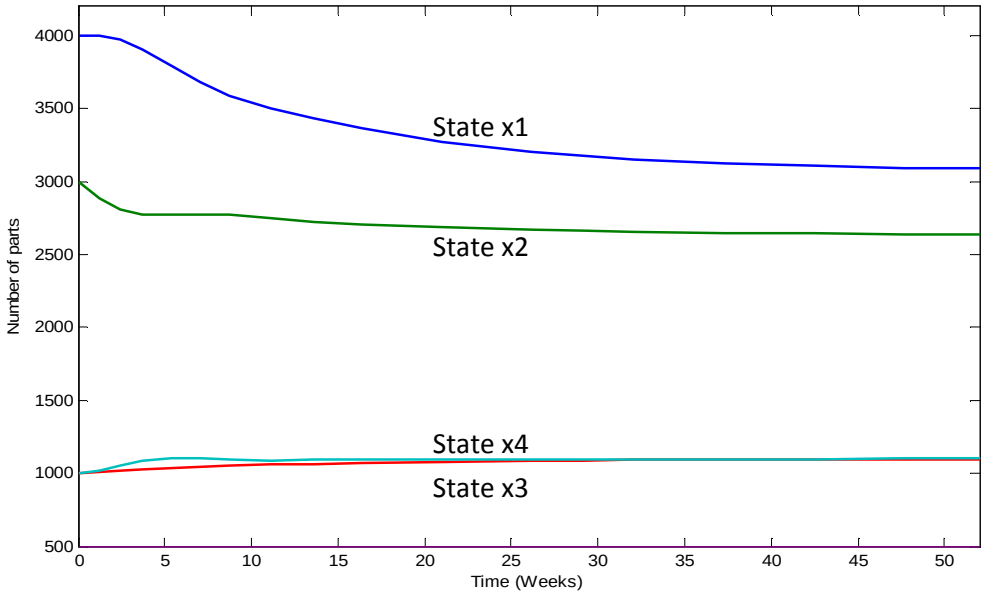


Figure 9: A Step response on the Stock Control System (Case 1)

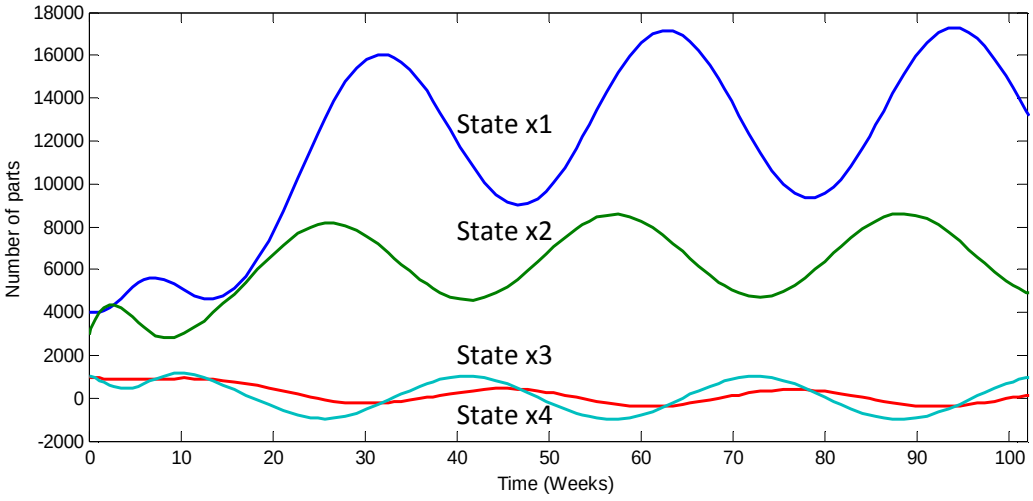


Figure 10: A Sine response on the Stock Control System (Case 2)

5. CONCLUDING REMARKS

This paper presents a Theory of Connection (ToC) based approach for modeling physical systems. The main benefit using ToC based approach is that the approach emphasizes the connection between the primitive elements that compose the system; in another words,

geometry is used for system modeling. The originality of this paper is the application of a toolbox of functions for modeling and simulation. The toolbox is implemented on MATLAB platform. From the application example given above, it is apparent that with ToC based approach diverse system modeling problems can be solved efficiently, using the same set of functions.

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APPENDIX A: Simulation of PPC System

For simulation of the PPC system, two inputs are given, 1) A step input representing 100 units of increase in sale, 2) The step function overlaid with an additional sinus function (omega = 0.2). The responses are shown in figures 9 and 10.

```
%%%
```

```
% xprime = YN * x + transpose(sine_ip); % differential eq.
% ========================================

[time1,States_1]=ode23('step_input',[0, 52],INIT_VALUES);
[time2,States_2]=ode23('sine_input',[0,104],INIT_VALUES);

%%% PRINT (PLOT) RESULTS %%%%
print_system(time1, State_1);
print_system(time2, States_2);
```

APPENDIX B: Toolbox of Functions

A list of functions that are commonly used for modeling and simulation is given below. Bjorke (/1995) presents the complete set of functions,

Function name	*Purpose*
I. Functions for Creating elements, and grouping of elements (primitive system)	
Element	To create a primitive element with an element ID number and with its properties
primitive_system	To group a set of primitive elements together. Thus, property matrices such as Y and Z can be created
II. Functions for Extracting topological structure (connected system)	
branin_row	To indicate the connections between different elements as row-1 and row-2
connect_system	To make the connected system. Thus, connection matrices like V and E can be created
Topology	Similar to the function connect_system, but more powerful for universal solution
III. Functions for Solving	
property_matrix	Transforms property matrix into different reference frames
Transpose	Geometric transformation based on reference frames
remove_reference	To remove a reference frame from the operating space
Source	To identify sources with characteristic (property) value
step_input	Step input as a source
sine_input	Sine input as a source
IV. Functions for Saving/Loading/Printing System (utility system)	
print_sys	To print the results (temporary, partial, or full results)
save_sys	To save the results (temporary, partial, or full results)
load_sys	To load partial results for further processing

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EXPLOITATION, EXPLORATION, AND KNOWLEDGE: A DYNAMIC AND LEARNING STRATEGY FOR A BETTER SIX SIGMA PERFORMANCE MODEL

Chinho Lin and Shing-Jen Song

ABSTRACT

Six Sigma is one of the most widely accepted quality management practices for continuous improvement strategies. Recently, scholars have been paid more attention to quality management (QM) in the strategic field relating competitive advantages, knowledge creation, and innovation. This paper proposes a model from dynamic capability and learning strategies for a better evaluation of six sigma performance. In this conceptual model for Six Sigma implementation, we suggest that firms exploit their prior technology and management resources to build a competitive knowledge management capability. On the other hand, these prior resources may also used to explore a pool of innovative processes outside its system to learn and assimilate into a new chromosome of dynamic capability for competitive advantages. Our model emphasizes that the creation of knowledge and innovation during the implementation could be a sustainable advantages for a firm. We provide a theoretical model for future Six Sigma study.

Keywords: Six sigma; Quality management; Innovation; Learning

1. Introduction and Theoretical Background

In a global competition environment, the conditions of uncertainty, complexity, and conflicts have become major concerns for both mangers and scholars. Recently, scholars have been paid more attention to quality management(QM) in the strategic field relating competitive advantages (Anand et al.,2009; Dean Jr & Snell, 1996; Flynn et al., 1995; Powell, 1995; Reed et al., 2000;), knowledge creation (Choo, et al., 2007; Levin, 2000; Linderman et al., 2004), and innovation (Prajogo & Sohal, 2004). The early perspectives that dominated enterprises' strategic management for gaining competitive advantage were rooted in traditional economic theory, with the quest of rents, strategic scholars emphasized on market power and industrial structure as determinants of organizational performance (Caves, 1971;Caves & Porter, 1977; Williamson, 1985; Porter, 1985; Chandler, 1990).

The advantage of competitiveness and the efficiency of performance are often depend on a firms internal 'resources, and their ability to allocate and bundle their resources and capabilities (Barney, 1991; Grant, 1991). As a result, one of the most important strategies for gaining operational effectiveness and competitive advantage is quality management, which has received significant attention from many such as manufacturing and the service sectors (Powell, 1995;Douglas & Judge Jr, 2001;Kaynak, 2003; Zhao, Yeung et al., 2006).

Quality management practices such as Total Quality Management (TQM) and ISO 9000 have been proposed to improve organization performance; still debates for the impacts have

not been universally agreed in all fields especially in hypercompetitive environments (Benner & Veloso, 2008; Cole, 1998; Micaela Martínez-Costa et al., 2009). There is no clear agreement of the casual relationships among factors such as competitive strategy, TQM, Six Sigma, performance, and empirical evidences are needed to further study (Yeung et al., 2006; McAdam et al., 2008). Especially, the most recent QM practice, Six Sigma has been widely adopted and been suggested as a goal oriented and performance driven quality management (Linderman et al., 2003). As the primary goals of Six Sigma are to reduce defects, improve productivity, eliminate waste and reduce costs (Kumar et. al., 2008; Zu et. al. 2008), the lacks of discriminative validity over prior QMS has increased the skeptic argument (Schroeder et al., 2008). In this paper, we purpose a model for empirical evaluating the competitive advantages of Six Sigma management from a continuous improvement, knowledge management and learning perspectives.

1.1 Resource based view (RBV)

For the development of strategic advantages are closely connected with a firm's decisions and environment conditions, both academics and practitioners notice that superior firm performance may explained by a "resource based view" which emphasizes firm-specific capabilities, assets and the isolating mechanism (Penrose, 1959; Rumelt, 1984; Teece, 1984; Barney, 1991). In the resource base of view, researchers suggest (e.g., Barney, 1986a, 2001; Cool & Schendel, 1988; Helfat, 1997; Kought & Zander, 1992) to give a sustainable competitive advantage to a firm some important resources must be heterogeneously distributed in industry or costly to imitate.

Traditionally, Strategies considered by economic researches as continuously search for the "rent" and the sustainability of rent. The necessary conditions for the sustainable competitive advantage of a firm on one hand have been discussed among many researchers (Porter, 1985; Barney, 1991; Dierickx and Cool, 1989; Lawless and Fisher, 1990). On the other hand, some researchers (e.g., D'Aveni, 1994, 1995; MacMillan, 1988; Oliva et al., 1988; Williams, 1992; Priem & Butler, 2001) have questioned the sustainability of competitive advantages especially in a hyper competitive global environment.

Resources viewed as bundles of tangible and intangible assets, including a firm's management skills, its organizational processes and routines, and the information and knowledge it controls (Barney *et al.* 2001). The resource base view argues that resources or capabilities tend to survive competitive imitation when they are path dependent, social complex, causal ambiguous, and formed isolating mechanisms of time compression diseconomies, historical uniqueness (Barney 1991; Dierickx and Cool 1989; Peteraf 1993; Reed & DeFillippi, 1990). Resources from intangible assets may be more value-creating than those purchasable resources have drown a great deal attention of researchers (Conner, 1991), yet the key challenges from imitation, transfer, or substitution raise the undesirable outcomes (Lieberman, 2006;Terlaak, 2008).

In particular, the competition from intangible resources has received intensive interest to many researchers and the knowledge-based resources have been claimed as the key of competitive advantage (Conner, 1991; Nonaka, 1991; Kogut & Zander, 1992; Grant, 1996; Spender, 1996; Nickerson & Zenger, 2004; Macher, 2006). In response to the knowledge-

based competition to degrade the advantage of opponents' resource position, challengers may always attempt to imitate intangible resources held by successful competitors, duplicate their strategies such as 'isolating mechanism' (Rumelt,1984), negate the time compression diseconomies (Kessler, 2000; Lieberman, 1998) or destruct their social network advantages (Dyer & Singh, 1998; Gulati et al., 2000). Whether the imitation of particular stock of intangible assets is time consuming or costly will decide the success of rivalry. Researchers and practitioners recognize in broad terms that knowledge is an important factor in the creation of competitive success over time (Carlile 2002; Kogut & Zander, 1992).

1.2 Knowledge-based View (KBV)

As manufacturing technology is characterized by rapid innovation, technological complexity, demand uncertainty and highly competitive, manufacturing firms may not only develop their capabilities internally but also seek to obtain externally (Baines, 2004; Keil *et al*., 2008; Ranft, 2002). Knowledge-based view provides insights how a firm aggregates its resources into a repository of knowledge (Grant 1996, Kogut and Zander 1992). The key to the knowledge-based competition is the efficiency of knowledge absorption which depends upon the recipient's abilities of learning and bundling their existing resources into new productive assets in the context of changing markets.

Knowledge-based view suggests that the goals of a firm are to create, to apply knowledge and to keep continuous innovation (Grant 1996, Nonaka, 1991). Knowledge can be a source of competitive advantage (Argote et al., 2003), and to sustain the competition of innovation firms in highly competitive technology-based industries should explore or exploit from externally or internally sources (March, 1991). The ability, referred to as absorptive capacity, has been defined by Cohen and Levinthal (1990) as the ability to recognize the value of new information, assimilate it, and applies to commercial end. They suggest these abilities collectively constitute as a firm's "absorptive capacity" (ACAP) and this capacity is depended largely on its prior knowledge. Resulting from the accumulative effect of continuous learning and a firm's decision calculus in allocating resources for innovative activity, Cohen and Levinthal (1990) suggest the development of ACAP when conditioned under the appropriability regimes, in turn; influence the path-dependent innovative performance.

Further, according to the ACAP, scholars suggest the development of an organization's competitive advantage, innovation, performance or flexibility is a product from (1) Antecedents: prior knowledge or knowledge source (2) Receptivity: explore and recognize the value of new knowledge (3) Accumulation: acquire and assimilate the path dependent knowledge (4) Transformation: exploitation and transform the organization's routines into innovative routines (5) Application: apply innovative routines to commercial ends(Cohen & Levinthal, 1990; Zahra & George, 2002; Lane *et al.*, 2006; Todorova & Durisin, 2007).

In a global competing environment, the competitive advantages become more complex and obscured, the time-based competition has been recognized as an important factor to create sustainable competitive advantages, especially in industries with shortened life cycles i.e. information technology (IT), innovation products and R&D (Dierickx & Cool, 1989; Kessler & Chakrabarti, 1996; Schilling & Hill, 1998; Lin, 2003; Fichman, 2004; Marinova,

2004; Gibson et. al, 2007). For ACAP involves organizational learning, industrial economics, evolutionary view of the firm, dynamic capabilities and has been wildly noticed by academic fields such as strategic management, information management, organization science, knowledge management etc. (Eisenhardt and Martin, 2000, Teece et. al , 1997).

Moreover, organizational routines can be thought as the repository of organizational capability (Cyert and March, 1963; Becker et al., 2005; March & Simon , 1958; Peng et al., 2008), they pave the way for learning inside a firm and prepare for new capabilities in the future (Bergh & Lim, 2008; Ray et al., 2004; Zollo & Winter, 2002). Some scholars suggest that operational capabilities define as bundles of interrelated yet distinct routines (Amit and Schoemaker, 1993; Hult et al., 2003). In terms of manufacturing processes and operations management, quality management which can be further developed into a series of proprietary routines or processes will lead to competitive advantages. Analyzing how knowledge is stored and enacted in organizational knowledge creation routines can provide insights how a dynamic capability is formed (Eisenhardt & Martin, 2000). In the light of evolutionary economics particularly the framework of Nelson & Winter (1982, 2002) and the dynamic capability perspectives of Teece et al. (1997), we take these resource based concepts as an as foundation stones to discuss the model for introduction of Six Sigma quality management.

1.3 Six Sigma management

Six Sigma was first developed at Motorola Corporation in the 1980s and expanded by General Electric Corporation in the 1990s (Barney, 2002). Following the success at Motorola, Six Sigma evolved into a more comprehensive process improvement program. In quality management literature, process management plays an important role in TQM, ISO9000, Six Sigma management (Benner & Tushman, 2002; Cole & Scott, 2000). Six Sigma is a disciplined, data-driven approach to improving product, process and service quality (Kumar et al., 2007).

The term “Six Sigma” refers to a process improvement initiative and aims to reduce defect rate of 3.4 defects for every million opportunities (Linderman et al., 2006). Six sigma controls the occurrences of unwanted variation by following a structured problem solving method known as ‘Define Measure Analyze Improve Control’(DMAIC), which provides the basis for continuous improvement through a more detailed outline of Deming’s Plan Do Check Act cycle (Pande et al.,2000).

Linderman et al. (2003) defined Six Sigma as follows: Six Sigma is an organized and systematic method for strategic process improvement and new product and service development that relies on statistical methods and the scientific method to make dramatic reductions in customer defined defect rates.

Although six sigma was originated to reduce waste during manufacturing process, firms and researchers have shifted their focus from defect reduction to strategic objectives. Recently Schroeder et al. (2008) defined Six Sigma as follows:

Six Sigma is an organized, parallel-meso structure to reduce variation in organizational processes by using improvement specialists, a structured method, and performance metrics with the aim of achieving strategic objectives.

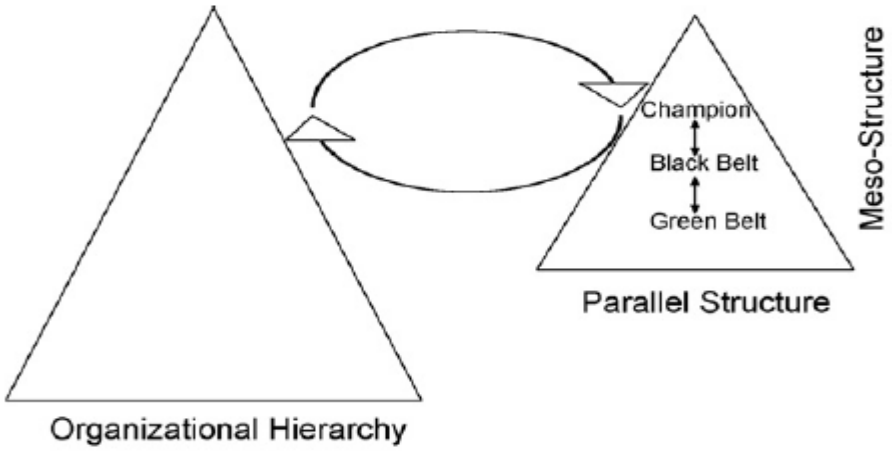

Figure 1. Six Sigma parallel-meso structure (Source: Schroeder et al. 2008)

The right way to implement six sigma in R&D is to focus the training on designing effective experiments, and then provide the tools and technical support to ensure that this gets done. Six Sigma is more than just a project implementation; it emphasizes combining a good business application of statistics with the power of effective strategy (Barney, 2002). Linderman et al. (2004) proposed that quality management practices that result in knowledge creation enhances organizational performance. Organizational knowledge exists not only in the documents and storage systems, but also in the routines, processes, and norms (Davenport & Prusak, 1998).

2. An exploitation, exploration, and process innovation model for Six Sigma

The differentiated nature among QM practices, organizational learning and strategy has raised debates their performance. However, market performance and competitive advantages of a firm can be predicted to a degree by a firm's ability to develop dynamic capabilities (Song et al., 2005; Peng et al., 2008; Yalcinkaya et al., 2007). Dynamic capability can be disaggregated into the capacity (1) to sense and shape opportunities and threats, (2) to seize opportunities, and (3) to maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets (Teece, 2007).

Similar to Teece's micro foundations of dynamic capabilities: the distinct skills, processes, procedures, organizational structures, decision rules, and disciplines which undergird enterprise-level sensing, seizing, and reconfiguring capacities are difficult to develop and deploy (Teece, 2007), Six Sigma uses a structured DMAIC method for process improvement and routine innovation which could related to the theory of organization routines and dynamic capability.

The second generation Six Sigma at Motorola is not limited to the classic product and service domains but in a balanced scorecard of strategic goals with metrics and initiatives to identify the improvement points (Barney, 2002). They find gaps not only limited to business process but also the improvements of market share or human resources etc.. They carefully **D**efine the business issues to be improved then reconfigure their resources and construct a team in a "parallel-meso" structure (Schroeder et al, 2008). The team **M**easures the current state against the desired state, then **A**nalyzes the root causes of the business gaps. Followed by brainstorming, selecting and implementing the best **I**mprovement solutions, the team dynamically builds and **C**ontrols the long-term sustainable advantages through continuous improvement and learning processes.

We follow the coevolution of three learning mechanisms proposed by Zollo and Winter (2002): tacit accumulation of past experience, knowledge articulation, and knowledge codification processes for the dynamic capability development of Six Sigma. Organizational routines or processes are stable patterns of the behaviors of a firm. A dynamic capability systematically generates and modifies its operating routines in pursuit of improved effectiveness. Similarly, Six Sigma accumulates prior experience of management and technology by using the structured DMAIC method and "parallel-meso" structure to improve and articulate new knowledge. Through this learning mechanism, dynamic capability is built and market performance could be sustainable.

2.1 Six Sigma and ACAP

The common factor between Six Sigma and the dynamic capability is organizational learning. Since the first documented learning curve published by Wright (1936) who had observed that unit production costs of an aircraft manufacture declined with cumulative output, learning has been considered as a powerful source of productivity, the ability of a firm to learn and acquire new knowledge and regarded as key factors to enhance manufacturing performance and survive (Argote et al., 2003; Grant, 1996). Cohen and Levinthal (1990) 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 performance for an adoptive learning process could be done.

2.2 Qualitative Case Study for constructs of ACAP priors

Stern (1980) indicated that the goals of qualitative research include (1) exploring the phenomena related to people's knowledge, and (2) obtaining new cognition from the current phenomenon. In addition, qualitative research can thoroughly acquire the intricate details necessary to investigate specific phenomena (Strauss & Corbin, 1998). Given the limited previous research on the key evolutionary activities of quality management, an effort was made to develop a workable description of how firms operate in the 'real world,' as well as generate some possible explanations for their practices.

Following the guidelines of Strauss and Corbin (1998) and Eisenhardt (1989), this paper uses a grounded theory-building approach and exploratory case study which entails the comparison of carefully selected cases. Grounded theory is the process of 'discovering' theory from data that fits empirical situations. It is particularly useful for studying issues that

are without much existing theoretical development (Glaser & Strauss, 1967; Handfield and Melnyk, 1998).

We use in-depth interview process i.e. designing, interviewing, transcribing, thematizing, analyzing, verifying and reporting procedures to validate the findings of our interviews through triangulation. Our interview strategy is to use a systematized procedure, such as open coding, axial coding, and selective coding, aimed at deeply exploring and generalizing a certain phenomenon to lead to better understanding of the thematic structure. Following these procedures, we empirically surveyed cases for the key constructs during the evolution of their quality management and aggregated into two main constructs i.e. technology and management as priors for successful introduction of a new QM practice.

In this section we develop propositions about the relationship between constructs for the adoption of Six Sigma. Constructs derived from the case analyses and literature reviews are synthesized in the eight hypotheses. Our propositions and the links between them are outlined in Figure 2.

H1: Technological resources are more positively related to a six sigma adopter's exploration capabilities than management resources.
H2: Prior quality management resources are more positively related a six sigma adopter's exploitation capabilities than technological resources.
H3: Exploitation capability is positively related to six sigma adopter's exploration capability.
H4: Exploration capability is positively related to six sigma adopter's degree of new process management innovations.
H5: Exploration capability is positively related to six sigma adopter's market performance.
H6: Exploitation capability is negatively related to six sigma adopter's degree of new process management innovations.
H7: Exploitation capability is positively related to six sigma adopter's market performance.
H8: The degree of process (Knowledge management) innovation is positively related to market performance.

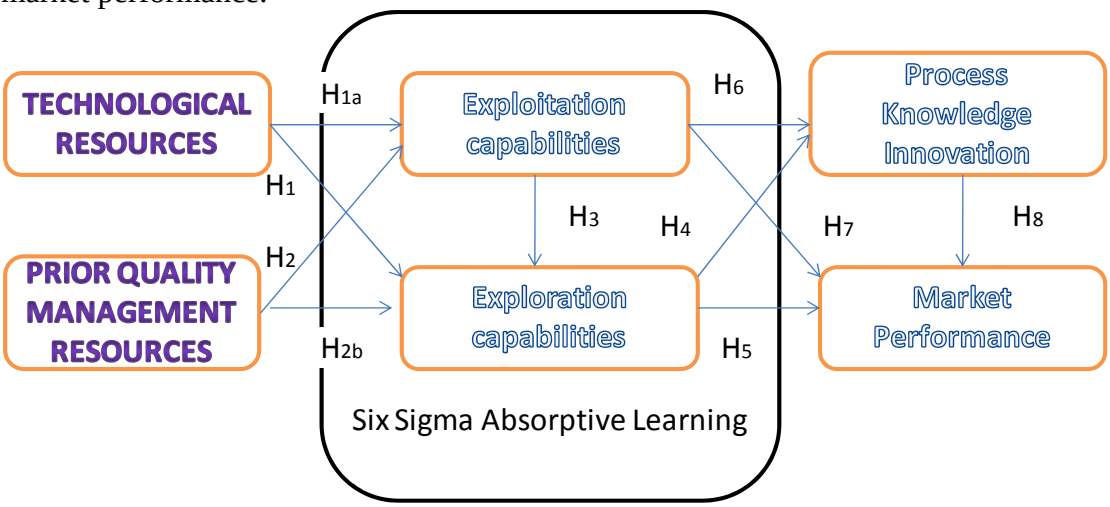

Figure 2. A dynamic learning model for Six Sigma

3. Conclusions, Limitations and Future Research Directions

Effectively enhancing the capability of Six Sigma is an important issue when firms confront with the global challenges. We propose a theoretical model for understanding the value of Six Sigma. Our model emphasizes that the creation of knowledge and innovation during the implementation as a sustainable advantages for a firm.

Although verification of our propositions is undertaken from case studies, they still provide solid managerial guidance for the adoption of Six Sigma. We thus suggest further quantitative research, such as factor analysis and SEM (Structural Equation Modeling), based on the six dimensions proposed in this work to get more insights into Six Sigma.

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THE APPLICATION OF PROJECT MANAGEMENT IN MARKETING—A CASE STUDY OF NEW PRODUCTS PROMOTION

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ABSTRACT

To increase the competition advantage and raise the image of the products, companies must constantly develop new products to attract consumers. In addition, apart from their traditional marketing strategies, companies also need to employ effective marketing tools because of the influence of internationalization that booms a great number of competitors. The strength of project management not just combined every effective planning tools and theories but also possess the generalization of practice so as to be suitable for each field of enterprises. On the basis of every planning tool and theory of project management, this study aims to target advertising campaigns in the automobile industry and identify all possible influence factors using data-collecting, processing, and analyzing. Moreover, this study hopes to expand and scheme the mode of new car promotion, both in car characteristics and marketing, through specification defining, market analyses and every leading groundwork in the procedure of new product development. As this project aims to scheme new product promotion, data such as enterprise tactics, industry characteristic, scope of the enterprise, market size and the like have to be concerned and collected from the literature and practice separately to pursue the combination of theory and practice, and then construct the appropriate new mode. The suggestion on the practice and the theory is proposed for industry's reference.

Keyword: project management, marketing, new product promotion

1. INTRODUCTION

The development of science and technology radically changes with time, so that the huge transformation drives the market environment to go with it. Consequently, consumers' demand and partiality become diversified. Therefore, every company needs to alter the ways of sales and operation management. Meanwhile, every company needs to understand the features of their company and target customers. In order to strengthen enterprises' competition, improve the image of the products, every company must be able to develop new products continuously and bring even more interests such as a generous profit to enterprises(Belassi, Kondra, & Tukel, 2007; Chang, & Chen, 2004).

Project management has grown into crucial knowledge for years, and it has been a well-developed tool applied to every field. However, in marketing, most of the promotion of new products still focuses on case studies, conducted by different task groups (task force) whose purpose is to fulfill the task demanded without integrating and systemizing their working experience and information to a company's intelligence capital. Such an execution not only increases the uncertainty of the subsequent new-product promotion but also wastes the relevant execution cost. In order to set up and organize the intelligence capital effectively, every company should take it as piority to file the materials right after carrying out a task evey time. This primary work includes collecting and building up every material and making it become report forms; this is what characteristic and speciality of project management is all about. Therefore, this study, based on the execution of project management on a new-product promotion, attempts to illustrate the possible materials, information, and files produced. It is hoped that this study can be regarded as an example to organizations (Chen, Ling, & Chen, 2003; Mustafa & Hunt,2009).

The aim of this project lies in building up a set of the complete scheme of new-product promotion, so during the process, important elements such as organization tactics and characteristic, the scope of the enterprise, the size of market and the like should be concerned. These elements should be planned and adjusted to a new car products and promotion; it is hoped to find out consumers' demand and combine their partiality from the diversification of the goods and develop more new products. Apart from popularizing new products, it is expected the scheme and experience of this project can be applied to the field of the same industry and win the sucess. This project is set up from its scope, personnel, and charge, schedule, carrying-out principle, resources and risk evaluation, etc. It will be operated and designed in detail and finished progressively(Allen & Katz,1995; Rustin,1985; Tennant & Roberts, 2003; Van Buskirk & Adams,1989).

2. PROCEDURE AND EFFECT

The following is the procedure of the project. Every stage will be introduced respectively.

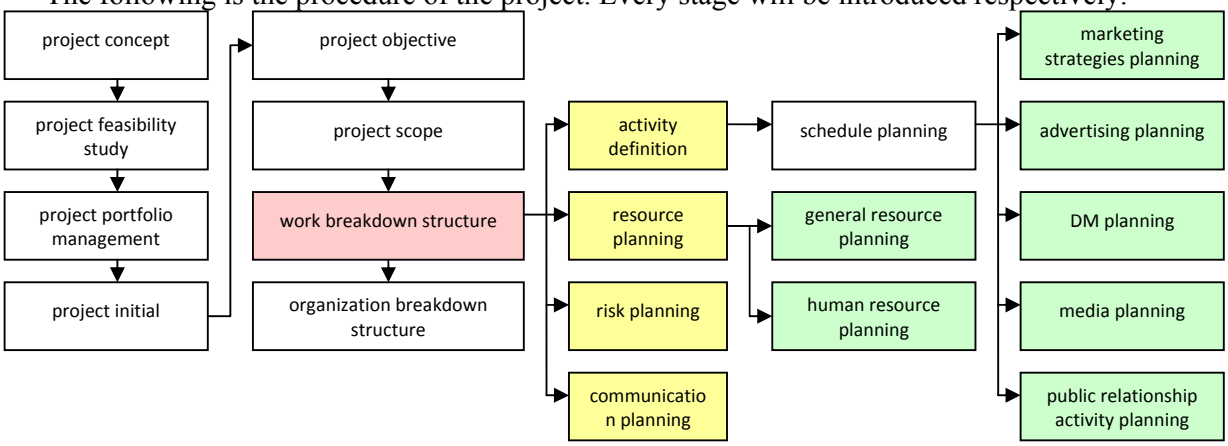


Figure 1: project flowchart

2.1 Project Proposal

The project proposal includes project background, project objectives, product description, key success factors (KSF), project strategies, schedule objectives, and financial objectives. When these elments mentioned above are concerned and collected, this will facilitate project participants and the organization to understand the whole project and brings up convenience of communication and management (Bonner, Ruekert, & Walker Jr.,2002).

2.2 Feasibility Analysis Report

The purpose of feasibility analysis report lies in the comparison and contrast of every possible project and fulfuill every item embedded in the project, including the evaluation of feasibility of economy, management and market, and put forward a best implementing scheme. Among the three major itesms, the evaluation of managerial feasibility focuses on whether the organization has the ability to organize the relevant resources of the project and conduct it; this ability can help execute the follow-up plans and projects. The evaluation of market feasibility is to detect whether the market can accept the new product and has purchursing power. Economic feasibility refers to the cost-benefit ratio to depict the total financial return for each dollar invested in the project, so that the organization can understand whether the relevant project activities are worth being conducted(Contino,1989; Marija, Le, & Jean-Claude,2009).

2.3 Project Goal

The project aims to establish a set of scheme for new product promotion, so certain important elements to promote the new products should be concerned. The elements include the organization's tactics, characteristic, its scope, size of market, etc. and these elements should be examined and analyzed according to the information and materials collected. Meanwhile, the organization should stipulate the execution time of the project and relevant budget amount clearly as the basis for the subsequent project (Murray, & Chao,2005).

3. PROJECT SCOPE

The project scope concerns the project background and the scope explaination, regarded as the key to success or failure of the project and also seen as the basis for the follow-up projects. The project scope includes structures of the job analysis (see figure 2), the organization breakdown system (see figure 3), the responsibility distribution matrix (see table 1), the activity definition (see table 2), the timetable and the like. The timetable has Gantt chart (see figure 4), the milestone chart (see figure 5), and network chart (see figure 6). The tools mentioned above are used to illustrate the procedure, stages, prority, and relation of each detailed work of the project. They are used not only for illustrating the working content and relevant relations of each participant in the project but also for concretely and clearly conveying the importance of each job and the job order (Fiedler, 2010; Pons, 2008; Voropajev, 1998).

3.1 WBS

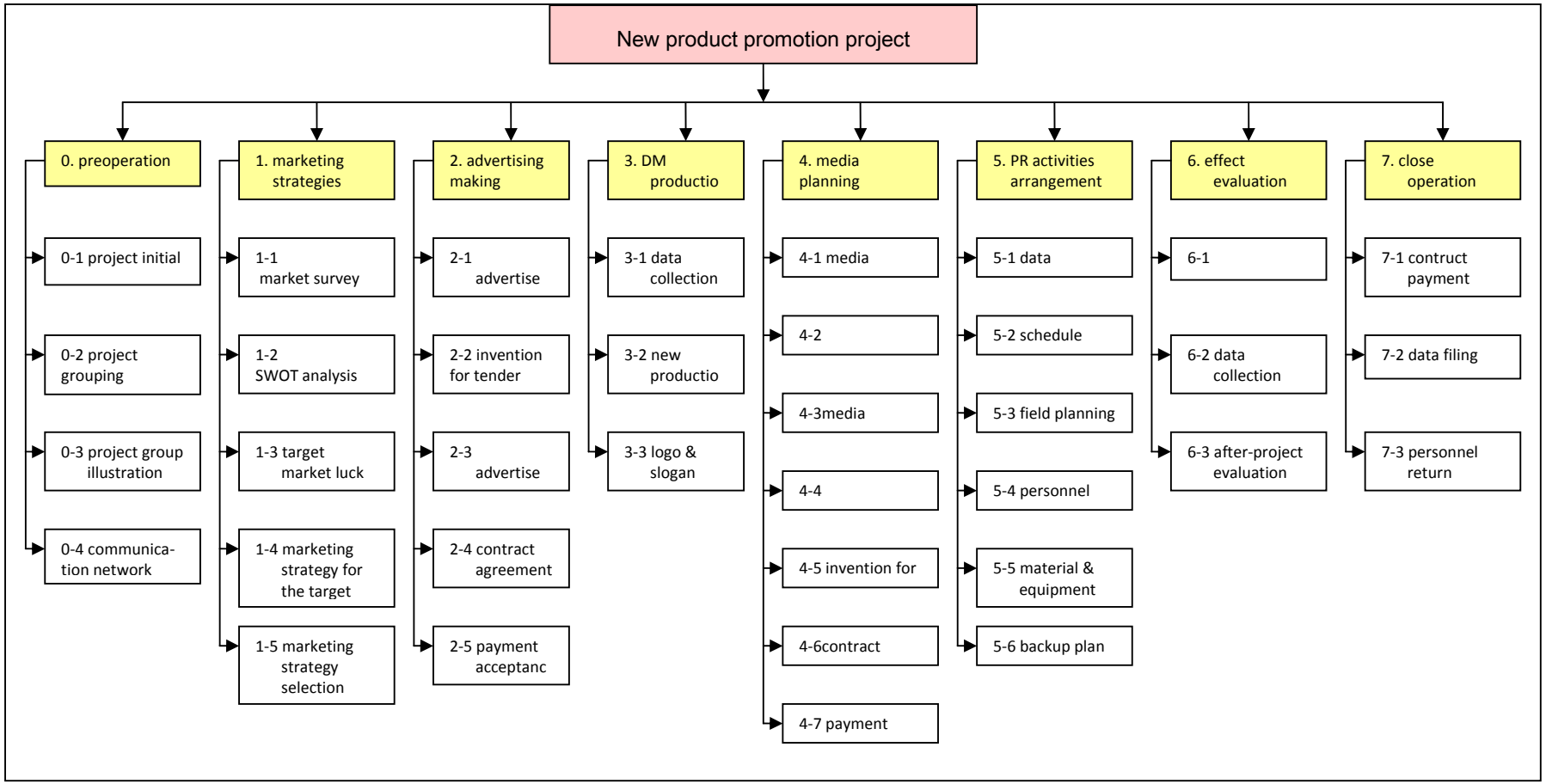


Figure 2: Work Breakdown Systwm chart

3.2 Organizational Breakdown System

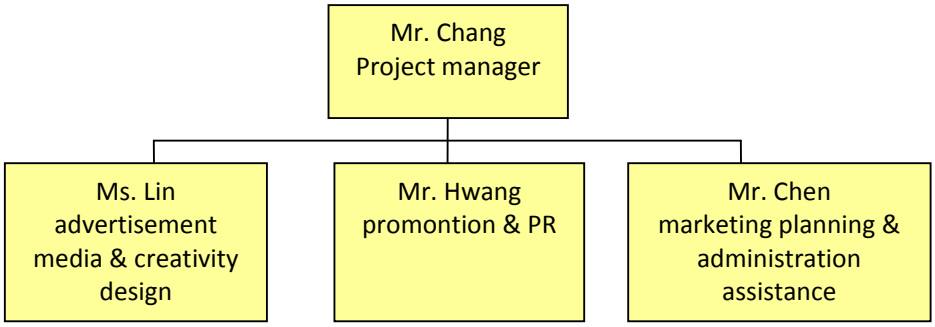


Figure 3: Organizational Breakdown System chart

Table 1: Responsibility distribution matrix for project

ID No.	Work package	Project manager	advertisement media & creativity design	promontion & PR	marketing planning & administration
		Mr. Chang	Ms. Lin	Mr. Hwang	Mr. Chen
0-1	project initial	●	◎	◎	◎
0-2	project grouping	●	◎	◎	◎
0-3	project group illustration	●	◎	◎	◎
0-4	communication network	●	○	○	◎
1-1	market survey	○	○	○	●
1-2	SWOT analysis	○	○	○	●
1-3	target market luck on	◎	○	○	●
1-4	marketing strategy for the target market	◎	○	○	●
1-5	marketing strategy selection	◎	○	○	●
2-1	advertisement benefit analysis	○	●	○	○
2-2	invention for tender	○	●	○	○
2-3	advertisement contractor selection	○	●	○	◎
2-4	contract agreement	○	●	○	◎
2-5	payment acceptance	○	●	○	○
2-6	contract agreement	○	●	○	◎
3-1	data collection	○	●	○	○
3-2	new production analysis	○	●	○	○
3-3	logo & slogan design	○	●	○	○
4-1	media objective	○	●	○	○
4-2	advertisement budget	○	●	○	◎

4-3	media selection	○	●	○	○
4-4	advertisement schedule	○	●	○	○
4-5	invention for tender	○	●	○	○
4-6	contract agreement	○	●	○	◎
4-7	payment acceptance	○	●	○	○
5-1	data collection	○	○	●	○
5-2	schedule planning	○	○	●	○
5-3	field planning	○	○	●	○
5-4	personnel arrangement	○	○	●	○
5-5	material arrangement	○	○	●	◎
5-6	backup plan planning	○	○	●	◎
6-1	preevaluation	◎	◎	◎	●
6-2	data collection	○	○	○	●
6-3	after-project evaluation	◎	◎	◎	●
7-1	contruct payment	◎	◎	◎	●
7-2	data filing	○	◎	◎	●
7-3	personnel return	◎	◎	◎	●

ps: ●means Incharge; ◎ means Support; ○means No.

3.3 Acitvity definition

Table 2: List of activities and time estimate

No.	Task	days
0	preoperation	5
0-1	project initial	1
0-2	project grouping	2
0-3	project group illustration	1
0-4	communication network	1
1	marketing strategies planning	25
1-1	market survey	21
1-2	SWOT analysis	2
1-3	target market luck on	1
1-4	marketing strategy for the target market	2
1-5	marketing strategy selection	1
2	advertisment making	13
2-1	advertisement benefit analysis	1
2-2	invention for tender	5
2-3	advertisement contractor selection	2
2-4	contract agreement	3
2-5	payment acceptance	3
3	DM production	7
3-1	data collection	3
3-2	new production analysis	1

3-3	logo & slogan design	3
4	media planning	41
4-1	media objective	10
4-2	advertisement budget	3
4-3	media selection	2
4-4	advertisement schedule	2
4-5	invention for tender	5
4-6	contract agreement	3
4-7	payment acceptance	3
5	PR activities arrangement	25
5-1	data collection	7
5-2	schedule planning	6
5-3	field planning	3
5-4	personnel arrangement	3
5-5	backup plan planning	4
6	effect evaluation	71
6-1	preevaluation	30
6-2	data collection	30
6-3	after-project evaluation	3
7	close operation	12
7-1	contruct payment	10
7-2	data filing	1
7-3	personnel return	1

3.4 Schedule Planning

3.4.1 Gantt Chart

識別碼		task	time	start date	finish date	pretask
1		**mazda project**	**111 days?**	**2008/5/1**	**2008/10/1**	
2		**0.operation**	**4 days?**	**2008/5/1**	**2008/5/5**	
3		project initial	1 day	2008/5/1	2008/5/1	
4		project teambuilding	1 day?	2008/5/2	2008/5/3	3
5		project teambuilding description	1 day?	2008/5/4	2008/5/4	4
6		communication network	1 day?	2008/5/5	2008/5/5	5
7		**1.marketing strategies planning**	**25 days?**	**2008/5/6**	**2008/6/9**	
8		market survey	21 days?	2008/5/6	2008/6/3	
9		SWOT analysis	2 days?	2008/6/3	2008/6/4	
10		target market luck on	1 day?	2008/6/5	2008/6/5	9
11		marketing strategy on target market	2 days?	2008/6/6	2008/6/9	10
12		marketing strategy selection	1 day?	2008/6/9	2008/6/9	
13		**2.advertising making**	**13 days?**	**2008/6/10**	**2008/6/26**	
14		ad. Benefit analysis	1 day?	2008/6/10	2008/6/10	
15		Request for Proposal	5 days?	2008/6/11	2008/6/17	14
16		ad. Contractor selection	2 days?	2008/6/18	2008/6/19	15
17		contract signing	3 days?	2008/6/20	2008/6/24	16
18		delivery & check	3 days?	2008/6/24	2008/6/26	
19		contract signing	1 day?	2008/6/26	2008/6/26	
20		**3.ad. produce**	**7 days?**	**2008/6/10**	**2008/6/18**	
21		data collection	3 days?	2008/6/10	2008/6/12	
22		new production analysis	1 day?	2008/6/13	2008/6/13	21
23		logo & slogan design	3 days?	2008/6/16	2008/6/18	22
24		**4.media planning**	**40 days?**	**2008/6/10**	**2008/8/4**	
25		media objective	10 days?	2008/6/10	2008/6/23	
26		ad. Budge	3 days?	2008/7/11	2008/7/15	25
27		media selection	2 days?	2008/7/16	2008/7/17	26
28		ad. Schedule	2 days?	2008/7/18	2008/7/21	27
29		Request for Proposal	5 days?	2008/7/22	2008/7/28	28
30		contract signing	3 days?	2008/7/29	2008/7/31	29
31		delivery & check	2 days?	2008/8/1	2008/8/4	30
32		**5.PR activities arrangement**	**25 days?**	**2008/6/10**	**2008/7/14**	
33		data collection	7 days?	2008/6/10	2008/6/18	
34		schedule planning	6 days?	2008/6/19	2008/6/26	33
35		ground planning	3 days?	2008/6/27	2008/7/1	34
36		personnel arrangement	3 days?	2008/6/27	2008/7/1	
37		material & equipment arrangement	5 days?	2008/7/2	2008/7/8	36
38		backup plan planning	4 days?	2008/7/9	2008/7/14	37
39		**6.effect evaluation**	**70 days?**	**2008/6/10**	**2008/9/15**	
40		preevaluation	30 days?	2008/6/10	2008/7/21	
41		data collection	29 days?	2008/8/1	2008/9/10	40
42		evaluation	3 days?	2008/9/11	2008/9/15	41
43		**7.case close operation**	**12 days?**	**2008/9/16**	**2008/10/1**	
44		contract paymen	10 days?	2008/9/16	2008/9/29	
45		database building	1 day?	2008/9/30	2008/9/30	44
46		personnel get back	1 day?	2008/10/1	2008/10/1	45

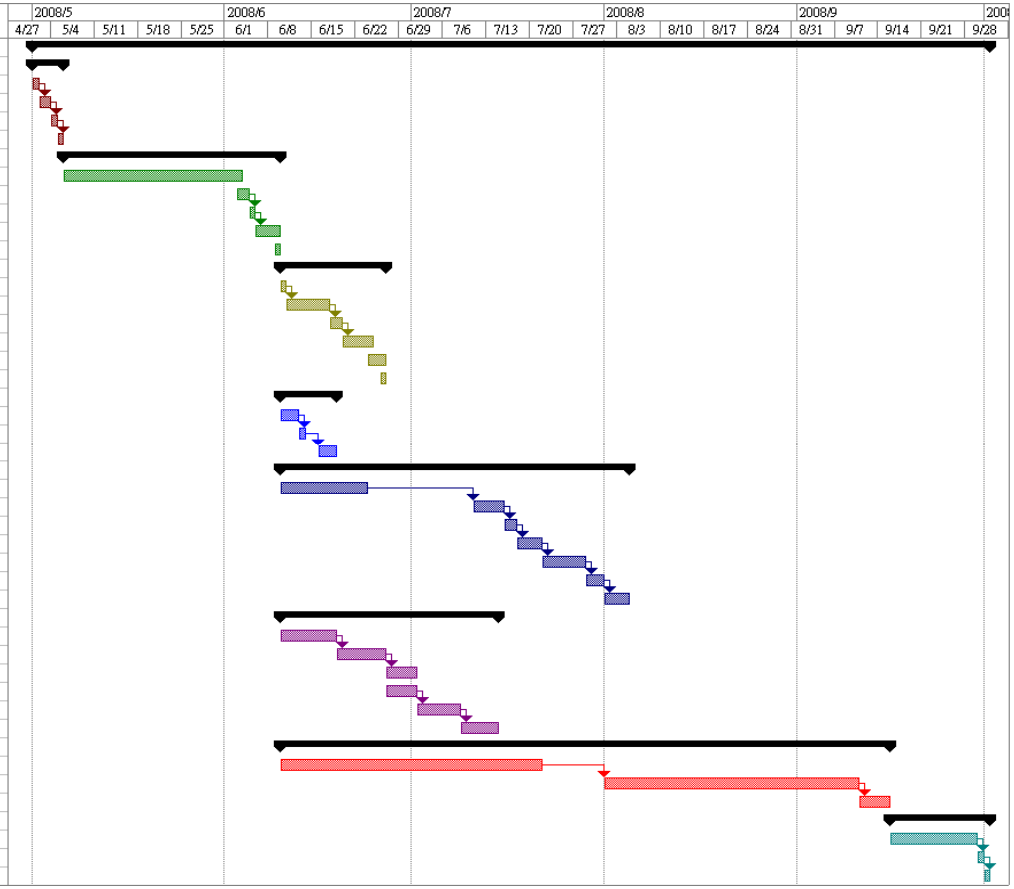


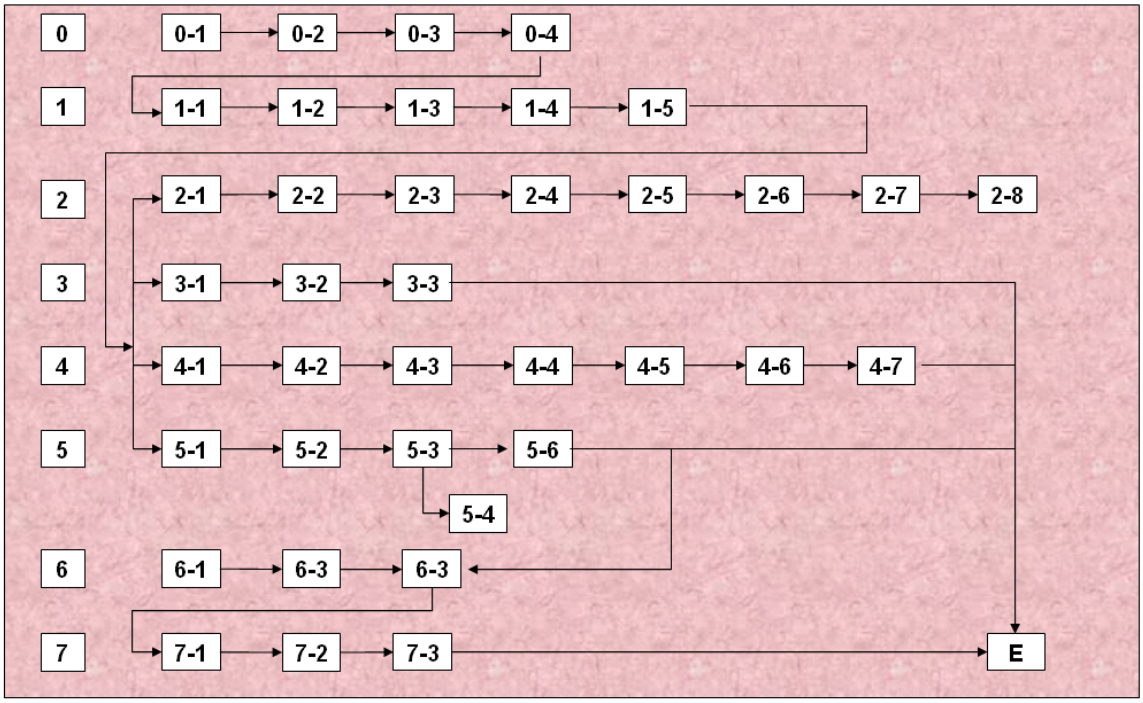
Figure 4: Gantt Chart

3.4.2 Milestone

ID No.	Task	Time	Start Time	Finish Time
1	New product promotion project	113 days	2009/5/1	2009/10/1
2	0. preoperation	5 days	2009/5/1	2009/5/5
7	1. marketing strategies planning	26 days	2009/5/6	2009/6/9
13	2. advertisment making	13 days	2009/6/10	2009/6/26
19	3. DM production	7 days	2009/6/10	2009/6/18
23	4. media planning	41 days	2009/6/10	2009/8/4
31	5. PR activities arrangement	25 days	2009/6/10	2009/7/14
38	6. effect evaluation	71 days	2009/6/10	2009/9/15
42	7. close operation	12 days	2009/9/16	2009/10/1

Figure 5: Milestone list

3.4.3 Network Chart



Fiugure 6: Network chart

4. MARKING TACTICS AND PLANS

Marking tactics and plans include the market research, the SWOT analysis (see table 3) and the targeted market. The market research is used to explain the present situation in markets, the SWOT analysis is to understand the organization's competitors and realize the superior and inferior position, and the targeted market is to recognize components of the markets including districts, intentions, motivations, satisfication of different consumers, regarded as the main demand for the new product promotion (Ayas, 1996; Rauniar, Doll, Rawski, & Hong, 2008).

Table 3: SWOT analysis

S (Strength) : 1. Dividing work detailedly and have strong ability to control the operation. 2. Having powerful brand products. 3. Having experienced marketing ability. 4. Adopting the medium-and-large-sized distributor in the area, so its marketing infiltration strength is high. 5. Having intact information systems. 6. Having fine after-sale service systems, so customers' loyalty is high.	W (Weakness) 1. Not having a wide range of products, so its sales volume is centralized, especially cars in the individualized style. 2. Easy for competitors to catch up with in the quality and difference of the products. 3. Decreasing after-sale service because of high sales volume. 4. High costs of the advertising expenses.
O (Opportunity) 1. Increading the competition after entering the WTO. 2. Lowing the restriction on importing cars. 3. Well-developed electronic cars and it also becomes a trend. 4. Gradually fond of cars in the individualized style.	T (Threat) 1. Increasing the burden of car users because of the high fuel price. 2. Strong compeitition that other importing cars bring. 3. Low sale price and a zero interest rate in the market.

4.1 Marketing Strategies for the Target Market

Marketing strategies for the target market contain strategies of marketing, sales channels, application of information technology (IT), and customers' relationship, etc. That is, after collecting the information and material of the different domains mentioned above, the organization can start conduct marketing strategies for the target market. In the respect of deciding the target market strategies, the organization must avoid certain traps such as the reduction of the benefit, the quality, after-sales service when pursuing the market share by consuming huge marketing resources and sales (Ash, & Smith-Daniels, 2004).

4.2 Public Relations (PR) Activities Arrangement

In order to maintain or establish friendly relationship with the related participants (e.g. sellers, buyers, and agencies, PR activities are an important key which includes collecting relevant information at first, then separating the different districts of consumers, and deciding the necessary field. The field planning also includes coordination of demand and reaction to unexpected situations while the organization carries out the activities (Bourgeon, 2007; Chakrabarty, Whitten, & Green, 2008).

4.3 Risk Management and Supervision

Different from other tools, project management has its unique functions to manage risk. It can effectively predict, analyze and respond to relevant risks that the organization may encounters when it carries out a project. It helps the organization well-prepare for carrying out the project in advance and make benefits. Risk management includes any of the risks that may influence the project such as the process, cost, and activities. It helps analyze the possibility and impact of risk probability and find out the soluation to the risk. The content of the work has regular meetings and risk inspection and management. The purpose is to to carry on risk analyses smoothly and distinguishment from possible risks (see figure 7). Then, it can also offer plans for every possible risk so that the organization has the ability to deal with the risk when it really occurs (Budd & Cooper, 2004; Edmondson & Nembhard, 2009).

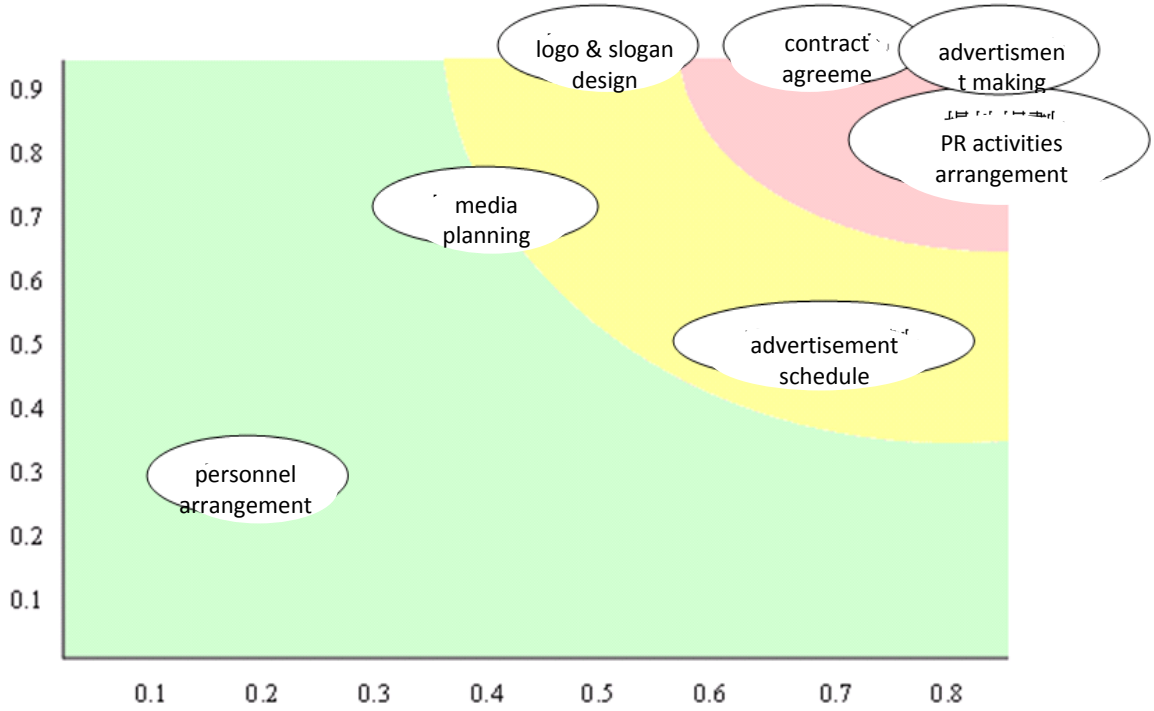


Figure 7: Risk analysis

4.4 Communication Planning

When the organization carries out a project, it needs to negotiate with different numerous people who may help or destroy the execution of the project. For that reason, it is necessary for the organization to keep good communication and interaction with the people related to the project. However, different people will have different ways of communication. Thus, communication planning is used to increase the effect of communication with the relevant people. Communication planning includes the analyses of relevant people, requirement of communication. Because of different people, the planning should be have different content and frequency of communication, communication management, and even a communication model in the right situation and appropriate time (Cartwright & Gale,1995; Rapp, 2004).

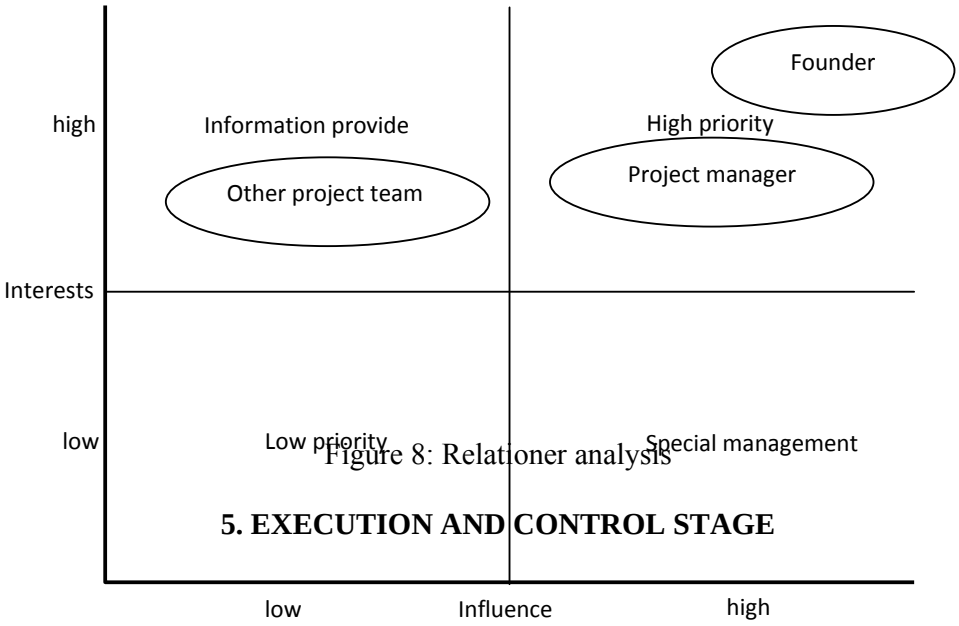


Figure 8: Relationer analysis

5. EXECUTION AND CONTROL STAGE

When the project is getting close to the end, it is the most important stage of executing the task. At this stage, the project team must finish the following work. First, the team must carry out the project which includes the result of the project and the possible extra requirement because of modification of the project. Secondly, the team should also carry out the revision work that may result from the project. The third task is to stipulate the authority of checking in accordance with the revision result. The four is to set up operational staff and channels to pass the information during the execution of the project. Finally, it is records of the fixed or imperiodic project meetings in order to accumulate relevant experience and important information (Boehm, 2003; Fleming & Koppelman, 1996).

5.1 Planning for Performance and Evaluation

Effective execution must be based on the rigorous performance supervision and evaluation system. The project in fact sets up a complete performance evaluation form (see table 4) which effectively reveals the performance of team members of the project. In addition, the problem management is also one of the performance evaluation items because it also helps team member's performance during the execution of the project (Brun & Steinar, 2009; Santell, Jung, & Warner Jr., 1992).

Table 4: Performance evaluation table

Performance / Evaluate Task item		Schedule performance		Cost performance		Total performance	
No.	Work package	Dead line	outcome	cost	outcome	standard	outcome
0-1	project initial	5/5	V	2,000,000	V	Qualify	V
0-3	project group illustration	5/4	V			No	
1-1	market survey	6/3	V	1,000,000	V	Qualify	V
1-5	marketing strategy selection	6/9	V			No	
2-1	advertisement benefit analysis	6/10	V	7,000,000	V	No	
2-3	advertisement contractor selection	6/19	V			Qualify	V
2-5	payment acceptance	6/26	V			Qualify	V
3-3	logo & slogan design	6/18	V			Qualify	V
4-2	advertisement budget	7/15	V			No	
4-4	advertisement schedule	7/18	V			Qualify	V
4-7	payment acceptance	8/4	V			Qualify	V
5-2	schedule planning	6/26	V	5,000,000	V	Qualify	V
5-3	field planning	7/1	V			Qualify	V
5-5	material arrangement	7/8	V			Qualify	V
6-1	preevaluation	7/21	V	1,000,000	V	No	
6-3	after-project evaluation	9/15	V			No	
7-1	contruct payment	9/29	V	1,000,000	V	Qualify	V
7-2	data filing	9/30	V			Qualify	V

5.2 Work for Closed Project

Work for closed project is also another important task for a project management. It contains systematic management and analyses and will be the basis for the follow-up projects. Therefore, when a project is getting close to the end, some of the relevant work must be done such as discussion on a project achievement, project payment, project experience and problems, and systematic project framework. Through appropriate IT management, the result

of the project will be presented in effective collection and classification. Such an empirical experience not only can be the important reference basis of carrying out a project but also can be regarded as an important intelligence asset of the organization (Chiesa, Frattini, Lazzarotti, & Manzini, 2007; Huang & Newell, 2003).

6. CONCLUSION

Project management includes five major tasks, namely initiation, planning, execution, controlling, and closing; however, accompanied by the project in every step of the procedure, many other different, effective planning tools are also produced. These tools can be unreservedly applied to help execute the project according to different objective environments or subjective conditions. In the field of marketing, new product promotion, for example, has been conducted for years. Unfortunately, most of the organizations still carry out their projects by using cases and each of the cases is separated and unrelated. This not only increases uncertainity of every project such as marketing promotion activy but also wastes the experience and information produced by every project. To solve the problem effectively, it is very important and useful to implant the method and executation procedure of project management in every project such as new product promotion. From different marketing activities, the organization can induce, collect, categorize, and systemize the information and experience according to categorization, scope or even other criteria. This not only collects the experience and information from all the new product promotion activities and makes them become intelligence assets, but it also decreases the cost of the following promotion activities because of try and error. It is for sure for the organization to earn profits and increase the competition of the new product as well as that of the organization. Project management is not only used in new product promotion; instead, it can be applied in many other fields. This study sets up an example of illustration for other projects in the marketing field and hopes project management can bring facilitation to marketing.

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ENHANCING HIGH TECH PRODUCT DEVELOPMENT THROUGH FUNCTIONAL COMMUNICATION

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ABSTRACT

Product development faces communication challenges which are accumulated when several companies are involved as is typically the case in high tech industry. In this research, project personnel's communication needs are studied and improvement ideas are sought. This paper aims to help companies and project managers improve communication and hence enhance product development. The research was conducted as a multiple-case study through a web-based survey to identify project personnel's perceptions of the primary information sources and typical communication problems. According to this study, personal relations are seen as the main source for information for the personnel conducting the actual work. Data management systems are also utilized; however, they should better support the communication needs of product designers. In addition, companies with own products should better acknowledge the communication needs of their sub-contractors and their personnel. Investments in functional communication, both planning and follow up, should be made at project, product development and organizational levels.

Keywords: communication, information, product development, information management, project management.

INTRODUCTION

Successful product development (PD) is vital especially for high tech companies. Increased speed of new product introductions is critical for the business (Mallick & Schroeder 2005). To a great extent, business logic is based on functioning product development: product development is the life-blood of these companies (e.g. Barczak 1995, Campbell Jr & Holmes 2004,Mallick & Schroeder 2005).

Typically, high tech product development projects are executed in a complex network of organizations (van Echtelt *et al.* 2008). A company developing its own products uses e.g. subcontractors for several reasons. On one hand, networks of organizations make it possible to split the risk of product development between companies (Wognum *et al.* 2002). On the other hand, companies utilize networks to acquire knowledge and competencies that they need but do not have in-house. Networks allow for more innovativeness and efficiency (Miles & Snow 2007).

From the viewpoint of a project team member, the working environment in high tech PD is complex for many reasons. Increasing number of project personnel work in different locations i.e. are geographically distributed (Paasivaara 2005, Harvey & Griffith 2007) (multi-site). Also, there are often many national cultures involved (multi-cultural working environment) (Harvey & Griffith 2007), even though the project may not be multi-site. In addition, in product development there are several on-going projects and the personnel may be simultaneously involved in more than one project (multi-project) (Killen *et al.* 2007). Furthermore, in high technology projects the product itself is complex (complex product structure) (Birk & Heller 2007) and the project may involve professionals with different technical backgrounds: e.g. software, electronics, mechanics, and system designers (multi-technical projects) (Edmondson & Nembhard 2009). Additionally, project personnel operate in an environment supported by a complex information technology (IT) framework (Sharma 2005). According to Zika-Viktorsson *et al.*(2003), compared to e.g. construction projects, product development projects require more cooperation and communication among project personnel. These all have several consequences influencing working practices and communication by project team members.

This research studies communication in very complex projects – which *simultaneously* are multi-site, multi-cultural, multi-project, multi-technical and where more than one organization is involved. The focus is on analyzing communication perceived by project employees. The main research questions addressed in this paper are as follows:

> *RQ1 What are the primary information sources and typical communication problems perceived by project employees?*
>
> *RQ2 How to enhance success of product development projects by acknowledging the personnel's communication needs?*

The research was conducted as a multiple-case study. The empirical part included five product development projects each from a different high technology company. In the studied cases a web-based survey was conducted to reveal project personnel's perceptions of the primary information sources and typical communication problems.

THEORY

Definitions of communication differ depending on the context. In this study the following definition is used: *"Communication is a process in which signals produced by people are received, interpreted, and responded to by other people"* (Galanes *et al.* 2004). Important implications of this definition include the following:

1. communication occurs between people although may be mediated via different technologies;
2. communication includes personal interpretation of messages sent by others i.e. communication is personal.

Channels for communication can be divided into three main categories: *face-to-face* communication (e.g. meetings), *printed media* (i.e. documents in a physical form such as

newspapers, leaflets etc.,(Kipphan 2001), and *electronic media* (i.e. technology aided communication such as telephone, email, databases (Albarran 2009), groupware (Lumsden & Lumsden 2000).

Communication within an organization can also be divided into *vertical* and *horizontal* dimensions. Vertical dimension refers to managerial communication and superior-subordinate interaction. Horizontal dimension, on the other hand, is communication between work colleagues, within one's personal *network*. Individual personal networks are important communication channels (Juholin 1999).

An individual may play different roles in the network(s) (Andrews *et al.* 1996). Typically, a project manager acts as a liaison between project teams, or as a gatekeeper between the project team members and the customer (Fig. 1).

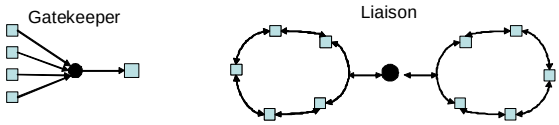

Fig. 1. **Typical communication roles of a project manager.**

Scientific literature on communication often emphasizes the role of personal communication networks. For example, Glückler & Schrott (2007) report that successful project managers and teams have a central role in the communication network within the organization. Whereas Kratzer *et al.* (2008) found out that communication in an informal situation – within one's social network – enhances creativity but possibly lessens productivity of work. Modern IT solutions should integrate people, processes and information (Ameri & Dutta 2005, Ebert & DeMan 2007).

According to Lievens & Moenaert (2000) project communication can be divided into project *internal communication* including communication flows between members of a project team and project *external communication* including communication flows between project team members and outside sources. Project external communication is also referred to as boundary spanning communication: boundary spanners are persons that act as mediators in communication between persons in different organizations (Lievens & Moenaert 2001). In a project environment there are several different organizational boundaries e.g. between buyer and seller organizations, between production and product development units, between different departments in product development, between different projects and project teams.

Earlier research documents the challenges of everyday interaction in a buyer-seller relationship (Lakemond *et al.* 2006, Wagner & Hoegl 2006, Ragatz *et al.* 1997, Wynstra *et al.* 2001. Allen (1970) highlights *physical boundaries* as a source of communication challenges in both project internal and external communication. Additional challenge originates from companies organizing communication differently. For example, Grunig & Dozier (2002) emphasize that the parties in a buyer-seller relationship should invest in two-way symmetrical communication. Ganesan *et al.* (2005) states that it is more important to create a good relationship between the parties than to be located next door.

Blended teams increase a client's trust, which in turn will increase a team's internal trust, cohesion, and performance (Webber 2008).

An organization's formal structure – organization chart, job descriptions, and regulations – influences the formation of communication channels. Informal communication e.g. rumors, grapevine, informal workgroups, personal networks, on the other hand, supplements the official communication system. (Pace & Faules 1994, Rogers & Agarwala-Rogers 1976). Both, planned vs. ad-hoc approaches are used for communication in a project context (Burke 1999).

Pinelli (2003) considers engineering work as acquisition, producing, using and transferring information or knowledge. In organizations, explicit information is stored in documents and databases. Electronic documents play important role as they leverage long-run organizational memory (Amami & Beghini 2000) by storing essential data (Hertzum & Pejtersen 2000). Data means separate objective facts while information refers to data having a purpose and meaning in a certain situation (Davenport & Prusak 1998). Information is data that can be utilized by project personnel. Documents and different databases serve as essential information sources for project personnel. According to Nonaka & Takeuchi (1995) knowledge can be divided into explicit and tacit knowledge: explicit knowledge refers to documented information, i.e. which can be stored in a database, while tacit knowledge is situational and personal.

Engineering organizations typically favor data bases, leaving other communication means with less attention. Data bases are necessary, but not adequate alone for functional communication in project organizations. According to Hertzum & Pejtersen (2000), engineering personnel's information seeking behavior is directed towards both people and documents. Engineers need exact product information stored in documents; however, they use people to find the right documents (Hertzum & Pejtersen 2000, Allard *et al.* 2009). People know why some solution was selected which is typically missing in documents. On the other hand, documents may direct one to finding the right person to address detailed questions. Decision-making can be supported by data bases enabling searches for people with specific qualifications (e.g. certain knowledge on lessons learned) (Hertzum & Pejtersen 2000).

RESEARCH PROCESS

The research was conducted as a multiple-case study: communication was studied in five case projects in high technology companies. All these companies have global operations, common nominator being offices in Finland. Table 2 presents the case companies. It was considered important that each case project would represent a typical project for the company in question. The studied projects included both large and small projects and they were all conducted under very complex circumstances. Two of the five case projects were conducted according to a specific customer order (the company was operating as a project subcontractor). See Appendix 1 for more detailed information of the studied projects.

Table 2. Case companies.

	Industry sector / % of R&D personnel	Organization structure	Business role (own products or subcontractor)
A	▪ software for telecommunication / 65%	▪ matrix: project personnel allocated to programs and projects from competence pools, line and project organization are partly integrated	▪ own products
B	▪ electronics / 90%	▪ matrix	▪ subcontractor
C	▪ software industry / 90%	▪ a business sector specific units are owners of everything (inc. personnel, customers and projects), units are grouped and each group has several customers and projects	▪ subcontractor
D	▪ electronics / 30%	▪ matrix	▪ own products
E	▪ telecommunication / 70%	▪ mixed matrix organization: project organization includes only project management and supporting personnel, while engineering personnel are in line organization, lines are responsible for customer projects and HR-management	▪ own products

The case A project is a large software project, of 150 man-years, for the telecommunication industry, including specification, testing, and project integration. The project involves personnel from different locations and cultures, and several companies, mainly subcontractors.

The company B operates as a product development subcontractor in the electronics industry. The case project is part of a much larger project managed by the customer and has agreed to go along with change requests coming from the customer. The technologies used are electro-mechanics and electronics hardware. The project size is 20 man-years. The project personnel work in a single location in Finland. The case project has subcontractors.

The case C is a software project based on customer specifications, including 5 man-years of work. Project personnel work in one location in Finland and in one location elsewhere in Europe. The project does not have any subcontractors.

The case D operates in the electronics industry, project size being 20 man-years. Although the end product has unique features, it is an improvement version of an existing product involving electronics, mechanics, and software technologies. Project personnel work in four locations: two in Finland, one elsewhere in Europe and one in Asia. The project includes subcontractors.

The case E operates in the telecommunications business. The case project involves 50 man-years and aims to a totally new product utilizing some earlier developments. The

project involves mechanics, HW, RF, and SW. The project has both internal and external suppliers. Most of the personnel work in one location in Finland.

A survey among project personnel was conducted in each case to clarify *information sources* and *communication problems* using a web-based questionnaire. In order to obtain an adequate coverage, the surveys were sent to *all* project personnel, total of 537 people. Among the cases, the average response rate was 52%. In the questionnaire, each respondent was asked to name one primary information source and one typical interface causing communication problems. In addition, interviews among project managers, quality managers and other key persons in case companies & case projects were used to collect background information, as well as to support formulating the questionnaire. Finally, a cross-case analysis was conducted for the results to allow comparison among the case specific results and to make conclusions.

RESEARCH RESULTS

This study aimed to clarify how project employees communicate in order to successfully perform their tasks. The primary information sources utilized in the case projects were analyzed, and were further divided into three categories of *personnel*, *meetings & infos*, and *data management systems*. The personnel category includes communicating with colleagues and supervisors via telephone, email, in person, etc. Meetings & infos included meetings and briefings at different organizational levels. Data management systems included all utilized document management systems and intranet. Figure 2 illustrates the primary information sources utilized by the case project employees.

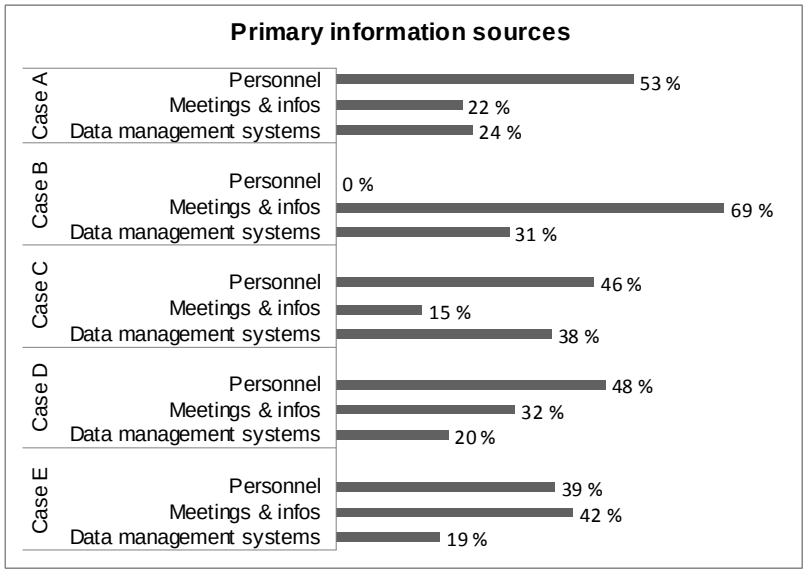

Fig. 2. Primary information sources in the studied case projects.

The results indicate that there are great differences among the case companies on what the employees consider as their *primary information source*. The importance of personal networks is highlighted in all the cases, except in case B. The communication in case B was

exceptionally dependent on their customer resulting in meetings with the customer to dominate. Case E seems to have the most balanced information source use.

Figure 3 presents *typical interfaces for communication problems* experienced by the case project personnel. These interfaces were divided into seven categories of project/customer, project/business management, different projects/programs, different professions, persons from different sites, team/project management, and team members.

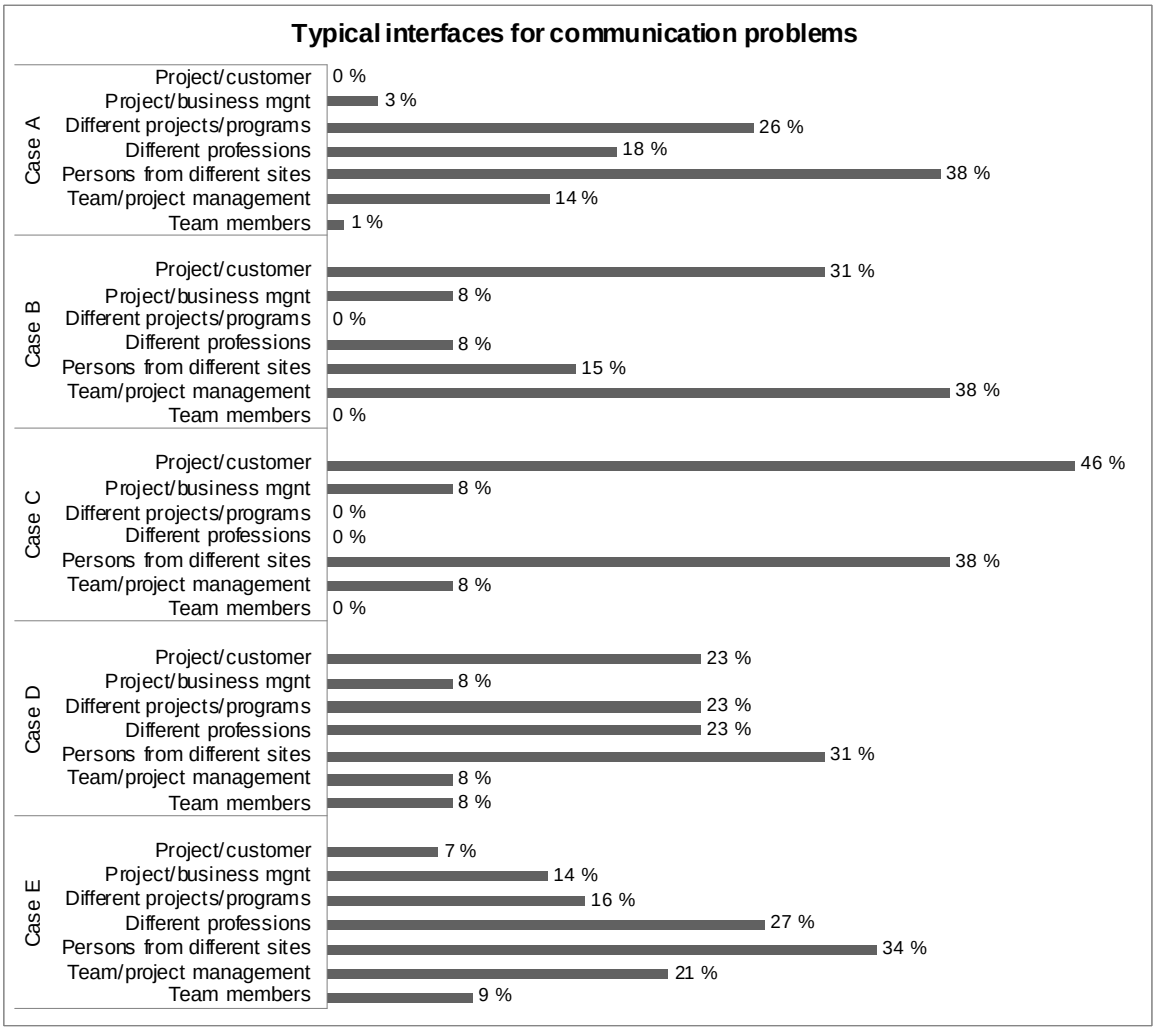

Fig. 3. Typical interfaces for communication problems in the studied cases.

Figure 3 shows that there are differences among the cases. However, communication between different sites seems to be an important source of communication problems in all of the studied cases. A closer analysis reveals that the company's business sector does not affect the perception of typical communication problems. Instead, the company's role in the business network does have an effect on the perceived communication problems: cases B and C who are subcontractors face problems in communication between the project and the customer. In A, D and E, who develop their own products, communication problems, were seen to occur most often between different sites and professions. Communication among team members and project/business management interfaces were seen less problematic.

Discussion

The results indicate some issues that are applicable to all the studied companies, but also some issues specific to company's role in the supply and development chain were identified. The results did not seem technology or the industry sector dependent.

Personal relations were typically experienced as the main source for information, according the project personnel conducting the actual product development tasks. Communication among personnel from different sites was experienced as the most challenging, as communicating in-person is, obviously, more difficult when the distance becomes greater. This challenge is highlighted when the personnel involved are new to each other. Data management systems are typically utilized to alleviate this problem, however, do not replace the need for personal communication. Project managers can better utilize databases for their own tasks, whereas the personnel conducting the actual development work see the benefits as more limited.

Case B is exceptionally dependent on their customer and the information given by the customer. The most important source for information is meetings with the customer. Additionally, the customer's data-base has an important role as their information source, however, the access is limited. As a result personal communication towards the customer is almost non-existent. From the perspective of the subcontractor, case B, the arrangement is not optimal.

In cases when a sub-contractor is responsible for some product elements, it seems that the customer companies have not adequately addressed qualitative and quantitative information needs of the sub-contractor, including the need for adequate personal communication.

CONCLUSIONS

Product development in modern high tech industry faces communication challenges due to organizational & cultural boundaries and physical distance. These challenges are accumulated when several companies are involved in co-organized product development. In this research, communication needs of project personnel are studied and ideas are sought for improving product development work.

According to project personnel conducting the actual product development tasks, personal relations are the main source for information. Data management systems are also utilized, however, are seen not to replace the need for personal communication. Communication among personnel from different sites was experienced as the most challenging, as interaction in-person is, obviously, more difficult when the distance becomes greater. Challenges were strongly influenced by the company's role in the supply and development chain. In supplier companies, the main communication problems were typically experienced between the project and the customer. In companies with own products the main challenges were perceived between different sites and professions. Noteworthy is that business sector did not seem to influence the way the

product development personnel experienced their information sources nor communication challenges.

Electronic documents play an essential role in high tech product development, hence investments in data management systems are needed. Existing data bases are not adequate from the perspective of product development personnel. The companies should enhance the usability so that the data bases would better support the actual information and communication needs of product designers. One way is to tailor user interfaces separately for main user groups. Companies should organize the systems to support the actual individual work and information flows within personal networks and over organizational interfaces.

In order to enhance the success of product development, companies with own products should better acknowledge the communication needs of their sub-contractors and their personnel. Companies must understand that also sub-contractors' personnel require adequate access to relevant data bases. Also, following supplier, especially their personnel, satisfaction may be worth measuring. Data management systems are typically created to support management work, however, it is worth noting that there may be a clear obtainable added value if they are designed to support project employees' work.

The personnel should be encouraged to develop their personal networks. Project management could invest in arranging kick-off meetings at the beginning of projects informing on desired outcomes, tasks, resources, schedules etc. This way the project members obtain a level of understanding on the bigger picture. Understanding what others do also helps the employees in familiarizing themselves with each other.

Functional communication is so important in modern high tech product development that it is worth acknowledging in strategy. Investments in functional communication, both planning and follow up, must be made at project, product development and organizational levels.

The limitations of this study include a limited number of companies and projects analyzed. Even though this study included individuals from numerous different cultures, the sample may be narrow from the viewpoint of company origin. Potential topics for further study, aside addressing the above mentioned limitations, include identifying best practices for systematic follow up of perceived communication and supplier involvement.

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APPENDIX 1

Table 3. Case projects.

	▪ type of contract ▪ technologies ▪ uniqueness	Size: ▪ duration in years ▪ size in man-years ▪ persons involved	Complexity: ▪ cultures ▪ network ▪ locations ▪ personnel
A	▪ own product ▪ SW ▪ typical program to the organization: although the end product has unique features it is improvement version of an existing product	▪ 2 ▪ 150 ▪ 270	▪ multicultural project environment ▪ many companies (subcontractors) involved ▪ personnel in many locations in Finland and internationally ▪ most are working also for other projects at the same time
B	▪ organization is operating as a subcontractor ▪ typical project to the organization: unique end product ▪ electro-mechanics, HW	▪ 2 ▪ 20 ▪ 26	▪ all personnel are Finnish ▪ project has subcontractors ▪ personnel in one location in Finland ▪ some of the personnel are working also for other projects at the same time
C	▪ the case company has two kinds of business areas: project business (e.g. the case C project) and product business ▪ typical to the business unit: the end product is unique but based on customer specifications ▪ SW	▪ 0,5 ▪ 5 ▪ 15	▪ multicultural project environment ▪ project has no subcontractors, the project itself is a part of larger R&D project by the customer ▪ two: one location in Finland and one elsewhere in Europe ▪ personnel is working only for the case project
D	▪ own products ▪ typical project to the organization: although the end product has unique features it is improvement version of an existing product ▪ electronics, mechanics, software	▪ 1 ▪ 0,5 ▪ 20	▪ multicultural project environment ▪ project has subcontractors ▪ four: two in Finland, one in elsewhere in Europe and one in Asia ▪ some of the personnel are working also for other projects at the same time
E	▪ own products, although sometimes the are some customer specific specifications ▪ typical project to the organization: the end product in totally new but utilizes earlier development results ▪ mechanics, HW, RF, SW	▪ 1 ▪ 50 ▪ 130	▪ multicultural project environment ▪ project has both internal and external subcontractors ▪ most persons in one place in Finland ▪ most are working also for other projects at the same time

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PROJECT MANAGEMENT PRACTICES AND INNOVATION CAPABILITIES: A CONCEPTUAL FRAMEWORK AND RESEARCH PROPOSITIONS

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ABSTRACT

In recent years, the shorter product life cycle, rapid changes in customer need and product technology have caused sever market competition. There is an obvious neglect through the project management practices. The project management is emphasized in the process and the integration of the existing knowledge, as well as the application into products, processes, procedures, and routines. These would help concretize in developing new products, technology, and services, and then could enhance the innovation capability of organization. The present study integrated the existing literatures on project management and innovation to construct conceptual framework and research propositions of the relationships between project management practices and innovation capabilities. The study concludes that different dimensions of project management practices improve specific types of innovation capabilities.

Keywords: Project management practices, Innovation Capabilities.

INTRODUCTION

In recent years, the shorter product life cycle, rapid changes in customer need and product technology have caused sever market competition. Innovation is considered as an imperative for firms to sustain competitive advantage. In an era of rapidly changing technology and highly unpredictable markets, manufacturers must enhance their innovation capabilities to satisfy market demands and customer preferences in order to maintain a long-term competitive advantage (Panayides, 2006). Tidd et al. (1997) indicated that manufacturers possessing higher product and service innovation capabilities can earn twice the profits of those manufacturers without innovation. Given this, effective development of innovation capabilities to meet the demands of highly unpredictable competitive markets has become an important issue for manufacturing firms (Shane and Ulrich, 2004).

However, previous research about innovation capabilities has discussed the types of innovation capabilities or the effect of innovation capabilities to the performance of organization. There is not enough research discussing how to enhance innovation capabilities. Pertaining to the innovation management program, most emphasized the R&D department in point of R&D management program affecting the innovation capability. There is an obvious neglect through the project management practices. The project management is emphasized in

the process and the integration of the existing knowledge, as well as the application into products, processes, procedures, and routines. These would help concretize in developing new products, technology, and services, and then could enhance the innovation capability of organization. Unfortunately, there is no related research recently. Thus, for these reasons, the purpose of this study is to investigate the relationship between the project management practices and innovation capabilities.

The present study integrated the existing literatures on project management and innovation to construct conceptual framework and research propositions of the relationships between project management practices and innovation capabilities. The study concludes that different dimensions of project management practices improve specific types of innovation capabilities.

PRPJECT MANAGEMENT

Project management, including the tools, techniques, and knowledge-based practices applied to manage the creation of products and services, is becoming an increasingly accepted and applied discipline across industry sectors. The first sings of project management as a distinct field of practice were the network analysis and planning techniques, like PERT and CPM, that emerged in the 1950s for use on major projects in construction, engineering, defense, and aerospace industries (Kerzner, 1979; Morris, 1994; Stretton, 1994). According to the literatures of project management (as Table 1), we classify the dimensions of the project management practices as: Time Management, Cost Management, Quality Management, Team Management, and Risk Management.

Table 1 Dimensions of Project Management

	Isik, Arditi, Dikmen, and Birgonul (2009)	Anderson and Merna (2003)	Jaafari and Manivong (1998)	Pheng and Chuvessiriporn (1997)	Turner (2006)
Time	√	√	√		√
Cost	√	√	√	√	√
Quality	√		√	√	√
Team	√	√	√		√
Risk (Uncertainly)	√	√	√	√	
SCM	√		√		
Contract	√			√	
KM	√	√		√	
Safety and Healthy	√		√		
Need		√			
Process		√			
Environment		√			
Crisis		√			
Design		√			
Purchase		√			
Scope					√

INNOVATION CAPABILITY

Schumpeter (1912) first defines the innovation as new products, new methods of production and new markets and sources of supply. Daft (1982), Damanpour and Evan (1984) define innovation as the firm applies the idea or technology in organizational systems, policies, managerial activities, products, process, and services. Brown and Eisenhardt(1995) identified two major research streams on innovation. The first stream is defined an innovation as a technology strategy or management practice that a firm is using for the first time, whether or not other organizations or users have previously adopted it, or as a significant restructuring or improvement in a process (Nord and Tucker, 1987; Li and Atuahene-Gima, 2001). The second stream is defined an innovation as a new product that an organization has created for the market; it represents the commercialization of an invention (Myers and Marquis, 1969). New products, process, or services may take different forms, such as upgrades, modifications, and extensions of existing products or new to the firm, the market, or the world (Brentani, 2001; Li and Atuahene-Gima, 2001). Drucker (1995) defines innovation activities cover invention and commercialization. Betz (1993) suggest invention is creating new products and processes, and innovation is to introduce new proudcts, processes, and services into organazation or market. Afuah (1998) suggest that although innovation is introduced and

applied new products and processes, the important thing is to connect the innovation with market demands.

In general, innovation capability is classified by innovation degree and scope. Innovation degree is the level of comparing with the pass products, processes, and services. Dewar and Dutton(1986), Green et al.(1995), Griffin(1997), Veryzer(1998) and Wan et al.(2005) classify the dimensions of innovation degree as radical and incremental innovation: (1) radical innovation disrupts an existing technological trajectory (Dosi, 1982; Tushman and Anderson,1986; Herbig, 1994); (2) incremental innovation involves refining improving, and exploiting an existing technical trajectory (Hollander, 1965; Myers and Marquis, 1969; Green et al., 1995; Gatignon et al., 2002; Stieglitz and Heine, 2007). Innovation scope is the category of the innovation activities. The classify dimensions of innovation scope as technical and non-technological (Damanpour, 1991): (1) technical innovations include production innovation, process innovation, and service innovation (Daft, 1978; Damanpour and Evan, 1990; Herbig, 1994); (2) non-technical innovations include marketing innovation and managerial innovation (Kimberly and Evanisko, 1981). However, firms undertake both technological and non-technolgical innovations and all such innovations can lead to competitive advantage (Hyvarinen, 1990; AMC, 1995).

Thus, some scholars ignore the situation of technical or non-technical innovation to categorize the innovation capabilities. Weerawardena (2003) treats the issue of Innovation-based Competitive Strategy and suggests innovation as improving the product, process, management, and marketing systems to creating customer value. In other words, the innovation capabilities of the firm include: (1) Product Innovation: Improving existing products, or creating entirely new products; (2) Production Process Innovation: Introducing computer-based production applications, automated material-handling, or introducing manufacturing information systems; (3) Managerial/Administrative Innovation: Introducing computer-based administrative applications, developing new employee reward/training schemes, obtaining new financing sources, or introducing new departments or project teams; (4) Marketing Innovation: Introducing new pricing methods, new distribution methods, new sales approaches or leasing arrangements or entering a new market. Moore (2004) indicates the innovation capability in the market development life cycle will has eight kinds of types: (1) Disruptive Innovation: Gets a great deal of attention, particularly in the press, because markets appear as if from nowhere, creating massive new sources of wealth; (2) Application Innovation: Takes existing technologies into new markets to serve new purposes; (3) Product Innovation: Takes established offers in established markets to the next level; (4) Process Innovation: Makes processes for established offers in established markets more effective or efficient; (5) Experiential Innovation: Makes surface modifications that improve customers' experience of established products or processes; (6) Marketing Innovation: Improves customer-touching processes, be they marketing communications or consumer transactions; (7) Business Model Innovation: Reframes an established value proposition to the customer or a company's established role in the value chain or both; (8) Structural Innovation: Capitalizes on disruption to restructure industry relationships.

Base on our study purpose and above literatures, this study both discusses radical/incremental and technical/non-technical innovation. Besides, recently the importance of services to the global economy has grown steadily. The companies are constantly seeking to provide better

services, regardless of whether they are in a "pure" service business or in a manufacturing industry that must increasingly rely on its service operations for continued profitability (Berry et al., 2006). Besides, service is the interaction process of salespeople and customers, thus, it is a part of customers' experiences, and also a part of service innovation. So this study changes Moore's (2004) experiential innovation to service innovation, and defines innovation capabilities as compared with the main competitor, the innovation frequency of the firm in product, process, marketing, service, and management. Thus, we classify the dimensions of innovation capabilities as: (1)Product Innovation: the quantity and speed of interducing new products in market (Subrahmanya, 2005; Black, 1997) or improve existing the performance of products, and quality (Herbig, 1994); (2) Process Innovation: improve existing production processes or establish new production process (Black, 1997; Koberg et al., 2003); (3) Marketing Innovation: innovative practices in market research, pricing strategy, market segment, and advertisement promotion (Weerawardena, 2003; Vorhies and Harker, 2000); (4) Service Innovation: in order to increase customers' satisfaction, the innovative practices in after-sales service, and deal with customers' (Ray et al., 2004); (5) Managerial Innovation: the innovative practices in managerial level, such as organizational reengineering, job design, job process, and compensation system (Gopalakrishnan and Damanpour, 1997).

Table 2 Dimensions of Innovation

	Dewar and Dutton (1986)	Damanpour (1991)	Weerawardena (2003)	Drejer (2002)	Wang and Ahmed (2004)
Radical	√				
Incremental	√				
Management		√	√		
Technological		√		√	
Product		√	√		√
Process		√	√	√	√
Marketing			√		√
Strategy				√	
Organization				√	
Development				√	
Behavior					√

RESEARCH PROPOSITIONS

Best practices in project management may be described as optimum ways of performing work to achieve high performance (Loo, 2003). Numerous scholars believe that using project management practices in widely applying strategic and operational processes is an important element for survival and an imperative management issue for firms to advance innovation capability (Ramani and Kumar, 2008; Teasley et al. 2009). Teasley et al., (2009) demonstrated that collectivist teams have positive effects on innovation capability.

Based on the lectures about the fields of project management and innovation capability, we have designed the following propositions: we construct the conceptual framework of the relationship between project management practices and innovation capabilities shown in Figure 1.

P1: time management has a positive influence on innovation capability.
P2: cost management has a positive influence on innovation capability.
P3: quality management has a positive influence on innovation capability.
P4: team management has a positive influence on innovation capability.
P5: risk management has a positive influence on innovation capaibility.

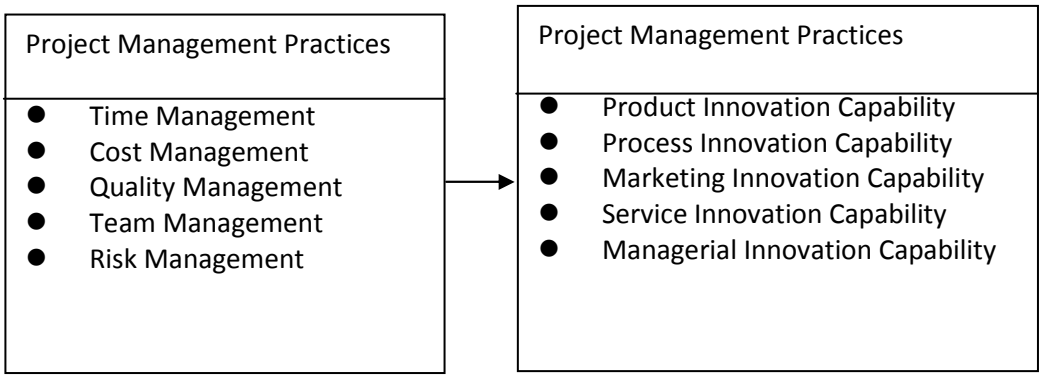

Figure 1 Conceptual Framework

CONCLUSION

Our study purpose is to explore the relationship between the project management practices and innovation capabilities. Based on the literature research and practitioner expert interviews, we construct the conceptual framework of the relationship between project management practices and innovation capabilities.

Based on our discussions, in terms of managerial theory contribution, we adapt the project management perspective to explore the research issues between the project management and innovation capabilities. Our study approach is different from past researches and provides another research direction. Regarding the managerial implication contribution, we construct the framework between the project management and innovation capabilities. Our framework could serve managers a strategic reference to elevate ad hoc innovation capabilities in terms of planning and obtainment of appropriate the practices of project management.

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DEVELOPING INFORMATION SYSTEMS (IS) PROCESS INNOVATION CAPABILITY IN ORGANIZATIONS

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ABSTRACT

This paper highlights the importance of Information Systems post adoption stage and proposes a conceptual model that investigates the relationship between Information Systems Maintenance and process innovation. Innovation literature from different research streams is integrated together to develop the model. The model highlights the enabling factors that influence business process innovation at the post adoption stage. The paper also highlights the academic and practitioner contributions and implications on the future research.

Keywords: Information Systems Innovation, Process Capability, dynamic capabilities

INTRODUCTION

Every year many organizations spend billions of dollars in the development, implementation, deployment and maintenance of Information Systems (IS). The major goals for this investment are to automate, reengineer, improve or support their business processes. This investment is made mainly in different parts of the organization so that each department in the organization can work in a more effective and efficient way. Some studies suggest that majority of the organizations hardly exploit the true potential of the Information Systems. The inability of these organizations for not realizing the value and not unleashing the true potential of these investments has significant implications in terms of cost (Davenport and Short 1990). Furthermore, senior management teams are continuously put under pressure to improve the process or product innovation capabilities of their organization to fully exploit the investment made in different parts of the organization.

A great deal of academic and practical attention has been devoted to studying process or product innovation in the literature; considerably less attention has been devoted to studying what and how these capabilities are formed within an organization. This paper assimilates knowledge from management and Information Systems (IS) literature to define what constitutes Information Systems process innovation and how companies develop this capability at an organization level. A theoretical model is proposed based on the dynamic capabilities literature. The research is guided with main research question that will explore how the activities at the post adoption stage influence process innovation in the organization context. The following section reviews the relevant literature from Information Systems and business perspective followed by discussion on the proposed research model

INFORMATION SYSTEMS MAINTENANCE

Information Systems maintenance (ISM) is defined as a process of refining the existing information systems to make sure it continues to meet business needs (Khan and Zheng 2005). Table 1 show that money required to maintain a system is increasing every year and will continue to rise. Erlikh(2000) predicts that the information systems maintenance and support costs will reach almost equal to the total cost of the system in the near future. Chapin et al. (2001) suggests that ISM involves complex activities, both of the "doing" and the "managing" character. Khan & Zheng (2005) further adds that there is a need for "defined formalism describing various tasks, tools and methods is required to enable a clear understanding of the IS evolution and maintenance activities".

Reference	Date	Maintenance (%)
Pressman	1970s	35-40
Leinz and Swanson	1976	60
Pigoski	1980-1984	55
Pressman	1980s	60
Schach	1987	67
Pigoski	1985-1989	75
Frazer	1990	80
Pigoski	1990s	90

Table 1: Evolution of maintenance cost (Polo, Piattini et al. 2003)

Even though post adoptive activities like maintenance and support are reported as the most expensive activities yet very limited research has been focused to examine this area. Normally student or entry level workers are hired to carry out maintenance and support work. The people who carry out this work do not enjoy the same level of organizational status as others. They are normally treated as "second class citizens". The reason for this is because normally very few incentives are attached with their work. There work is not well regarded and high staff turnover rate is common in organizations. To date, there have been few studies that explore the relationship between post adoption and innovation consequence. Following two sections review the innovation literature from Information Systems and business perspective followed by discussion on the proposed research model.

UNDERSTANDING POST ADOPTION STAGE

Earlier studies have looked at the post adoption stage from many different perspectives. Some notable examples from IS implementation literature include Model of IS continuance (Bhattacherjee 2001), incorporation (Kwon and Zmud 1987) and routinization (Cooper and Zmud 1990). These studies examined post adoptive behaviors at an individual level. Different terms like post adoption / acceptance / implementation are used interchangeably in the literature. Markus and Tanis used a process theory approach to divide the enterprise system's pre adoption and post adoption experience lifecycle into four phases (Markus and Tanis

2000). The process theory argues that sequences of events leads to certain output stage, following a set of process. These four phases are shown in the Figure 1:

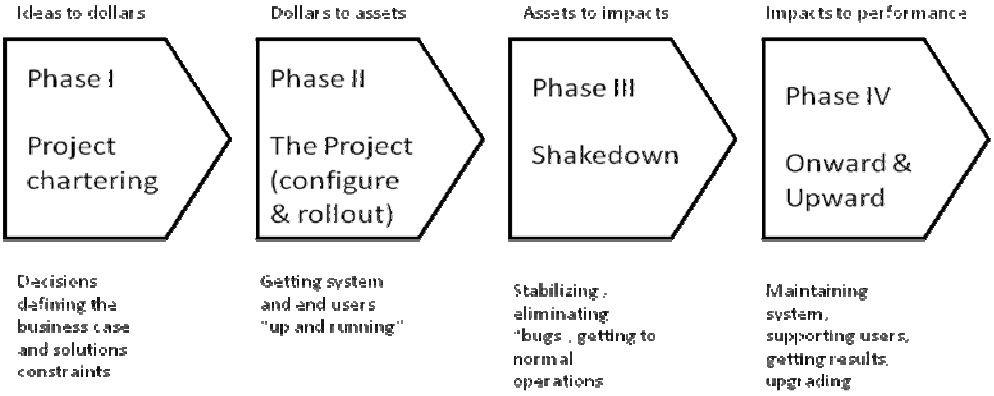

Figure 1: Enterprise System Experience Cycle(Markus and Tanis 2000)

The project chartering phase consists of the key decisions leading to funding of an enterprise system. Key players in this stage include company executives, vendors, consultants, and IT specialists. Key activities include the initiation and the development an idea and search for project champions. Additional activities include identification and selection of project partner, software and project scheduling and planning. In the project configure and rollout phase, all the activities are focused towards making the system up and running in different organization units. Key players include the project team members from different organization units, project managers, vendors, IT specialist and consultants. The partners that are selected in the implementation of the project work closely with the project team to ensure the project achieves the organizational goal of enterprise systems implementation. Key activities include software installation and configuration, system integration and testing, training, data conversion, and rollout. The shakedown phase refers to stabilizing state when the system goes live and normal operation or "routine use" has been achieved. Key activities include errors or bug fixing, fine tune the system, retrain additional staff members, and increase the staffing to handle the normal or temporary inefficiencies. In this phase, inefficiencies are realized that reduce the productivity and cause for business disruption (Markus and Tanis 2000). Effective monitoring and timely adjustment is required to ensure normal operations of the system.

The onward and upward phase continues from normal operation until the enterprise system is replaced with an improved, upgraded or a completely different and new system. This is the stage when organization discovers the true benefit of enterprise system investment. Key players include the end users, IT support personnel, operational managers. Internal and external consultants and vendors may be also involved if upgrades are considered. Key activities include the post implementation audits, benefit assessment, upgrading to new software releases, and additional user skill building. The phases identified in the Markus and Tanis's (2000) enterprise life cycle model are aligned with the stages of the traditional systems development lifecycle (Nah, Lau et al. 2001). For the purpose of this study, we consider the post adoption stage as the same as the onward and upward phase.

INNOVATION

Existing research in the area of innovation shows us that the organizations that innovate outperform their competitors in short and long term (Hammer 1994). In order to understand the concept of innovation, it is first important to differentiate between invention and innovation. There are many different definitions provided by several authors. Jacob Schmookler explained (Schmookler 1966) invention as "Every invention is (a) a new combination of (b) pre-existing knowledge which (c) satisfies some want" where as Peter F. Drucker defines innovation (Drucker 1973):*"They [organizations] know that innovation is not science or technology, but value. They know that it is not something that takes place within the organization but a change outside. The measure of innovation is the impact on the environment. Innovation in a business enterprise must therefore always be market-focused"*.

Categories of Innovation

There are five different categories of innovation(Gaynor 2001) as identified by previous research. Following section explains the each category:

Incremental innovation: This relates to minor enhancement or refinement made to the existing tasks, routines, products or services. This is usually being done based on the knowledge learned over the time.
Discontinuous innovation: This relates to introducing a completely new product or service which has never been introduced to market/customer. It is believed by some researchers that incremental innovation leads to discontinuous innovation.
Architectural innovation: In 1990, Henderson and Clark define architectural innovation(Henderson and Clark 1990) as "… change the way in which the components of a product are linked together, while leaving the core design concepts (and thus the basic knowledge underlying the components"
In other words, architectural innovation reconfigures different components into new architecture to achieve better system performance. They further claim that this innovation "destroys the usefulness of [the non-innovator's] architectural knowledge, but preserves the usefulness of its knowledge about the product's components"
System Innovation: This innovation takes many years to complete. In this innovation, input in the form of ideas or resources are required to create new function by uniting different parts in new ways. The use of automobile engines for two-wheelers is a perfect example of system innovation.
Radical Innovation: This relates to the introduction of new products or services that result in the creation of major business or unit. Radical innovation is often get confused with an incremental innovation. An incremental innovation is introduced based on the existing knowledge and resources within a certain firm. An incremental innovation helps in enhancing the competence of certain firm. On the other hand, a radical innovation requires an introduction of completely new knowledge/resources within a certain firm. A radical innovation may destroy the competence of the organization. Another major difference between incremental and radical innovation involve the level of technology changes and market competiveness. An incremental innovation involves small technological changes and hence existing products can remain competitive while a radical innovation involves large technological change and hence existing product may become obsolete and non-competitive.

The goal for this research is to study the incremental process innovation because this type of innovation deepens the relationship with the existing customer instead of focusing on acquiring new ones. The assumption behind this type of innovation is that no extra effort is required to establish the relationship between customers. On the contrary, product innovations require significant effort to first establish a relationship between new customers.

Information Systems and Innovation Types

Swanson argued that the "overall domain of IS innovation may be mapped on two basic dimensions: 1) business impact and 2) technological and organizational feature composition" (Swanson 1994). He identified three types of innovation based on the dual-core model (technical vs administrative) of organization innovation extended it to tri-core model of IS innovation. Following table summarize the type of IS innovation types identified in this study:

Innovation Types	Description
Type Ia	IS Administrative Process-Innovation
Type Ib	IS Technological Process-Innovation
Type II	IS Product and Business Administrative Process-Innovation
Type IIIa	IS Product and Business Technological Process-Innovation
Type IIIb	IS Product and Business Product Innovation
Type IIIc	IS Product and Business Integration Innovation

Table 2: IS Innovation Types (Swanson, 1994, p. 1076)

Type I can be defined as a process innovation that enhances the efficiency or effectiveness of Information Systems. Few examples include the usage of relational database or object oriented technologies in the company. Swanson suggested that Type I has a potential to support other business innovations in the company but in a "weak-order effects; they may support but they do don't compel innovation elsewhere" (p.1077). Another example of Type I innovation is software maintenance which is likely to have effects beyond the boundary of the Information Systems unit. Type II innovation contributes in the enhancement of the administrative work processes of an organization. Few examples include payroll systems, office productivity software and decision support systems. The main focus of this type of innovation is towards enhancement of administrative tasks and activities. Type III innovation involves integration of IS products and services with organization's core technology. This type of innovation enables firms to gain competitive advantage. An example of Type III innovation includes the usage of technology systems like Enterprise Resource Planning (ERP) systems in the organization.

Swanson's innovation classification was further extended by Erja and Kalle. Their model (Mustonen-Ollila and Lyytinen 2004)suggests that ISPI can be further subdivided to two categories (as shown Figure 1)

Information Systems Process Innovation	
Administrative Innovations	*Technological Innovations*
Management Innovations (M) Description Innovations (D)	Tool Innovations (TO) Core Technology Innovations (T)

Table 3: ISPI categories (Mustonen-Ollila & Lyytinen, 2004)

Management innovations (M) deal with bringing changes in the administrative processes that deal with the overall IS development activities. The result of this change can bring improved project management guidelines or new organizational structure. Description innovations (D) deals with bringing changes in the notational systems that can be used for effective communication between different stakeholders of the project. Few examples include the usage of standardize notational techniques like Data flow diagram (DFD) or Unified Modelling Language (UML) in Information Systems development projects. Tool innovations (TO) deal with the adoption of the technology tools to support IS processes. Core Technology (T) innovations deal with bringing improvements in the overall technical infrastructure that is required to deliver IS products. Few examples include the usage of programming language and database management system in the organization.

Following sub section reviews the existing literature on business process innovation and describes the innovation enabling constructs selected for this research.

Business process innovation

Business process innovation is a type of innovation that focuses on extracting waste not from product or service but from the enabling processes that produce it (Moore 2008). The goal for this type of innovation is to remove the no value-adding steps from the workflow. Dell's direct-retail is a typical example of process innovation. The concept of process innovation has been looked from different perspectives including and not limited to Resource Based View (RBV).

In this study, we are concerned with how the post adoptive activities like ISM & support bring process innovation related to technological changes in the organization. Mustonen-Ollila and Lyytinen (2004) classify technological innovation in to Tool innovations (TO) and Core Technology Innovations (T). Both TO and T are part of process innovation as shown in Table 3. The focus of this study is to examine how the ISM activities bring incremental technical innovation in the organization. Incremental innovation relates to enhancement or refinement made to the existing tasks, routines, processes, products or services Administrative changes like structural or notational changes are not focus of this study.

This study extends the incremental technical innovation literature by examining the effect of Information Systems Maintenance on this type of innovation within an organization context. Madanmohan (2005) explains that these innovations are "construed as refinements and improvisations to existing technology based on an established foundation of technical knowledge". In the IS literature, technological innovation is classified into Tool innovations (TO) and Core Technology Innovations (T) (Mustonen-Ollila & Lyytinen, 2004). We believe that these two incremental technological innovations are different in terms of their inputs, source and investment. This study assimilates previous research on RBV and process innovation to identify key literature to be included in this research. Table 4 shows the list of innovation-enabling IS competencies, activities and roles with supporting literature.

Source	Innovation-enabling Competencies
Tarafdar & Gordon (2007)	Knowledge Management Collaboration Project Management Ambidexterity IT/innovation governance Business IS Linkage Process Modelling
Marjanovic (2005)	Knowledge Management Coordination
Ravichandran and Lertwongsatien (2005)	IS planning sophistication System Development Capability IS support maturity IS operations capability
Bhatt and Grover (2005)	IT Infrastructure IT business experience Relationship infrastructure
Attaran (2003)	Infrastructure flexibility Communication Coordination Project Management Process Analysis

Table4: Innovation-Enabling Constructs

RESEARCH MODEL

Three steps process is used to identify the innovation-enabling constructs mentioned in Table 4. First step involves identification and selection of innovation-enabling constructs from business literature. For example, the term "coordination" is expected to have an influence on the process innovation. Several studies including (Marjanovic, 2005; Attaran, 2003) identified coordination as an innovation enabling construct. Based on the extent literature, it is proposed that "inter functional coordination" as innovation-enabling construct for this study. Second step involves critical review of the available competencies, activities and roles and identify only those constructs that positively affect business process innovation. This step further reduces the number of innovation enabling construct to only those which contribute in the successful innovation outcome. Third step involves the further reducing down the innovation enabling construct to those that are affected by post adoptive activities. For example, empirical evidence shows us that organizational learning is improved based on the knowledge gained in the post adoption support activities.

Based on the above discussion, the research model is proposed as shown in Figure 2. Four factors that affect the business process innovation are identified based on the literature.

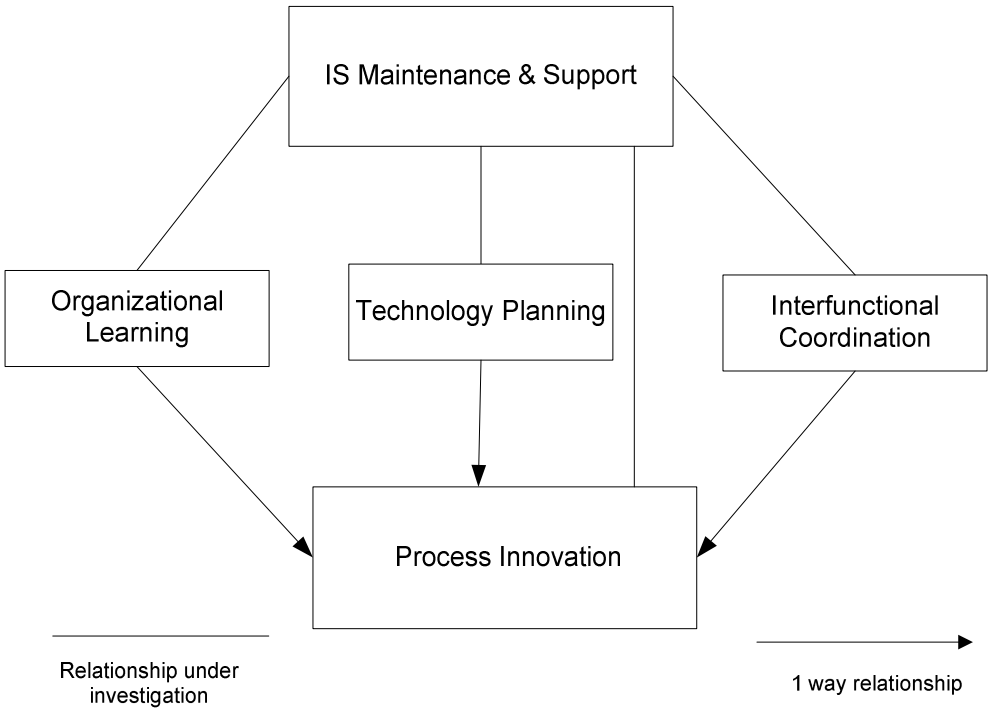

Figure 2: Proposed Research Model

Organizational Learning

Organization learning (OL) is an area of study that studies models and theories about the way an organization learns and adapts. Takeuchi and Nonaka (1995) argued that OL development is based on the well structured knowledge. Garratt (1990) suggested that organization learning capabilities are required to support and satisfy customer demands. He further added that well Knowledge management (KM) processes should be in place to develop organization learning capabilities. The ability of an organization to develop personal and group learning abilities depends on KM (Garratt 1990; Su, Huang et al. 2004). Furthermore, Pilar et al. (2005) argued that Knowledge acquisition and creation along with Knowledge dissemination and integration within the organization has become the key strategic resource to OL. For the purpose of this study, we propose that the knowledge gained at the post adoption stage directly influence the OL capability of an organization, thus we propose that IS maintenance and support will influence the organization learning and it will then direct impact on process innovation.

Technology Planning

Cusumon and Elenkov (1994) suggested that firms ability to develop incremental innovation depends on their technical capabilities. These technical capabilities are developed when serious attention is given to the technological planning phase. Furthermore, technological development and quality literature suggest that technology planning plays an important role towards building technological innovation (Garvin 1988; Panizzolo 1998; Song and Montoya-Weiss 1998).

Inter functional Coordination

Wheelwright and Clark (1992) identified that interface management is required to achieve successful technology innovation. Interface management (IM) is defined as "managing the problems that often occur among people, departments, and disciplines rather than within the team. Examples of IM include the improvement of quality of physical connections between building components, the reduction of project conflicts among project participants through planning and close coordination, and the optimization of work place organization including people, resources, and environment" (Wideman 2002). Several studies suggest that increased inter-functional coordination improve the management process and reduce the information asymmetry. Grinstein (2008) argued that increased inter-functional coordination is one of the critical factors for achieving process innovation

DISCUSSION

The aim of this research is to explore four relationship represented by a line in the Figure 2. These relationships are identified based on the review of the existing literature. One way relationships are represented by an arrow in Figure 2. Three relationships are identified based on the empirical evidence drawn from Mandanmohan (2005), Panizzlo (1998) and Grinstien (2008) which indicate that Organizational learning , Technology planning and Inter functional coordination positively influence business process innovation. These relationships will be re-examined again in the context of this study.

In Figure 2, a solid line is used to represent the relationship that will be investigated in this research. Four relationships are identified based on the following premises:
First relationship will examine the link between organizational learning and IS maintenance & support. Second relationship will examine the link between technology planning and IS maintenance and support. Technology planning plays an important role at the IS development stage (Panizzolo, 1998). We predict that IS maintenance and support will be influenced when serious attention is given to technological planning phase. Third proposed relationship will examine the link between inter functional coordination and IS maintenance and support. It is important to test this link because at the post adoption phase, the essence of IS maintenance and support work is to manage dependencies and provide solution to carry out activities in better way. Fourth proposed relationship will examine the link between IS maintenance & support and business process innovation. It is important to examine this link because informed and intelligent decisions are only made possible when proper data maintenance protocols are in place. The whole chain from data to intelligent decision making will be broken if data is not properly maintained.

CONTRIBUTIONS

This research will add theoretical value to the existing literature in the field of information systems by establishing a theory that explains the relationship between post adoptive and innovation consequence. It also extends the Post-adoption literature by introducing the role of Information Systems Maintenance and support in it. The proposed model can be used to further develop theories in IS product or services innovation.

Industry practitioner will also benefit from this study. This study will help them better understand the value of maintenance and support operations and the innovation it can bring in the organization. This study would enable practitioner to revise their current policy regarding maintenance work and motivate and reward employees who take part in the maintenance work.

CONCLUSION

In this study, we propose that maintenance and support operations may contribute to the business innovation. Three innovation enabling constructs were identified based on the extensive literature review. The proposed research model is an attempt to address an issue raised in the recent Gartner survey (Gartner 2009) that asks for finding ways to bring improvement in the overall business processes. This study may be used to build a theoretical model to further study the post adoption related studies at an individual or organization level.

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TO FORMULATE THE INNOVATIVE MARKETING STRATEGIES FOR EXPORTING AGRICULTURAL PRODUCTS – CASE STUDY OF "SHIE RICE" IN TAICHUNG CITY, TAIWAN, ROC

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ABSTRACT

After Taiwan joined WTO, we imported many low-price agricultural products from other countries. It satisfied the domestic demand, urged the agriculture being more exquisitely, and also raised the production quality of agriculture products in Taiwan. With the accumulating experiences and improving techniques, the cost of production decreased gradually. It makes these high-quality, high-value, domestic agriculture products have export potential.

This case takes the strategies of exporting agricultural products of Taichung in Taiwan for example. Taichung city has it's own harbors, and it is close to Taoyuan International Airport. It has great geographical conditions in exporting. As the agricultural technology is progressing constantly in recent years, it is able to export agricultural products with high technique of epidemic prevention and freshness maintenance. These advanced technologies are beneficial to transport agricultural products to farther countries. It takes advantages of export extremely.

Although Taichung has so many strength of export, the situation was not very effective in the past because the traditional exportation method of Taichung is "Try & Error". It means that we always export our agricultural products by luck and experience before. The innovative point of this paper is talking about how we segment the target market and formulate marketing strategies to export these products to international markets for achieving the goal of gaining the high foreign exchange by exquisite agriculture.

Keywords: Marketing strategies, agricultural products, Shie rice

INTRODUCTION

General outline

This case study is divided into the three following parts for introducing "Shie Rice", selecting the export target market and consumption groups, and analyzing the marketing strategies:

1. The choice of agricultural product for exporting:
First of all, we introduce the "Shie Rice"(the First-Class Cabin Package Gift). Providing the information and the reason why we choose it for exporting at the beginning of this case.

2. The selection of target markets and customers for exporting the agricultural product
After finding out the export product, we represent what export target markets we choose, and explain why we choose these target markets for exporting “Shie Rice”. Then, we analyze the environment and potential of these markets. Furthermore, make the segmentation for the consumer groups in the markets.

3. The export strategy and counterplot of the agricultural products in Taichung city:
The research selects Shie Rice as subject produce, and discusses the developmental goal and marketing strategy in target markets. Based on the 4P viewpoints in marketing, we table an innovative proposal as the new marketing strategies for exporting agricultural products.

The contribution of this paper is to demonstrate how marketing techniques can be used to formulate the exporting strategies for agricultural products. It must have more economic effect and less risk for exportation then before.

The choice of agricultural product for exporting - "Shie Rice"

The main produce of Farmers’ Association of Taichung City includes rice, bamboo shoots, sponge gourd, rough pearl barley, sweet potato, Wen-Shin Orchid, Soapberry, and citrus, etc. The rice has more value, and global markets have already had abundant perception for this agricultural products without feeling unfamiliar to them, and resisted the imports of these products to their countries. That is why we choose “Shie Rice” (the First-Class Cabin Package Gift) as research subjects. And it also generates high additional value from processing and packing, so it has great potential of development.

"Shie Rice" uses a new brand marketing concept from Taiwan. The traditional concept of selling rice regards it's quantity only. The scale economy makes the price of rice decrease with the quantity rise. It takes influence on the total profit that suppliers can't get the deserved income for their hard work. So the "Shie Rice" appears. It provides the fresh marketing notion of regarding quality of selling products and making use of the custom of giving presents.

"Shie Rice" uses the well-designed package with high quality rice to raise the value of original agriculture product. It not only increases the profitability of exporting, but gains consumers' desire for purchasing. The position of "Shie Rice" is the gift for Chinese festivals. "Shie Rice" provides foreigners and overseas Chinese a new choice for sending different mind to another people. That's the primary reason that this paper chose "Shie Rice" as research target for exporting representation.

The selection of target markets and customers for exporting “Shie Rice”

This part is divided into three statements:
(1) The criteria of choosing transactional target markets.

(2) The choice of target markets for "Shie Rice"
(3) The analysis of these target markets
First of all, we look for the criteria of selecting a target market, then use these chosen criteria to find out the different target markets for "Shie Rice", and analyze these target markets in the end.

(1)The criteria of choosing transactional target markets
In order to select target markets for agricultural products exportation, this research uses keyword search for academic journals to determine target markets in electronic databases (SDOS, ABI) available through the website of Chung Hsing University library. And then, we excerpt these factors for choosing target markets. In the end, we found 5 journals and 28 factors (see Table 2-1).

Table 2-1 The criteria of choosing transnational target markets

Source	Considered Factors	Explanation
Douglas, Craig, & Keegan, 1982	The channels distribution	The state of target market: product channel distribution - intensively, non-intensively etc.
Young, Hamill, Wheeler, & Davies, 1989	The markets enter and operate control cost	The cost to enter target market , get the local channels, control the local market etc.
Woodward & Rolfe, 1993	The degree of retrieving interests	The profit which earned at the target nation market and could shift to the parent company's country market
Cook & Hebner ,1993	International status	The position of prestige, financial affairs in the target nation market.
	Credit limit	Debt-credit ability of the target country
Bradley, 1995	Economic development	GDP, education level, national salary level, inflation rate, etc. of target country
Diamantopoulos & Cadogan, 1996	The assistance from public source in target market	The aid from the government or enterprise at the target market
Narula & Dunning, 2000	Market scale	The quantity of population and consumers at the target market
	Market growth ability in the future	Whether the products sales volume in the market can raise up
	Government restriction and policy	Whether the target country's government have any import policies for helping the coordination and finance
	Political stability	The stability of political system, political degree of freedom and present situation of the target country
Robertson & Wood, 2001	Diplomatic relations	The relationship and diplomatic policies of the target country
	Cultural difference	The different degree of acceptation from different ethnicities
Cadogan & Paul, 2001	Sales experience	Whether have sold the relevant or similar products at this market
	Motive force of target market	The positivity or passivity of essential willing of buying products in target market
	Intensity of local competition	Whether the export products have competitive advantages, compared to

		the similar local products
Papadopoulos, Hongbin Chen & Thomas, 2001	Obvious demand (consumption)	Whether the importation and the target market's demand rely on the type of products
	Penetration of importation	The accessibility of import and the index of competition in target market
	Primitive advantage	Whether the other exporting countries share the relevant information about their imports to the target country
	Similar degree of market	The degree of similarity about the view between new products and other similar products
	Limit of tariff	The tax for exportation
	Limit of non-tariff	If there is no tax charged on the exporting country, the competition will become harder
	Limit of foreign exchange rate	The currency rate of the target country
	Distance cost	The cost of distance limits transportation of products
Zhao & Levary ,2002	The index of national boom	The willing of consumers spend money in target market
	Infrastructure and the technology development	The development of infrastructure, IT, and logistics of the country
Philip Kotler & K.L. Keller, 2002	Entering barrier	The obstacle of entering a new market
	Exportation conversion cost	Maintenance of the products and communication, and adaptation cost

Because this exportation research is funded by the Agricultural Policy Unit of Taichung City, we have to eliminate the consideration factors of political influence factors, non-agricultural products influence factors, and money raising factors (see Table 2-2):

Table 2-2 The form of factors eliminatation

Resource	Considered Factors	Reason to delete the factors
Woodward & Rolfe, 1993	The degree of retrieving interests	Influence by politics
Cook & Hebner ,1993	International status	
Narula & Dunning, 2000	Political stability	
Robertson & Wood, 2001	Diplomatic relations	
Papadopoulos, Hongbin Chen & Thomas, 2001	Primitive advantage	Influence of the non-agricultural goods factors
	Similar degree of market	
Cook & Hebner ,1993	Credit limit	Capital collection

After eliminating the inadequate consideration factors, we excerpt the following factors (see Table 2-3). Furthermore, we sum up these factors to 6 choosing criteria of target markets of agricultural products as the following: Environmental consideration, Location advantage, Potential demand, Competition advantage, Trade barrier and Cost efficiency：

Table 2-3 The form of agricultural products target market choosing criterion

Resource	Considered Factor	Explanation	Criterion
Robertson & Wood, 2001	Cultural difference	The different degree of acceptation from different ethnicities	Environmental consideration
Bradley, 1995	Economic development	GDP, education level, national salary level, inflation rate, etc. of target country	
Zhao & Levary, 2002	Infrastructure and the technology development	The development of infrastructure, IT, and logistics of the country	
Narula & Dunning, 2000	Market scale	The quantity of population and consumers at the target market	Location advantage
	Market growth ability in the future	Whether the products sales volume in the market can raise up	
	Government restriction and policy	Whether the target country's government have any import policies for helping the coordination and finance	
Papadopoulos, Hongbin Chen & Thomas, 2001	Obvious demand (consumption)	Whether the importation and the target market's demand rely on the type of products	Potential demand
	Penetration of importation	The accessibility of import and the index of competition in target market	
Zhao & Levary, 2002	The index of national boom	The willing of consumers spend money in target market	
Cadogan & Paul, 2001	Sales experience	Whether have sold the relevant or similar products at this market	Competition advantage
	Motive force of target market	The positivity or passivity of essential willing of buying products in target market	
	Intensity of local competition	Whether the export products have competitive advantages, compared to the similar local products	
Diamantopoulos & Cadogan, 1996	The assistance from public source in target market	The aid from the government or enterprise at the target market	
Papadopoulos, Hongbin Chen & Thomas, 2001	Limit of tariff	The tax for exportation	Trade barrier and
	Limit of non-tariff	If there is no tax charged on the exporting country, the competition will become harder	
	Limit of foreign exchange rate	The currency rate of the target country	
Philip Kotler & K.L. Keller, 2002	Entering barrier	The obstacle of entering a new market	
Young, Hamill, Wheeler, & Davies, 1989	The markets enter and operate control cost	The cost to enter target market , get the local channels, control the local market etc.	Cost efficiency
Philip Kotler & K.L. Keller, 2002	Exportation conversion cost	Maintenance of the products and communication, and adaptation cost	
Douglas, Craig, & Keegan,	The channels	The state of target market:	

1982	distribution	product channel distribution - intensively, non-intensively etc.	
Papadopoulos, Hongbin Chen & Thomas, 2001	Distance cost	The cost of distance limits transportation of products	

From the considered factors above, we are aware of the composition and standard of 6 criteria, thus in order to judge a given target market. The 6 criteria are as follows: 1. "excellent" environment consideration, 2. "excellent" position advantage, 3. "large" potential demand, 4. "great" competition advantage, 5. "small" trade barrier and 6. "high" cost efficiency. Then we explain the meaning of each criterion as following:

1. Environmental consideration:
This criterion composes of cultural difference, economic development, and infrastructure and the technology development. The advantage and disadvantage of the criterion is based on the compatibility of culture and product, the level of economic development, the advances of infrastructure and the development and application of technology of target markets. The advantage of this criterion represents high compatibility of culture and product, highly-developed economy, advanced infrastructure and highly-developed and applied technology.

2. Location advantage:
This criterion composes of market scale, market growth ability in the future, and government restriction and policy. The advantage and disadvantage of the criterion is based on the scale of the market, future potential of the market, and severity of government restriction and policy. The advantage of this criterion represents great scale of target markets, high growth potential of target markets, and loose governmental restrictions of imported goods.

3. Potential demand:
This criterion composes of obvious demand (consumption), penetration of importation, and the index of national prosperity. The advantage and disadvantage of the criterion is based on the degree of demand of products, degree of openness of target markets, and the desire of consumption. The advantage of this criterion represents high demand of products, high degree of openness of target markets and great desire of consumption.

4. Competition advantage:
This criterion composes of past marketing experience, consumer motive force of target markets, the intensity of local competition and market assistance of target markets. The advantage and disadvantage of the criterion is based on the prior experience of local marketing, consumer willingness, competitiveness and market assistance in target markets. The advantage of this criterion represents substantial prior experience, high consumer voluntariness, high competitiveness and local government or enterprise assistance in target markets.

5. Trade barrier:
This criterion composes of limit of tariff, limit of non-tariff, limit of foreign exchange rate, and entering barrier. The advantage and disadvantage of the criterion is based on the percentage of tariff in target markets, the operation difficulty in non-tariff limit target markets, i.e., marketing competitiveness against tariff-free or low-tariff markets, and the ability to remove barriers of target markets. Whether exchange-rate difference influences

profit and whether the possibility of joint boycott of target markets exists also determine the advantage and disadvantage of this criterion. The advantage of this criterion represents low tariff of target markets, low operational difficulty in non-tariff markets, low exchange-rate difference and low possibility of joint boycott in target markets.

6. Cost efficiency:
This criterion composes of the cost of entering target markets and operation, the cost of exportation conversion, channels of distribution, and distance cost. The total cost of these 4 kinds of cost affects the advantage and disadvantage of this criterion. The advantage of this criterion represents low cost of entering target markets and operation, low cost of exportation conversion, wide ranges of channels of distribution and low distance cost.

(2) The choice of target markets for exporting "Shie Rice"

a. According to the statistic figures of UN member nations, by 2004, there are 193 sovereign nations, 61 non-independent regions, and 6 disputed regions in the globe. This research aims to select exportation target markets of Shie Rice, and apply the 6 criteria mentioned above to select form among 193 sovereign nations (that hold advantages in at least 4 of the 6 chosen criteria as following table 2-4):

Table 2-4 Outcome for selecting target markets for exporting "Shie Rice"

Criteria / Country		1."great" environ-mental consider-ation	2."great" location advantage	3."huge" potential demand	4."strong" competition advantage	5."less" trade barrier	6."high" cost efficiency
North-east Asia	Japan	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ
	S.Korea	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ
Asia	China	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ
South-east Asia	Singapore	ˇ	ˇ	ˇ	ˇ	ˇ	
	Thailand			ˇ	ˇ	ˇ	ˇ
	Malaysia	ˇ	ˇ	ˇ		ˇ	
	Indonesia	ˇ	ˇ	ˇ			ˇ
	Philippine			ˇ	ˇ	ˇ	ˇ
North America	Canada	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ
	U.S.A.	ˇ	ˇ	ˇ	ˇ	ˇ	ˇ
Oceania	Australia	ˇ	ˇ	ˇ		ˇ	

Note: "ˇ" mark represents that the country holds advantages in the chosen criterion

b. Weighted scores of target markets
Eleven nations are selected and weighted scores of these 6 criteria are calculated. High degree of compatibility of each criterion obtains 2 points (represented by ●); medium degree of compatibility of each criterion obtains 1 point (represented by ○); low degree of compatibility or non-compatible to each criterion obtains 0 point. The scores are calculated in order to search for an exportation target market for "Shie Rice" (see the Table 2-5):

Table 2-5 The weighting scoring form of "Shie Rice"

Criteria / Country		1."great" environ-mental consider-ation	2."great" location advantage	3."huge" potential demand	4."strong" competition advantage	5."less" trade barrier	6."high" cost efficiency	total
North-east Asia	Japan	●	●	●	●	●	●	12
	S.Korea	●	●	●	○	●	●	11
Asia	China	●	●	●	●	●	●	12
South-east Asia	Singapore	●	●	●	●	○		9
	Thailand			●	●	○	●	7
	Malaysia	●	●	●		●		8
	Indonesia	●	●	●			●	8
	Philippine			●	●	○	●	7
North America	Canada	●	○	●	●	○	●	10
	U.S.A.	●	○	●	●	○	●	10
Oceania	Australia	●	●	○		●		7

(3) The analysis and suggestion for exporting to target markets:
According to the result of the weighted scores(see the Table 2-4), we can find out the possible exporting market for "Shie Rice" (at least 10 points) are Japan (12 points), China (12 points), S.Korea (11 points), Canada (10 points), and America (10 points). Because the handling and processing time should be shortened, we use the "location advantage" criterion, the distance from Taichung to destination, to divide these markets into three parts : short-, midium-, and long-term target markets. We take long-term target markets for example, analyze the market entry time, market environment, market potential, and the segment of consumer groups as following:
The short-term target markets - Japan & S. Korea
The medium-term target market - China :

The long-term target markets (Canada & U.S.A.) -Take U.S.A. for example:

a. The analysis of the long-term market entry strategy:
(a)The distance of market is farther from the others, so we take longer time for planning.
(b)The main meal is Western-style in America. Most of American seldom or never eat the rice for meal, so it is necessary to have some guidance for cooking, For instance, putting the English cooking method in the package. So the exportation of U.S.A. markets must add the adaptation cost.
(c)The number of Chinese is just relatively high in America. It is unable to compare with those in China and Japan, but it still has enough potential market to develop, so the case takes it to be the long-term target market.
(d)Through the cultural exchanges, Americans can accept the eastern diet gradually. It has become another possibility of development.

b. The analysis of market environment:
The immigrant trend makes the market of North America more attentive. America is an international and economy powerful country, and it has high tolerant ability of different races, too. So many Chinese would like to immigrate and live there. This is the main reason that we choose it for the long-term target market. Whereas the export weakness of the market is the high transportation cost. So we have to use strategies to reduce the marketing cost, but still keep it's sales efficiency. With a small population in a large area, America has quite high rice production volume on their own, but Taiwan rice has greater taste and higher quality. So there is a exporting chance.

c. Market potential:
Through this research, asking the students who have studied abroad in the U.S., we realize that it is not an easy thing for the Chinese who live abroad to have rice for meals. Sometimes though they are able to eat it in the restaurants or as take-out in Chinatown, most of the rice is imported from Southern Asia, and there is a tremendous gap of the quality and the taste of rice between from Southern Asia and from Taiwan.

In such case, it usually trigger nostalgia, and this makes quite a few Chinese who live abroad regularly come back to Taiwan or China to have rice which they have been long for. As a consequence, in order to promote in this market, we can regard it as a starting point, targeting the Taiwanese students or businessmen abroad, capture the holiday time to make heavy promotions, targeting the gift market, and then appeal the main Chinese market by high fine reputation.

d. Market Segmentation
The target segments in the American market are:
(a) To give a gift to the Chinese students abroad who feel nostalgic about their home country.
(b) The Taiwanese businessmen who live in the U.S. for business
(c) The overseas Chinese who live abroad
(d) Those who want to abroad celebrate conventional Taiwanese customs
(e) Local dealers (e.g. apply EC or MIS systems to implement B2B to gift shops or wholesaler throughout the U.S.)

Marketing Strategies for Exporting of Taichung City Produce

Based on the 4P viewpoints in marketing, we propose the marketing strategies of the long-term target markets for example.

1. Shie Rice medium-term goal of target markets: Canada and U.S.A

American and Canadian markets are known as the melting pots of the world. They have the advantage on the criteria of highly economically developed, great locations, great potential demand and high cost efficiency. The number of Taiwanese and Chinese immigrants and students to the U.S. and Canada is stable, and the acceptance toward Asian cultures increases along with the number of Taiwanese and Chinese living in these two nations. For these target markets, the strategy adopted is product differentiation and focus strategy to enter them. Except for the demand of high-quality products, exquisite packaging, and special product characteristics (i.e. combining the traditional Chinese custom of giving present in return with special functions of the product), the demand of specific time and place (i.e. during the time of traditional Chinese holidays celebrated in Chinatown) or specific consumer group is also of great importance. For the targeted consumer groups, the classification of products is multi-tiered to attract different costumers in order to satisfy the need of multiethnic societies (see Table 3-1).

Table 3-1 Analysis of 4P strategies in U.S. and Canadian markets

Marketing Strategy	Content of strategy combination
Product Strategy	1. Construct high-quality image of Taichung Shie Rice (including the quality of rice and epidemic prevention procedures, etc.); target high-spending consumers 2. Multi-tiered packaging catering to different groups of consumers, such as Taiwanese businessmen in America, students abroad, Chinese Americans, etc. 3. Print recipe and healthy tips on the packaging 4. Design small and exquisite packaging for Shie Rice gift boxes
Price Strategy	1. Multi-tiered pricing: target different consumer groups and cater to their demand and suitable price 2. Discount pricing: offer and encourage early reservations, bulk purchases (quantity discount), early payment (cash discount)
Promotion Strategy	1. Hold agricultural fairs to promote the product 2. Make use of media (public report) and Internet to produce topics on Shie Rice; increase the availability of information of Shie Rice 3. Employ market segmentation; personal promotion to different consumer groups, such as American/Canadian Chinese and other ethnic groups in the U.S. and Canada. 4. Offer discounts on bulk purchase and group ordering in traditional Chinese holiday seasons
Place Strategy	1. Construct online shop; consumer can obtain the product by mail or by pick-up services 2. Market in cities where Chinese population concentrates

CONCLUSION

The exportation strategy of "Shie Rice" was set to use the high-quality with high-price for the main position. So we make different 4P strategies from the different markets. In order to rise up the quality and the image of the agricultural products in Taichung, make it and reach the difference from other products, improve the view that quality and foreign country sell agricultural products to Taichung. Besides the products and price, the other thing deserves to be mentioned is that the two agricultural products are both influenced by periodical factor. It is the best plan for selling them during the festivals time. "Shie Rice" can have more control the sales volume for maintaining the reserves, and match the marketing activities to sell in a large amount during the festival celebration. In addition, there are large amount of Taiwanese businessmen all around the world. Using the local businessmen from Taiwan to create a channel of exporting is a large place strategy. The strong and steady channel cooperate with positive marketing can create the huge and unpredictable profit.

On the whole, since the exportation agricultural products of Taichung are high-quality. So the main marketing strategy is to create the high-quality, high-price for building products image. It's differentiation strategy.

Because the promoting agricultural products are acceptable for general consumers, so to sell is not difficult. The difficulty is how to get the higher profit. The climate of Taichung is great for the growth of agricultural products. With the analysis of all target markets' demand, we make different marketing strategies to decrease the risk and difficulty of exporting. It is worth to try in the future.

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A STUDY OF AUSTRALIAN INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) INNOVATION MANAGEMENT AND THE I-CAN TOOL

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ABSTRACT

Australia, while being a large and eager consumer of innovative and cutting edge Information and Communication Technologies (ICT), continues to struggle to remain a leader in Technological Innovation. This paper has two main contributions to address certain aspects of this complex issue. The first being the current findings of an ongoing research project on Innovation Management in the Australian Information and Communication Technologies (ICT) sector. The major issues being considered by the project include: investigation of the possible inherent entrepreneurial nature of ICT; how to foster ICT innovation; and examination of the inherent difficulties currently found within the ICT industry of Australia in regards to supporting the development of innovative and creative ideas. The second major contribution is details of the I.-C.A.N. (Innovation by Collaborative Anonymous Networking) software application tool created and evolving in our research group. I-CAN, besides having a positive reinforcement acronym, is aimed at facilitating productive collaborative innovation in an Australian workplace. Such a work environment is frequently subjected to cultural influences such as the 'tall poppy syndrome' and 'negative' or 'unconstructive' peer-pressure. There influences are frequently seen as inhibitors to employee participation, entrepreneurship and innovation.

Keywords: Innovation Management, Knowledge Management, Information Privacy and Security

INTRODUCTION

The art of entrepreneurship has the potential to ignite creativity and innovation within the ICT industry. With the advent of the internet, increasing popularity of broadband and the introduction of Web 2.0 applications; the information age has become an opportunistic environment for entrepreneurs. The rapid evolution of technology in the last fifty years plays a significant role in our day to day lives. Information and communication technology (ICT) builds and supports the processes of organizations on a competitive global platform. The shift from the physical world to the virtual world is also a noticeable trend as an increasing number of everyday functions and processes are shifting to an electronic realm.

Traditionally, ICT entrepreneurship has been most successful and lucrative in the United States (US). Areas of Asia and Europe – particularly Scandinavia – have exhibited entrepreneurial flair but not to the quality and frequency of the US. There are a number of theories proposed as to why this may be the case; including the likes of resource availability, exposure to venture capitalists, working environments, education standards, market size, risk taking experience and business strategies. Despite suggestions of the lack of the above

elements retards innovation, there is no conclusive evidence as to why successful entrepreneurship and innovation cannot happen anywhere else in the world, such as a 'geographically remote' location like Australia.

The idea of combining the traditional business skills and traits of entrepreneurship within information technology innovation practice is a relatively new concept. Our research group has not been able to find any clear methodologies or templates that specifically aim to foster the process of creativity, innovation and entrepreneurship in the ICT realm. Therefore, the topic of this paper is twofold. First, is to detail to date an ongoing study that is investigating Information and Communication Technology (ICT) innovation. The main focus is placed on the issues found within Australia due to it being directly relevant to the research group's geographical location. The work has three major research questions, in addition to their related derived hypothesis, formulated to be addressed by the study. They are the following:

1) What constitutes successful ICT entrepreneurship?

Hypothesis 1.1: The traditional characteristics of entrepreneurship and the entrepreneurial traits of an entrepreneur will show to have a positive effect on ICT creativity and innovation.

Hypothesis 1.2: Focusing on the creative aspects of innovation will improve the success of entrepreneurial ventures in the field of information communication technology.

2) What sparks innovation in ICT?

Hypothesis 2.1: The majorities of innovations in the ICT industry are derived from previous innovations and in most cases will show to be an emulation of a physical-world process, product or practice as a digital-world representation.

Hypothesis 2.2: ICT innovation will be come through to fruition in at least one of the following three ways:

- via an intrinsic or extrinsic motivation;
- through technological evolution;
- personal financial gain and/or entrepreneurial opportunity

3) Is it possible to improve the frequency and consistency of ICT entrepreneurship in a positive manner within Australia?

Hypothesis 3.1: Formalizing the act of creativity and innovation in the development of new ideas and technologies will foster the quality and quantity of ICT entrepreneurship

Hypothesis 3.2: Incorporating an entrepreneurial attitude in the approach and creation of new ICT ideas will improve the process, frequency and consistency of ICT innovation

The second topic of this paper is detailing the I-CAN software application tool we have developed and continue to evolve in our research center. Our ongoing literature review and peer discussions has found little in the way of a software networking and collaboration application that fosters innovation while also being well suited for the Australian cultural working environment. The I-CAN, Innovation by Collaborative Anonymous Networking, tool has evolved from one of our earlier professionally tested applications called SOUP [1]. SOUP's motivation and inspiration came by identifying factors that facilitate innovation from

the available literature and our own research endeavors. That is, it was found innovation is more effective through collaboration [2,3,4], good knowledge management [5,6], and specifically in the ICT sector an employee having access to their enterprises internal knowledge base [7,8,9]. Further, as the tool was specifically aimed at Australian enterprises and work environments we were aware that we need to take into consideration the cultural influences on innovation. From experience and supported by the literature the design and operation of the tool needed cater for the issues of the 'tall poppy syndrome' (TPS) [10,11] and extensive peer pressure [12] prevalent in Australian organizations.

As technological innovation has been identified as a research priority for Australian academics, considerable efforts are underway in this field. A number of initiatives have recognized that ICT and other science related disciplines are particularly subject to TPS [12]. New Zealand shares many things in common with Australia, including a cultural affliction for TPS. A recent study [13] highlighted the problem entrepreneurs face in New Zealand with TPS and discussed methods to avoid it and its implications. All of the points were extremely valid for the Australian environment, and therefore our I-CAN tool has been designed to accommodate and manage this cultural nuisance to ensure innovation is not suppressed. Therefore, we felt our research could make a unique and useful contribution to this body of work by providing an ICT application for use in ICT innovation. In developing the software application many of the issues and possible solutions proposed in [14] have been taken into consideration. The key elements of I-CAN include its incorporation of collaboration and networking, knowledge management, and the ability for participants to remain anonymous if so desired to avoid being subjected to TPL and negative peer pressure. Full details of the I-CAN application tool are provided later in this paper.

The remainder of the paper is used to detail the work and results of the research to date. A best effort has been made to encompass a vast body of results and research in this paper in a limited space. Therefore, brief background and related works are detailed in the next section with discussion of the components of the project following after. Proceeding sections provide the research results and conjectures on what can be done to foster and manage ICT innovation in Australia along with details of the i-CAN tool. A conclusion and discussion of our ongoing and future work is provided to summarize the paper, which is followed by a list of references.

BACKGROUND AND RELATED WORK

The ICT evolution is heavily linked with the core concepts of creativity which enables new technologies to emerge. Gupta [15] introduced the idea of creative knowledge networks that have the capacity to "unfold tremendous creative energy of our society by helping people dream and converting these dreams into reality by networking with other individuals and institutions." Likewise, the importance of collaboration, for our focus digital or virtual collaboration, is identified as being a valued commodity for successful innovation [16]. The authors of [16] examine the i-Land environment which is an interactive landscape for creativity and innovation. The literature identifies the i-Land application environment and educational setting as a prime example of ICT creativity and the fostering of creativity to support ICT development. Essentially, the i-Land innovation has shown that creativity is an important part of ICT development and that the evolution and implementation of ICT also has

an equally significant impact on the creative aspects of information organization and in producing new innovative processes and ideas.
The literature [17] describes Internet entrepreneurship as a concept that uses a global network in order to capture the potentially worldwide distributed nature of innovation processes involving knowledge-intensive products in the modern economy. The phenomenon involves social and economic components and not just technology as IT, computers and the Internet. Furthermore, it states that the definition of "Internet entrepreneurship" has five main attributes:

1) That multiple persons are distributed organizationally and/or geographically but can still interact in real time to create novelty;
2) That one person can be both user and developer but s/he does not necessarily combine both roles;
3) That copying and distributing information may be costless or may be costly, depending on the situation;
4) That distributed persons contribute to innovation through the investment of their resources (time and effort – without necessarily being 'paid' for their labor);
5) The instantaneous worldwide distribution of software and communication over the internet, or World Wide Web enables an identifiably different process of knowledge creation from organization-based innovation.

Internet entrepreneurship exists as a modern phenomenon that functions as a new means of innovating and has shown to have a positive impact on the economy as it has led to a system of improvements with regard to the evolution of ICT. Open source software (OSS) has had an impact on traditional R&D processes and strategies of firms. It must be understood as an early stage of innovation with strong convergence toward commercialization [17]. It has been [18] identified that those who combine skills and creativity in Internet site creation, business know-how, access to finance and knowledge are successful ICT and Internet entrepreneurs and that the frequency of this act is still relatively rare worldwide.

There is overwhelming support that the era of the entrepreneur is coming of age and the literature [19] reveals that entrepreneurial opportunities in ICT are becoming more and more prominent as technology evolves. The technological challenges of today's evolving ICT/business environment can be pre-determined by conditions that shape social change; it has been [20] proposed that technology and organization co-evolve, and that this process is characterized by periods of social construction and periods of technological determinism. Empowering people and corporations to develop entrepreneurship has greater success when supported by correctly using together computing resources and existing knowledge. Further, access to architectural tools for business and business knowledge and understanding of the opportunities arising out of new ICT are two essential conditions for entrepreneurship development [18, 19].

According to Preston [20], students studying at the Massachusetts Institution of Technology (MIT) create roughly two new inventions every day. "MIT's Technology Licensing Office files four patents a week, licenses hundreds of inventions to industry each year, and creates ten to twenty new start-ups a year around these inventions" [20]. Some authors [21] suggest that the advent of the Internet has been a positive but "disruptive force" to the world's economies. For example, the arrival of wireless communications has revolutionized the

telecommunications industry with access and adoption rates growing exponentially. In reference to the last 50 years of technological advancement, ICT innovation goes hand in hand with the rate of its evolution. The Internet has redefined the boundaries of technological advancement and innovation and with it created levels of uncertainty that provide opportunities for natural innovators in every market of every industry.

Innovation in the ICT industry is evolving and formal ways of fostering technological advancement at all levels of operations are still in its early stages. Preston [20] suggests that success in innovation should be rewarded as positive reinforcement fosters future innovations and suppresses the stigma of failure. This is the major difference between successful innovation in the US and any other part of the world. Gupta [15] proposes the idea of knowledge networks in a bid to "connect grassroots innovators" which aims to help generate a "market for ideas which may network innovators, investors and entrepreneurs". Gupta [15] goes on to suggest that through the use of modern ICT devices such as "real time connectivity through data bases and multimedia technology across language and cultural boundaries may increase societal capacity to spur, spawn, stimulate and sustain grassroots innovations". Further, Bernstein, Klein & Malone [22] put forward that "online repository of knowledge" and the use of ICT to achieve this can greatly improve the effects of innovations and increase its frequency for future innovative endeavors.

The idea of an online repository of knowledge and this author's previous work on virtual collaborative environments [23,24] and digital ecosystem's [25,26] was the background motivation and foundation upon which the development of the initial SOUP [1], and now evolved I-CAN, software applications were formulated. Collaborative environments have been shown to provide an ideal digital platform for knowledge sharing and distribution [27], shared workspaces, and, from a potential innovation perspective, virtual brainstorming. Further, digital collaborative environments due to their very nature are ideal for collaboration between diverse geographically located [28], and therefore possibly culturally diverse, users. The author's extensive work on data security and information privacy in digital collaborative environments [29,30] provided a sound knowledge base for assuring the availability of anonymous and pseudo-anonymous interaction within a collaboration. In addition, the data collected and distributed in the collaborative environment is likewise protected by stringent security and privacy controls [31]. As a result, the author and associated research group were in a very good position to develop a tool and operating environment that facilitated user (employee) input and access to innovative ideas while having the ability to remain anonymous. As mentioned, the incorporation of a user's ability to remain anonymous was a defining and critical feature of any such tool developed for Australian enterprises and organizations. That is, anonymity was one method of alleviating employee hesitation and non-participation due to the possibility of being subjected to negative peer pressure and the tall poppy syndrome [12] if they were identifiable.

ANALYSIS OF LEADING ICT INNOVATIONS AND ENTREPRENEURS

An important component of our research to date involved the investigation and analysis of ten influential and widely-recognized innovations of the ICT industry. Each concept, product or venture was profiled by describing how the idea came about, what made the idea unique and how the innovation became so successful. The review incorporates the definition and use of a

success metric which aims to classify the origins of ICT innovation. The review contributed to knowledge on ICT entrepreneurship and particular trends that contribute to successful ICT innovation and creative idea generation. The objective of the investigation was an attempt to answer some of the following questions: What is a successful IT innovation?; How did the creators first come up with the idea?; and How did they then market and transform that idea into reality?

The following ten ICT 'products' were chosen for analysis: MySpace [32], YouTube [33], eBay [34], PayPal [35], Skype [36], Hotmail [37], Second Life [38], Apple [39], Expedia [40] and Facebook [41]. All of these ICT products have a prominent and successful standing being used by millions of entities every day. For many, these innovations make life easier, contribute to economic growth, provide entertainment and connect a globally diverse user entity base. Each of the products in their own right has delivered something unique in addition to representing successful examples of creativity, innovation and entrepreneurship in the ICT sector.

Our study aimed to examine common success traits of ICT innovation by studying what the product is, how it is unique and how it became successful. In addition, to provide important knowledge to the analysis the creators or founders of each product was also investigated. This included their background, experience and other personal characteristics. From these we developed a number of categories to use in a classification scheme and formulate a metric of success.

The analysis showed that the majority of ICT innovations and entrepreneurial internet ventures are started either through the natural evolution of technology, the intrinsic or extrinsic motivation of the creator, or a form of cloning innovation, where by a previous idea was improved upon. Therefore, the first category in our classification scheme involved grouping an ICT innovation into one of three CREATION categories:

- Innovation – the product or idea was built upon another idea that was similar or improvements were made as an extension to an original concept. The product is still unique and different but may serve the same or similar purpose as the root idea.
- Evolution – an idea or product that is an act of innovation where the idea came about and evolved via the natural advancement in technology. Opportunities and new ideas are made possible through the advent of new technology.
- Motivation – a drive that comes from within the entrepreneur themselves. It can be evident in different forms such as the opportunity of personal financial gain, or the fulfillment of a personal need in which one recognizes as an opportunity in the market.

The next category was the CREATOR category and contains sub-categories relating to demographical and personal information of each product creator or creators. The sub-categories for classification are the following:

- Sex – the sex of the creator(s). This is an important demographic due to the fact that the IT industry has traditionally been a male dominated industry. Do males still dominate this industry?
- Age – the age of the creator(s) when the product was launched and at the time of its success. This is an important characteristic because age can relate directly to

experience, potential for creativity and risk taking behavior. Is the age of the entrepreneur a determining factor in the success of an IT innovation?

- Nationality – the birth place, cultural background and upbringing of the creator(s). Does one's nationality or where one was raised have an effect on the success of an entrepreneurial IT innovation?
- Education – the education of the creator(s) – did they have a tertiary education? How did they learn what they needed to learn in order to be successful? Are qualifications important in attaining success?
- Development Environment – where the product was developed. The majority of successful IT innovations have come from the USA, why is this the case? Can products flourish just as well in other parts of the world?

The final category used for classification was what we termed the SUCCESS METRIC. As a product success means different things to different people it is useful to have various classifications for success besides the common net worth, or in some cases the 'sale price'. That is, an ICT innovation and their creator(s) are often seen as being successful based solely on how much they sold their idea for. Our classification scheme argues that net worth is not the only metric of success as our classification framework includes the following categories:

- Sale value or estimated worth – the annual net revenue of the company/product/idea. If sold tomorrow, what would be the net worth or value of the company/product/idea? This determines the success threshold in terms of currency value.
- Registered users or quantities of products sold – the number of registered users or total products sold of the innovation and the time it took to reach that figure – this measures the success of a company/product/idea with regard to popularity, usefulness and competition. At what point did the company/product/idea become successful and how quickly did it get there?
- Product name and brand association – Reputation, recognition and the establishment of the company/product/idea as a "generic term" within common society – has the company/product/idea reached a level of success where the brand is now well known and synonymous with superior quality and customer satisfaction? This measures the longevity and sustained success of the company/product/idea with regard to industry standards and customer loyalty.
- Cloning – the re-creation of a company/product/idea by a competitor – has the company/product/idea been copied or is it a copy? The copying of an original concept signifies success in terms of a contribution to technological advancement or a pioneering change in the industry.
- Globalization and localization – the widespread use and acknowledgement of the company/product/idea within its chosen industry. The use of global/national domains with local customized content signifies widespread success.

Another phase of the study involved the analysis of successful innovators and entrepreneurs within the ICT sector. Within this phase two specific approaches were taken. The first was a case study of perhaps one of the most publicized and recognized technology entrepreneur and innovator, Mark Cuban. The second component involved a professional questionnaire completed by six high profile Australian ICT entrepreneurs. The six professionals that participated in research included: Martin Wells founder of Tangler [42], Cameron Reilly founder of The Podcast Network [43], Chris Deere founder of Hunterlink [44] and Ipera

Communications [45], Robert Buck founder of Diamond IT [46], Matt Freedman founder of Redback Solutions [47], and Lloyd Davies co-founder of Liveware Solutions [48].

A case study has the benefits of detailing what may or may not have worked in the past and determining whether it is applicable as a benchmark and guidance for those wishing to emulate its success. Mark Cuban currently is a benchmark in ICT innovation with a string of success's both by his amassed personal fortune and the fact many of his most successful innovations either fulfilled one or a number of our success metrics. For example, he sold his first company MircoSolutions Inc for US $30 million, followed by the sale of Broadcast.com for US $5.7 billion. Further, registered users for Broadcast.com were in their millions and one of Cuban's recent projects, HDNet, is received in 66 million US households. Besides being described as having a natural entrepreneurial nature, Cuban is the epitome of problem-based learning as his philosophy is to say yes to basically any challenge set before him. The results we draw from this case study also indicate that a formal education in computing is not required for success. Rather, the ability to identify an opportunity and take advantage of it is of more importance. As our study aimed to show, the ICT sector continues to provide many such windows of opportunity due to its rapidly evolutionary nature.

As our research was primarily aimed at fostering better technology-based entrepreneurial behavior and managing innovation in Australia, it was imperative that successful Australian entrepreneurs were able to contribute to our work. Their input added another professional dimension to our research to ensure that first hand practical or real-world knowledge was also reflected in our results. Therefore, the six ICT professionals responded to a total of ten primary questions, with a number of sub-questions among the ten primaries. The the results of the survey and our conjectures are discussed in a following section.

FUTURE INNOVATORS AND ICT FOR FOSTERING ICT INNOVATION

The next component of the research was to identify ICT strategies and applications that facilitate creativity and innovation in ICT entrepreneurship. Firstly, brainstorming is shown to be a fundamental collaboration technique that facilitates the collection and generation of new ideas that enriches the act of creativity. Mind mapping is identified as a form of brainstorming that displays and organizes information and ideas in a formal and concise manner. The art of mind mapping links ideas via the diagrammatic representation of a core concept and their related attributes. This activity is shown to be beneficial in assisting creativity as a physical world process. More importantly, the evolution of ICT and the increasing need for efficiency has led to the equivalent formation of physical world processes in the virtual world.

Two examples of virtual world emulations analyzed during the research included The Personal Brain [49] and SOUP [1] applications. The Personal Brain is an application used to mimic the process of mind mapping in an electronic format. It is a software program that organizes files and creates relationships to improve the accessibility and management of information. The SOUP application has characteristics of an anonymous peer review digital suggestion box for creative ideas. The application formalizes the process of creative idea evaluation in order to foster and reward innovation in a collaborative environment.

Another major contribution of the research was a student survey based around their perceptions of the influence of tertiary education on innovation and entrepreneurship. The sample set for the survey was a mix of undergraduate and graduate students across a number of campus locations at a tertiary educational institution in Australia. Close to 200 students participated in the survey with each student answering ten multiple choice questions. Statistical analysis was performed on the results to discover any potential trends emerging relating to the impact of entrepreneurship on the ICT industry and the current IT tertiary curriculum. The purpose of the student survey was to determine the current perspectives of students studying at a tertiary institution regarding the role and impact entrepreneurship, creativity and innovation has on IT.

The student survey consisted of ten multiple choice questions. Each multiple choice question contained options ranging from (A) to (G). Participants selected the most correct answer from their point of view. It was a prerequisite to answers all questions on the survey, as failure to do so voided the respondent's participation. Three out of the ten multiple choice questions in the survey had "other" as an option with a corresponding space for a written comment. The option of "other" was only selected and filled out when the answers provided were not sufficient or more detail was required. There were no right or wrong answers as the perceptions and opinions of the participants were of the utmost importance.

A total of 125 students participated in the survey. All participants were enrolled in an IT degree or computing related course at the University of Newcastle. Participation was entirely optional and the survey itself was first passed by the ethics board before the submission, collection and analysis of surveys commenced. As mentioned earlier in the methodology, students from the Callaghan, Ourimbah and Singapore campuses formed the sample set.
Students completed the survey in one of two formats; either a paper based hard copy survey or an online version. The paper based hardcopy surveys were submitted as optional participation and completed after the student's lectures and/or tutorials of their relevant IT courses. The online version was made available to students in case a student missed the day of tutorials and lectures when the hardcopy version was made available. The online version of the survey was also used as a mode of convenience for students attending tutorials and lectures at locations other than Callaghan; such as the Ourimbah and Singapore campuses. This allowed for a greater spread and number of participants thus enriching the sample set size. It was also a way of reaching willing participants in a less upfront and invasive manner, here the student could complete the survey in their own time and in a less peer pressured environment.

A brief summary of the major statistics and findings for each question from the survey are as follows:

1. 40% of respondents felt that the current academic structure of university education has a detrimental effect on creativity, innovation and entrepreneurship within IT. 38% of students are unsure whether or not the current academic structure has a detrimental effect on creativity, innovation and entrepreneurship within IT.
2. 93% of respondents believe that creativity and innovation is either very important or essential to the success and evolution of the IT industry.
3. 54% of respondents agree that entrepreneurship and other business skills should be incorporated into the IT degree.

4. 40% of respondents agree that there is a lack of freedom to express one's own creativity within the current subjects being studied as part of the IT degree.
5. 46% of respondents believe that entrepreneurship and other business related skills are "very important" to their IT career.
6. 23% of respondents who took the survey are currently doing the information technologies applications major.
7. 48% of respondents believe their key motivation for creating something new in the IT industry and fulfilling that idea would be for financial gain
8. 39% of respondents use the internet greater than 30 hours a week (on a weekly basis)
9. 69% of respondents were first attracted to the IT industry as their chosen career path for their enjoyment and interest in IT
10. 34% of respondents believe that the hardest obstacle to overcome in order to achieve intended success from an entrepreneurial IT idea would be time.

MANAGING AUSTRALIAN INNOVATORS

As previously mentioned the major objectives of the research project are to attempt to determine what makes a successful ICT entrepreneur and how can the ICT sector foster innovation. A parallel objective is to focus on results deriving achievable outcomes to apply to the Australian ICT industry. These objectives are reflected in the three primary research questions formulated for the research direction. While some of the results to date have been mixed there are a number of positive outcomes that can make useful contributions to more effectively managing technology-based entrepreneurial activities in Australia and possibly abroad. The remainder of this section details the more prominent results and important contributions of the research to date.
The investigations of ten 'successful' ICT innovations lead to the following deductions:

- There is a noticeable trend toward "social networking".
- The properties of Web 2.0 have a significant impact on the direction of new ICT ventures.
- The most successful ICT innovations and ideas are global competitors on a worldwide ubiquitous platform.
- The life cycle of an entrepreneurial venture is significantly compressed with an ICT innovation. It is important to note that even though the windows of opportunities are smaller, the rapid evolutionary growth of the ICT industry induces greater frequencies of these opportunities.
- The idea of linking, communicating and networking are major contributors to a successful ICT innovation.
- Although one person – usually the founder – may initiate the novel idea of a successful venture, it is rare that the venture is entirely successful without the help of others. It is crucial for any entrepreneurial venture to have a supportive and organized network throughout its life cycle, especially in the start-up phase and phases of growth.

The results of the professional questionnaires supported many of the projects deductions to date. Specifically, Australian innovators recognized the importance of collaboration and support in a comparatively smaller market place like Australia. With a lot less venture capital

available it is important that besides being the first person to implement the idea, it is equally important that support for the implementation is provided. This is well expressed by Martin Wells when he states that a good idea is only as good as its execution. Therefore, we stress that for Australia to remain a technology-base innovation leader more schemes that provide not only financial support for such ventures but also other resources such as quality staff and knowledge is really needed. The key is Collaboration and is an issue we address in our research with the ongoing development and evolution of the I-CAN tool.

As we expected the results of the student survey were very diverse, with only a strong majority for a single question but in general a fairly even distribution of responses. In summary around 90% of students felt that Innovation and Entrepreneurship are either very important or essential for to the success and evolution of the ICT industry. Further, around 55% agreed that entrepreneurship and other business skills should be a foundational part of a computing degree. What we found most interesting is that only 40% of students perceive current academic programs as having a detrimental effect on creativity, innovation and entrepreneurship within ICT. From this we conclude that to protect Australia's innovative future it is worth investigating the feasibility of integrating entrepreneurial skills into tertiary computing programs. Further, tertiary education structures should facilitate more creative thought and expression either through content delivery or assessment items.

Our analysis of what the literature describes as successful ICT applications for fostering entrepreneurship and innovation revealed that they again all supported some degrees of collaboration and knowledge sharing. Further, creativity and innovation is more affluent when people are provided an environment supporting creative freedom and are encouraged to think laterally and explore ideas that may or may not be worthwhile. Allowing anonymous peer review of ideas, such as supported by the I-CAN application we have developed and continue to evolve, is a positive element for incorporation into innovation fostering initiatives.

INNOVATION BY COLLABORATVE ANONYMOUS NETWORKING (I-CAN)

The Innovation by Collaborative Anonymous Networking (I-CAN) tool is a software application designed and developed for use in digital collaborative networked environments. The parts of its title, Collaborative and Networking, reflect this feature by allowing users to be geographically dispersed but able to interact in a virtual setting. The Innovation element reflects the purpose of the tool, in that it is aimed at fostering and managing innovative ideas generated by collaboration users. The fourth and final element making up its title is a reflection of the tools ability to allow users to interact in an anonymous way with it. Together, it provides the tools acronym title of I-CAN. From a positive motivation and psychological dimension the acronymic title is based on the 'can do attitude' [50] identified as a character trait of successful entrepreneurs and innovators [51]. That is, the I-CAN application name hopefully empowers users to adopt an 'I can do' attitude and therefore actively and positively participate in the innovation fostering environment. As will be explained in this section, the I-CAN tool provides not only a digital repository for innovative ideas, but also a medium for evolving those ideas through peer feedback and interaction.

The Evolution of I-CAN

The simplest function and therefore easiest method of explaining the I-CAN tool is to consider the traditional suggestion box and translate it's functionally and purpose to the virtual world. With a traditional suggestion box entities are able to write their comments and feedback, normally on sheets of paper, and deposit them in a labeled container. At some time later, possibly predetermined and/or periodically, the contents of the suggestion box are collected and evaluated. Ideally, the comments and feedback on the sheets of paper are constructive and the collector is empowered to take action on the comments and feedback where feasible. This simple concept works very well in a digital environment and most websites offer a simple 'Feedback Form' where users, customers, employees, members, etc are able to perform a similar feedback and comment deposit.

The main difference that is often overlooked, and vital to our own I-CAN application, is that by moving such a physical world Suggestion Box (SB) to a digital environment entities making 'deposits' in the box can remain anonymous. Where as a physical SB could be subjected to passive monitoring leading to possible deduction of which entity made a deposit. For example, if in any given collection period only one deposit was made and the SB was monitored then the collector and other entities could determine who made the deposit. Where as in a virtual setting if designed, constructed, and implemented correctly you can create an Anonymous Suggestion Box (ASB), which can protect the privacy of its user's. The I-CAN application incorporates the anonymity feature with the technical details of its implementation are provided in later in this section. As previously mentioned, the option for a user to remain anonymous alleviates the possibility of a user being subjected to peer pressure, the tall poppy syndrome, and in the worst case punishment or bullying for their deposits. For example, an employee may use the ASB to report bad peer behavior or comment on their supervisor's unfair treatment of them or illegal behavior. As the entity can remain anonymous they can be free from being subjected to potential revenge or retaliatory actions. It should be noted however that the ASB is not designed or meant to be a medium for such a use. The purpose of an ASB is aimed at only collecting positive and constructive suggestions and feedback. That is, ideally in its simplest form, the I-CAN application can act as an ASB for collecting innovative ideas and suggestions.

SOUP [1] was the next evolved phase preceding the I-CAN application. SOUP also represented our first unique and recognized contribution to the field, as the ASB concept was already available in a number of different formats and implementations. SOUP introduced the ability for peer review and feedback on submitted ideas through negative and positive feedback. SOUP has proved successful and is currently being used by a number of institutions in Australia for innovation management and idea generation. The full details of SOUP are beyond the scope of this paper but a brief summary of its key features follows. The SOUP application when running contains a number of 'SOUP bowls' and each bowl normally represents a particular theme, topic, or area of focus. Each enabled (being registered, active, and granted access permission) member entity is provided a fixed amount of 'Nutrient' and 'Poison' each 24 hours. A member entity is not only able to create a new item, being a creative or innovative idea, which is given an initial 'Health' level, but they are also able to feed ideas other than their own with their daily allocated poison or nutrient effecting that idea's health.

The basic functional purpose is that at a predetermined periodic time frame interval the 'cream' of idea's are collected for review. In sticking with the soup analogy the idea is that those ideas receiving the most nutrient will rise to the top like cream in a SOUP as they are the healthiest. Those ideas that have been fed poison will continue to decrease in health until their health reaches 0 and therefore they die off and are removed from the bowl. The most popular ideas have then been subjected to 'anonymous' peer review while the bulk of ideas submitted have already been filtered out. It is again important to highlight that ideas are submitted in an anonymous format and are not 'attached' to specific entities in any 'visible' way. Fortunately, due to the benefits of PKI [52] remuneration may be offered as a reward and a means of motivating entities to participate and contribute. That is, entities with successful ideas can remain anonymous when the ideas are being subjected to peer-review. They can also prove they 'own' an idea once it has been extracted from the bowl as being identified as an idea and hence they can claim their 'reward'. As mentioned not all operation details are provided in this paper due to both proprietary reasons and space limitations. However, after being tested and used in live production environments a number of useful modifications were identified, motivating the next major evolutionary phase of the software application to its current state called the I-CAN application.

Technical and Operational Details of I-CAN

I-CAN is a software application designed for use within a digital collaborative environment as a tool for fostering and managing innovation. In short, I-CAN can be used as a tool allowing authorized member entities of a collaboration to create new innovative ideas and also peer-review current innovative ideas deposited by other authorized member entities. Entities are able to interact with I-CAN in one of three modes: Anonymous; Pseudo-Anonymous; and Identifiable. This is possible as Public Key Infrastructure is integrated into the I-CAN application that allows an entity to generate a unique Public-Private Key pair each time a new 'Innovative Idea' (II) is generated by them. The II is 'digitally signed' by one of the keys while the other key of the pair is kept secret by the II entity owner. At anytime the II entity owner can prove their ownership of a particular II by publishing the matching key of the PKI key pair that they have in their possession. Due to the nature of PKI the keys are unique to both an entity and also each individual II created. For example, if an entity creates five II's then they would have a corresponding five Private-Public Key pairs; one for each of the II's created.

I-CAN consists of a number of Innovative Idea Incubator Containers, which are simply termed an I3C within the I-CAN application. Each I3C represents a different subject, or theme, or focus area. For example, the author's research is directed specifically towards fostering and managing ICT innovation in Australia. Therefore, some example hypothetical I3C's may have labels such as Database Innovations, Network Innovations, Social Networking Innovations, and Programming Innovations to represent different sectors within the ICT industry. Each I3C has a lower (waste) and upper (cream) threshold set and moderated by the I-CAN I3C moderator. II's within an I3C are either collected for processing when they are above the 'cream' threshold or discarded when they are below the 'waste' threshold through an automated real-time routine. II's can be archived for cross-referencing and building a knowledge repository for future reference. For example, an II may fall below the discard 'waste' threshold but may have future merit once reviewed through data mining

processes at a later date. A newly created II is given an initial health value corresponding to the medium value of the upper and lower thresholds values for the I3C it is placed in. I3C moderators can have the authority to remove malicious or erroneous II's from an I3C. The reason for moderator removal must be documented within the II before it can be removed. This is to ensure a degree of accountability, integrity and hopefully remove potential bias of a moderator when auditing I-CAN operation.

All authorized users of I-CAN are provided a fixed amount of both food and poison which is in set increments and replenished to the set limit every pre-configured time period. That is, the I-CAN administrator can set the time period in which the food and poison are replenished along with the replenishment level. An authorized user can feed or poison any II in any I3C they have access to, except their own. The requirement of only feeding or poisoning other II's required considerable framework configuration and work to ensure that the application preserved the ability for a user to remain anonymous. Therefore, a user needs to login and authenticate with the I-CAN application to ensure they are unable to feed or poison their own II's. To maintain data integrity and privacy, II ownership tags are encrypted with an encryption key known only to the II entity creator. Further, no records are kept of the entity feeding or poisoning any II to ensure no profiling or statistical analysis can be run to determine who an II belongs to. Only the health of an II is modified and recorded in its data tags when it is either fed or poisoned along with other tags including II creation date, encrypted owner date, and I3C bowl it in active in. Further the date an II is removed from an I3C is also recorded in an II tag, along with the reason for removal. That is, either it went above the 'cream' threshold, below the 'waste' threshold, or was removed by a moderator. As mentioned, if removed by a moderator then the moderator must provide a reason why they have removed that II. A conceptual representation of an I3C and II's within it is shown in Figure 1.

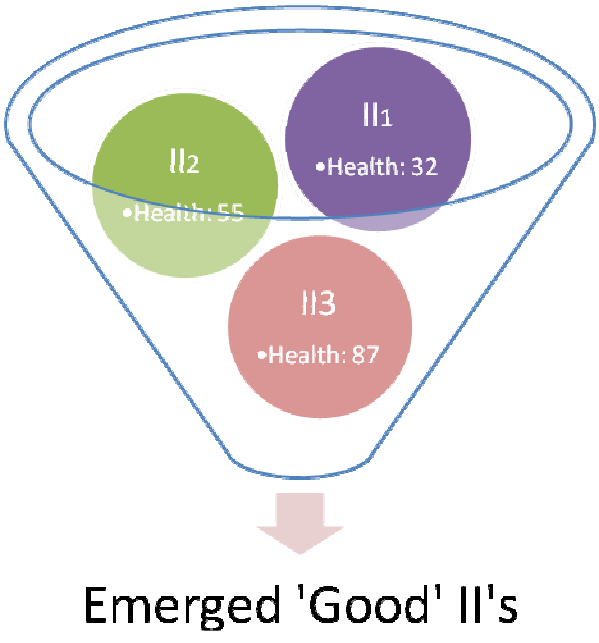

Figure 1: Conceptual Representation of an I3C bowl with three II's active in it.

I-CAN is aimed at Australian work environments but can just as easily be used in any virtual collaborative environment. That is, authorized users are free to interact in an identifiable manner if they so choose but we advise that the preferred operating mode is anonymous. The reason being that other factors, besides peer pressure and the tall poppy syndrome may affect the 'health' of an II. For example, if we take the hypothetical case of I-CAN being used in a large organization made up of many different departments. If rewards are given to those departments with the most II's to elevate above the 'cream' threshold then potential completion may effect and bias user feeding habits. However, if all II's remain anonymous then to a greater degree the II's can be free of this potential completion bias. The author does note that regardless of the anonymity measures in place the system may still be subject to bias through external collusion. For example, a group of people may put forth an II in which all members of the colluding group are aware of. All colluding group members can then feed the II until it quickly elevates above the 'cream' threshold. Unfortunately, to date there are no system and design controls that can be put in place to stop this potential fraudulent behavior. Such behavior would be best monitored in the physical world and ensuring where ever possible that the remuneration can only be 'consumed' by an individual. For example, instead of offering a financial reward perhaps an individual may be granted an extra leave day.

As to be expected I-CAN continues to evolve and due to space limitations not all of its technical and operational parameters can be provided in detail in this paper. However, ways in which I-CAN is planned to be improved in the future are provided in a later section, along with the results to date on the success I-CAN has had in it prototype testing phases.

REVIEWING RESULTS TO DATE

The metric of success as defined previously; stated and analyzed five major points in determining the success of an entrepreneurial idea in the ICT industry. The five metrics of success were:

1. Sale value or estimated worth
2. Number of registered user or quantities of products sold
3. Product name and brand association
4. Cloning
5. Globalization and localization

This research has shown that innovation can be sparked by the three main influences: positive creativity; necessity; and opportunity. The results show that necessity sparks innovation, which is in agreement with common sense deduction and analysis. That is, the history of the human race has shown that in most instances when there is a clear need for something many people set about finding a solution for addressing that need. Response's to the professional questionnaire shows that a good idea in the ICT industry is one that provides a product or process in order to solve a particular problem. The product or process invariably caters for a significant number of people in which those people are prepared to pay money for. The six respondents came up with the following characteristics that all contribute to the definition of a 'good idea' in the ICT industry:

- Solves a problem
- Creates value to an extent where customers would be willing to pay for it
- Incorporates the use of a combination of the latest and most reliable technology

It is important to note that entrepreneurs find most success in sparking innovation when compared to their technical IT counterparts because they tend to have the ability to come up with ideas without limitation. That is, ideas are driven by imagination in which current or new technology must adapt to or be created. On the other hand, negative innovation can occur when the current technology drives what is possible in terms of new possibilities. The perspectives of the respondents regarding creativity and innovation in the ICT industry and the factors that trigger this behavior can be summarized and attributed to the following reasons:

- "Need" is generally considered the major spark to innovation
- Innovation eventuates through the ability to see problems
- Creativity and innovation is achieved best without limitation – entrepreneurs tend to have this positive mind set
- IT professionals tend to achieve innovation when two or more existing ideas are put together in a different way to assist or create a new application or process
- Creativity and innovation is more affluent when the environment where people have creative freedom and are encouraged to think laterally and explore ideas that may or may not be worthwhile
- Creativity and innovation occurs best in a collaborative environment – industry alliances and partnerships facilitate success.

The results throughout the study have shown that there are certain ways to improve the frequency and consistency of ICT entrepreneurship in a positive manner. The most prominent example of improving entrepreneurial behavior was highlighted by a case study on the 3M Corporation studied as part of our background literature review for the research. The company has evolved with the changing times and with over 100 years of experience 3M have managed to sustain their innovative standard. The turnover in innovation at 3M was shown to be a significant attribute to their sustained success. The rule of thumb in the company is that managers of each department are challenged to successfully introduce thirty percent of their product innovations within a four year period. Each business unit within 3M is given incentives to accomplish the thirty percent of revenues coming from the innovations of the last four years. This is a prime example of how entrepreneurship can be improved upon in a positive manner. The results have shown that a positive attitude toward creativity and innovation enhances entrepreneurship and its related endeavors. An optimistic perspective is a fundamental ingredient to a successful entrepreneurial approach. The optimist sees improvement and knowledge in every possibility. On the other hand, it can be said that the pessimist is naturally afraid of change, a disruption of the status quo or the prospect of something new.

The major findings of the research to date cover many areas of the topics in question. Entrepreneurship was found to be an interesting phenomenon especially when examined within the ICT industry. Three clear cut questions were asked of the study and two related hypotheses were made addressing each of the three questions. It was found that creativity, innovation and entrepreneurship are intrinsically linked. Further the key findings of the research to date are the following:

1) Positivity
    - The entrepreneur and the innovator share common basic characteristics such as positive creativity.

- Creativity was found to be innately positive and is a required exercise throughout the entire life cycle of a successful entrepreneurial venture

2) Many IT professionals are self and industry taught – education is only part of the equation. A formal education is a valued part of an entrepreneur's career but there are definitely other facets such as commercial experience, sales experience etc that can have an equal if not greater influence
3) Natural flair will shine through in the market. The gifted will always break free from conformity.
4) Universities focus on educating the masses – however, identifying the gifted at an early stage could increase the frequency of such people making large contributions to the world of innovation in ICT.
5) Promotion of creativity – it can be deduced that the promotion or restriction creativity can prove to be the difference between success and failure of innovation.
   - Fostering creativity in a positive manner in order to achieve continual innovation.
   - 40% of student survey respondents felt that the current academic structure of university education and their institution can have a detrimental effect on creativity, innovation and entrepreneurship within their future IT career
   - 93% of student survey respondents also believed that creativity and innovation was either very important or essential to the success and evolution of the IT industry
   - It was also intriguing to note from the results that the idea of mind-mapping has been prevalent for centuries and that the concept was found to have intrinsic links to the fundamental art of learning, brainstorming, memory, visual thinking, and problem solving. These characteristics have the capacity in one way or another to form the key derivatives for creativity

6) Empower potential entrepreneurs and innovators to explore what is possible in an uninhibited manner. This unique philosophy and approach to creativity and innovation is evidently entrepreneurial in nature. That is, in order to survive one must adapt or initiate change to increase profit and move technology forward.
7) Whether or not one started as an ICT person within the industry or came into the industry with an idea as an entrepreneur/business person outside the ICT industry; there is good cause to suggest that success can be attained just as easily. This shows that differing backgrounds is not a determining factor of success in the ICT industry.
8) ICT innovation is brought about either by:
   - Motivation – intrinsic/extrinsic
   - Evolution – advancement in technology
   - Opportunity – personal/financial gain and/or entrepreneurial opportunity

9) Positive creativity, necessity and opportunity spark innovation
10) Social networking is a lucrative ICT entrepreneurial environment

It is important to note that there seems to be a cyclic co-dependence for fostering ICT innovation. That is, the catalyst for change is re-creation and innovation and the catalyst for re-creation and innovation is change. Realizing and effectively managing this co-dependence and the cyclic incremental nature of the co-dependence seems to be one of the key elements to ICT innovative success in Australia. Some of the other major key elements include effective collaboration, staff support throughout all levels of an organization or enterprise,

and particularly in Australia deterring negative peer pressure and effects of the tall poppy syndrome.

The I-CAN software application tool has proved very effective for managing and fostering innovation while integrating a number of the key elements mentioned above. The evaluation of the prototype I-CAN tool in a testing environment showed that it provided a good platform for collaboration, staff participation at all levels, and supporting anonymous interaction. The results of the prototype testing did reveal that another major feature needs to be added to the next prototype version of I-CAN. That is, the test users of the I-CAN prototype nearly all requested the ability to 'evolve' or what we are now terming 'Mutate' current Innovative Idea's (II's). For example, like our literature review and survey confirmed, many new ICT innovations are actually inspired or built upon previous ICT innovations. Therefore, ideally I-CAN should support the ability for an authorized user to 'mutate' a current II in a bowl, effectively using and acknowledging the original II as their inspiration for their evolved and hence mutated II. The plan and method to do this modification are discussed in the next section under future work.

CONCLUSION AND FUTURE WORK

This paper has discussed the research and findings to date of an ongoing project investigating ways of managing and fostering ICT innovation, with a specific focus on the Australian sector. The study identified the importance and potential of entrepreneurial activity in the ICT industry and devised a unique classification framework. Some of the key elements for the successful fostering of technology based entrepreneurship and ICT innovation in Australia include: collaboration; recognition of compressed life cycles; sound idea execution; and due to the critical nature of Australians including the Tall Poppy Syndrome, anonymous peer review. Further, as part of the work we conducted a survey with the results indicating that the next generation of entrepreneurs feel somewhat limited by the bounds and rigidity of tertiary education at the tertiary institution they were attending. Further, they recognize the importance of creativity and felt that innovation should be included within the curriculum.

It was recognized throughout the study that limitations for this type of research were going to be inevitable. A number of limitations were prevalent especially in the early stages of data gathering and analysis. Firstly, due to ethical considerations and initial scope only students from one tertiary institution were able to be surveyed. Secondly, only those students in an ICT type program were surveyed. It is planned that one of the next stages of the research is to update the survey questions and expand the survey participant across a number of disciplines and Australian tertiary institutions. Time and ambiguity were two other major limitations in the research. The nature of the study subject involves a number of diverse disciplines, including IT, business, and psychology. For example, the creative aspects of innovation have shown to have an effect on the success of entrepreneurial ventures in the ICT industry. The degree of this positive affect is quite complex to measure and not within the scope of this study. The study is primarily aimed at developing ICT software application tools and collaborative environments for managing ICT innovation.

The research has had success in achieving this aim with the development and implementation of the I-CAN software application tool. I-CAN operates in a digital collaborative

environment and provides a useful tool for managing innovative ideas. Further, its mode of operation encourages member participation while also fostering further innovative idea creation. Through extensive prototype testing it was discovered that I-CAN can be further enhanced through the addition of an evolutionary function or what the researchers have termed an II Mutation. A major part of our future work will include the design, development and implementation integration of this capability into the I-CAN tool. Initial conjectures see this as quite challenging but achievable as both the anonymity of each user 'contributing' to the II evolution will need to be preserved. This is in addition to devising an equitable remuneration scheme for rewarding Mutated II's that elevate above the 'cream' threshold. However, it is feasible that additional tags can be added to an II entity that will store such things as 'Original II', 'Mutation Date' and encrypted data tags containing the PKI keys of each contributing user.

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MULTIOBJECTIVE OPTIMIZATION FOR MUTUAL BENEFIT STRATEGY IN A SERIAL SUPPLY CHAIN

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ABSTRACT

This paper presents a model for integrating replenishment and delivery planning in a serial supply chain consisting of a single supplier, single retailer, and multi customers for multi objective optimization for mutual benefit strategy. The objective of the paper is to optimize the average supply chain cost and simultaneously optimize other decision variables such as quantity transported, number of shipments, fill rate, and lead time. In this paper we have used Non dominated Sorting Genetic Algorithm II (NSGA-II) to solve these multi objective problems. We have found that the results are more attractive and competitive.

Keywords: Serial Supply Chain, Multi Object, NSGAII. Lead Time, Shipment.

1. INTRODUCTION

The business in today's Globalize environment is agile and highly looking for ways to optimize the Supply Chain Management (SCM) network by means of integration and cooperation. Many researchers have provided taxonomies and frame works to help practitioners and academicians to understand the nuances of supply chain management. Houlihan (1985) is credited for coining the term Supply Chain (SC) with insight concepts and a strong case for viewing it as a strategy for global business decisions. Many definitions of SCM have been mentioned in the literature and in practice, although the underlying philosophy is the same. The lack of a universal definition for SCM is because of the multidisciplinary origin and evolution of the concept.

Simchi-Levi et al.(2000) defined SCM as a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouse and stores, so that merchandise is produced and distributed at the right quantities, to the right location and at the right time in order to minimize system wise cost, while satisfying service level requirements. Since the supply chain consists of different echelons; supplier, retailers and customers, hence inventory at different locations has to be maintained to face stochastic demands. Therefore, inventory has become one of the most widely discussed areas for improving supply chain echelon

efficiency. Since the holding of inventories can cost anywhere between 20 to 40% of product value, hence an effective inventory management is critical and most essential (Ballou, 1992).

Supply chain integration has become the focus and goal of many progressive firms and it is used as strategy through which such integration can be achieved. Nevertheless, most quantitative analysis on supply chain management issues is dominated by the framework of multi-echelon serial systems or distribution systems where a relationship between a single vendor and a single buyer or a single vendor and multi buyers is considered. The main issues that have been addressed include deployment of strategies, and control policies. Finally, to survive and hold its position in the market it need to find a method of tactical business strategies which should be on the basis of mutual benefit of supplier, retailer and customers. For this purpose many multi objective evolutionary algorithm tools have been evolved in the recent past years, among them Non dominated Sorting Genetic Algorithm II (NSGA-II) is one. The problem considered here is typically deals with logistics aspects as well as the inventory level, lead time, and a cost which means a novel approach to mutually benefit suppliers and retailers and also finally customers. The delivery planning is to determine order-up-to level of the supplier and the retailer simultaneously for the objective of minimizing the expected average cost. Impact of Lead time variability is also investigated. The lead time reduction has been viewed as an investment for strategic mutual benefit.

This paper is structured five sections: Section 1 is introduction, Section 2 gives literature review, Section 3 will present the NSGA II method used to solve the problem, Section 4 gives the illustrative examples and results, and Section 5 gives the conclusions and future studies.

2. LITERATURE REVIEW

Pan and Yang (2002) were credited for minimizing the joint total economic cost of supplier and buyers inventory model with controllable lead time which is a decision variable; however, shortages are not allowed in their paper. Srinivas and Rao (2010, 2007, and 2009) decomposed lead time into four components each having a strategic different crashing cost for reduced lead time. They have proven that the lead time crashing component can be more than three components but it is in the interests of both parties involved in the strategic business.

Hans Siajadi et al. (2006) proposed new multiple shipment models for single vendor multi buyer single product problem. They assumed that the ordering cycle time for each buyer and production cycle time for vendor is same and the order amount for each buyer is delivered in a number of equal size shipments where the frequency and the size of the shipment might be different for each buyer.

The literature review paper of Aytug et al. (2003), Chaudhry and Luo (2005) reveals that no approach attempt has been made to develop a heuristic method such as Genetic Algorithm to determine inventory levels in supply chain echelons. The running time of enumeration technique grows exponentially (Goyal, 1974) while increasing the number of variable. Hence GA method is suggested for more variable problems.

Daniel and Rajendran (2005) studied Genetic Algorithm (GA), enumerate and random search procedure methods to single product serial SC operating with a base stock periodic review system and to optimize the base stock inventory levels in the SC so as to minimize the total supply chain cost, comprising holding and shortage costs at all the installations in the SC. They found the solution generated by the proposed GA is not significantly different from the optimal solution yielded by complete enumeration, but it is significantly good for deterministic replenishment lead times and the other with random replenishment lead times. They did not check for multi buyer stochastic demand and lead time models.

Huayu et al. (2008) has developed a multi objective model problem with time windows. NSGA II has been performed as an efficient algorithm in solving multi objective problems. Three objectives are considered: shortest total distance, least vehicle number and minimum time penalty. They have shown that NSGA II is efficient in solving multi objective problems due to the sorting procedure.

Huayu et al. (2009) has developed a model using both GA and Simulated Annealing to address problems in logistical distribution centers and its aspects of distribution centers, several customers, and different demand of customers and vehicles with capacity constraints in view of minimizing the total travel cost. This paper mainly focuses on scheduling and routing decision for shipment. The paper describes method to allocate shipment based on present and predicted demand. They proposed a new concept of latest departure time for shipment delivery.

The recent paper of Srinivas and Rao (2010) reveals that a quantitative analysis using GA gives significant results when decision variables are more and the computational CPU time will be less compare to enumeration technique. They conclude the inventory management policy with controllable lead time is suitable for facing new SCM challenges with random demand. The proposed models not only can make tradeoffs for mutual benefit but can also enable decision makers to deal systematically.

3. MODELING

In this paper we consider model that involves single supplier, single retailer and multi customers.

3.1 Assumptions and Notations

Note that the supplier does not have direct connection with customers. Hence we consider the model as two serial vender-buyer models, where in the supplier-retailer part we take the supplier as vender and the retailer as buyer, while in the retailer-customers part we consider it as single vender-multi buyer model.

Analysis of both parts is shown as follows.
Part I:Single Supplier – Single Retailer

- P supplier production rate (continuous), items per unit time
- D demand rate seen by the retailer (continuous), items per unit time, P/D = 3.2
- n number of delivery batches, from which the period between two orders is c/n
- Q quantity transported per delivery batch, given $Q = Dc/n$
- s supplier setup cost
- T transportation cost per delivery batch from supplier to retailer
- L_k lead time for each order / delivery, $k = 1, 2, \cdots, n$
- h_1 supplier stock holding cost per item per unit time
- h_2 retailer stock holding cost per item per unit time

Part II: Single Retailer–MultiCustomers

- m number of customers
- D_i demand rate seen of customer i (continuous) , items per unit time, $i = 1, 2, \cdots, m$
- σ_i standard deviation of D_i, $i = 1, 2, \cdots, m$
- I_s safety stock for retailer, $I_s = \min_i \left\{ D_i L + z\sigma_i \sqrt{L} \right\}$, where z is safety factor, ranging from 1.1 to 1.5.
- s' retailer setup cost
- C_s shortage cost per item
- n_i number of delivery batches to customer i, hence the interarrival time is c/n_i
- Q_i quantity transported per delivery batch to customer i, given $Q_i = D_i c/n_i$
- T_i transportation cost per delivery to customer i

Overall assumptions and notations

- c supplier production rate (continuous), items per unit time
- x items, in this paper we consider single item.

3.2 Model Formulations

The objectives are: (i) to minimize the total cost; (ii) to minimize the total shortage cost; (iii) to minimize the total lead time penalty; and (iv) to maximize the fill rate. The decision variables considered in this work are: (n, n_i, L_k).

The Total Cost is,

C_{total} = supplier setup cost + supplier holding cost + supplier-retailer transportation cost + lead time penalty + retailer holding cost + retailer setup cost + retailer safety cost + shortage cost + retailer-customer transportation cost

each part of which can be calculated as below:

supplier setup cost: $C_{setup}^{S} = sn$ (1)

supplier holding cost: $C_{h}^{S} = h_1 \frac{c^2}{2}\left(P - \frac{n-1}{n}D\right)$ (2)

supplier-retailer transportation cost: $C_{Trans}^{SR} = Tn$ (3)

lead time penalty: $C_{LT} = \sum_{k=1}^{n} C_{L_k}$ (4)

where each C_{L_k} can be calculated as [see Srinivas and Rao (2010)]:

$$C_L = c_u\left(L_{u-1} - L\right) + \sum_{w=1}^{u-1} c_w\left(b_w - a_w\right)$$

$$L_u = L_0 - \sum_{w=1}^{u}\left(b_w - a_w\right), \text{ and } L_u < L \le L_{u-1}$$

retailer holding cost: $C_{h}^{R} = h_2 \frac{c^2}{2}\left(D - \sum_{i=1}^{m} \frac{n_i - 1}{n_i} D_i\right)$ (5)

retailer setup cost: $C_{setup}^{R} = s' \sum_{i=1}^{m} n_i$ (6)

retailer safety cost: $C_{safety}^{R} = h_2 c I_s$ (7)

shortage cost (whenever a shortage occurs): $C_{short}^{R} = C_s\left(\sum_{i=1}^{m} Q_i - Q\right)$ (8)

where

$$C_s = \begin{cases} 0.5C_s^0, & \sum_{i=1}^{m} Q_i - Q > \frac{1}{m}\sum_{i=1}^{m} Q_i \\ C_s^0, & \sum_{i=1}^{m} Q_i - Q \le \frac{1}{m}\sum_{i=1}^{m} Q_i \end{cases}, C_s^0 \text{ is the basic shortage cost per item}$$

retailer-customer transportation cost: $C_{trans}^{RC} = \sum_{i=1}^{m} T_i n_i$, (9)

Note that the transportation cost also varies whenever a shortage occurs,

$$T_i = \begin{cases} \alpha T_i^0, & \sum_{i=1}^{m} Q_i - Q > \frac{1}{m}\sum_{i=1}^{m} Q_i \\ T_i^0, & \sum_{i=1}^{m} Q_i - Q \le \frac{1}{m}\sum_{i=1}^{m} Q_i \end{cases}, \ \alpha > 1$$

Besides, in calculating the shortage cost, we count the times of shortages, noted by n_s.

Hence we get the fill rate:

$$R_{fill} = \frac{\sum_{i=1}^{m} n_i - n_s}{\sum_{i=1}^{m} n_i} \qquad (10)$$

Therefore the first objective (the total cost) is the sum of Equation (1) to (9), and the rest objectives are Equation (8), (4) and (10) respectively.

3.3 NSGA-II Algorithm

The NSGA-II is implemented to optimize the single-supplier – single-retailer – multi-customers model. The NSGA-II was first introduced by Deb et al. (2002) and is fast and effective in solving multi-objective problems. The key idea is a fast non-dominated sort that deals with multiple objectives. The main procedure of NSGA-II is as below.

i. Initialization of population
ii. Non-dominated sort
iii. Selection
iv. Crossover and mutation
v. Repeat ii ~ iv until the termination criteria.

3.3.1 Initialization

The solution is coded as a chromosome simply in the form of (n, n_i, L_k). Each element of the chromosome is a real number. For example, given the number of customer's m = 3, the two feasible solutions / chromosomes are shown below:

Chromosome 1:	(**3**, 2, 4, 5, **3.5, 4.0**,**5.3**)
Chromosome 2:	(**2**, 3, 2.5, 4.6, **3.7, 6.0**)

Note that the length of different chromosomes might be different due to the value of n. In the example given above, the length of Chromosome 1 is 7, since n = 3 and thus there are 3 L_k's. On the other hand, the length of Chromosome 2 is 6, since n = 2 and thus there are only 2L_k's.A group of chromosome forms a population and in a population, a chromosome can also be called an individual. Given the population size N, we generate an initial population with size 2N.

3.3.2Non-dominated sort

This is the most important procedure, determining the performance of the algorithm. We call Individual p *dominates* q if and only if, none of the objective values of p is worse than q and at least one of the objective values of p is better than q. (Here a "better" could be more or less, depends on whether the objective function is to maximize or minimize.) A *front* (or *nondomination rank*) and a *crowding distance* are defined to each individual to present its domination status (see below).

The detailed procedure of front rank is shown as follows.

$F_i = \varnothing$: this set records all the individuals that belong to the ith front
for each individual p
  $S_p = \varnothing$: this set records all the individuals that are dominated by p
  $n_p = 0$: this counter records the number of individuals that dominate p
  for each individual q
    if p dominates q then $S_p = S_p \bigcup \{q\}$
    if q dominates p then $n_p = n_p + 1$
  if $n_p = 0$ then $p_{rank} = 1$; $F_1 = F_1 \bigcup \{p\}$: p is non-dominated
i = 1
while $F_i \neq \varnothing$
  $Q = \varnothing$: this set records the individuals in the (i+1)th front
  for each p in F_i
    for each q in S_p
      $n_q = n_q - 1$: that means p has been taken
      if $n_q = 0$ then $q_{rank} = i + 1$; $Q = Q \bigcup \{q\}$: q is non-dominated
  $i = i + 1$; $F_i = Q$

The detailed procedure of crowding distance is show as follows.

for each front F_i
  $n = |F_i|$: number of individuals in F_i
  for each p in F_i, set $p_{dis} = 0$
  for each objective function m
    sort $F_i = \{p^1, \cdots, p^n\}$ based on the value of m and get $\{d^1, \cdots, d^n\}$
    set $d^1_{dis} = \infty$ and $d^n_{dis} = \infty$
    for k = 2 to (n – 1)

$$d^k_{dis} = d^k_{dis} + \frac{d^{k+1}(m) - d^{k-1}(m)}{m_{\max} - m_{\min}},$$

    where $d^k(m)$ is the m function value of d^k, and $m_{\max}$ and $m_{\min}$ are the max and min value of m in this front.

Finally, all individuals in the 2N population are sorted first by front and then by crowding distance. Individual p is strictly better than q if and only if (i) $p_{rank} < q_{rank}$; or (ii) $p_{rank} = q_{rank}$ and $p_{dis} < q_{dis}$.

3.3.3Selection

After the non-dominated sort, we select a new population of size Nwith Roulette Wheel method. Suppose the sorted population is $P=\left\{p^1,\cdots p^{2N}\right\}$ with p^1 be the best and p^{2N} be the worst, then the possibility of p^i be chosen is $i/\left[N\left(2N+1\right)\right]$. Hence the better an individual is, the bigger chance it is chosen for the new population. Also an individual might be selected more than once or never. After N individuals have been selected, delete the rest un-chosen individuals.

3.3.4 Crossover and mutation

Crossover and mutation must be operated to make sure the offsprings are still feasible. Crossover is taken between two random chromosomes with possibility p_c. Since the length of individuals is different and n determines the length of an individual, a crossover only takes place in $\left\{n_i\right\}_{i=1}^m$ so that it won't change the feasibility of a chromosome. Randomly select two individuals and randomly choose $a,b\in\left\{1,\cdots,m\right\}$, where m is the number of customers. Suppose a < b and then exchange the subsequences $\left\{n_a,\cdots,n_b\right\}$ between the two individuals. See the example below (m = 3, a = 2, b = 3).

Parent Chromosome 1:	(3, 2, **4, 5,** 3.5, 4.0, 5.3)
Parent Chromosome 2:	(2, 3, **2.5, 4.6**, 3.7, 6.0)
Offspring Chromosome 1:	(3, 2, **2.5, 4.6**, 3.5, 4.0, 5.3)
Offspring Chromosome 2:	(2, 3, **4, 5**, 3.7, 6.0)

Mutation is very similar to crossover expect that it takes place in one individual with possibility p_m. As long as n is fixed, the length of an individual does not change. Therefore randomly pick from $\left\{n_i\right\}_{i=1}^m$ and $\left\{L_k\right\}_{k=1}^n$, and put them with new random real values. See the example below (m = 3, pick n_2, L_1 and L_2).

Parent Chromosome	(3, 2, **4,** 5,**3.5, 4.0**, 5.3)
Offspring Chromosome	(3, 2, **3.7,** 5,**5.5, 2.9**, 5.3)

4. ILLUSTRATIVE EXAMPLE

The input data refers to Srinivas and Rao (2010): $c=1$ year; $P=1600$ items per year for supplier; $D=500$ items per year for retailer ($P/D=3.2$); $s=400$ \$ per setup for supplier; $s'=100$ \$ per setup for retailer; $h_1=4$ \$ per item per year for supplier; $h_2=5$ \$ per item per year for retailer; $T=100$ \$ per delivery batch from supplier to retailer; $T_i=\left\{30,30,30,30,30\right\}$ \$ per delivery batch from retailer to customers; $D_i=\left\{120,155,90,180,55\right\}$ items per year for customers; $\sigma_i=\left\{5,6,3,6,3\right\}$; and lead time is calculated as Table 1.

Table 1.Lead time crashing cost

lead time component, w	Lead time (days)	$(b_w - a_w)$days	Unit crashing cost c_w (\$/day)	Total crashing cost C_L (\$)
1	7	0	0	0
2	5.25	1.75	0.4	0.7
3	3.5	1.75	1.2	2.8
4	2.625	0.875	5.0	7.175

The range of decision variables are: $15 \le n \le 24$; $10 \le n_i \le 39$; and $2.625 \le L_k \le 7$.
Given $p_c = 0.75$, $p_m = 0.05$, the population size 175 and the termination criteria: to run 500 generations, the computational results are shown in Table 2.The total CPU time is only 4.753 seconds (CPU 2.66GHz, RAM 2.00GB, VC6.0).

Table 2. Computational results

n	15
n_i	15, 15, 12, 15, 19
L_k	4.862, 4.834, 7.000, 3.779, 3.996, 6.838, 6.081, 3.833, 6.307, 3.954, 3.792, 3.484, 3.531, 3.070, 7.000
Objectives	24199.5, 67.2105, 16.9976, 84.2105%

In all generations, the population evolves well and the progress can be seen obviously. Since there are 4 objectives, it cannot be drawn completely in a 3-D figure. Fix each objective of the four, and the Pareto front can be seen in Fig. 1~ Fig. 4, respectively.

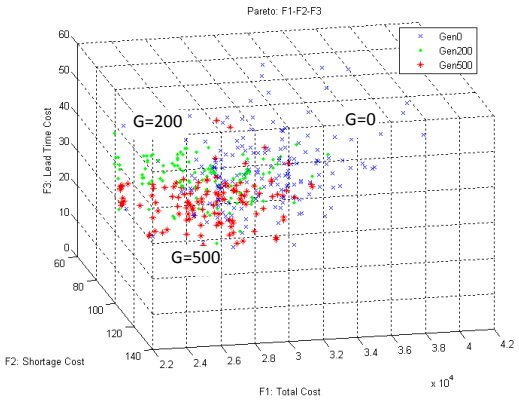

Fig. 1 Pareto front with objectives of total cost, shortage cost and lead time cost

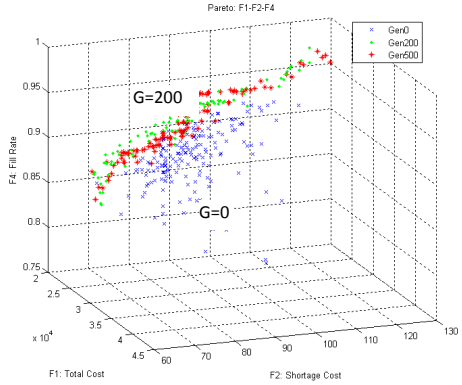

Fig. 2 Pareto front with objectives of total cost, shortage cost and fill rate

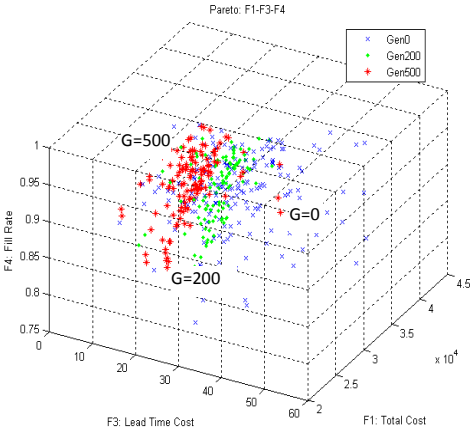

Fig. 3 Pareto front with objectives of total cost, lead time cost and fill rate

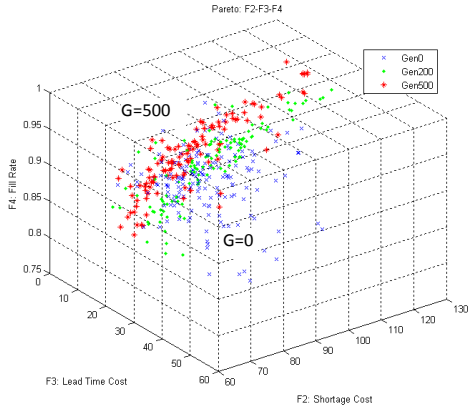

Fig. 4 Pareto front with objectives of shortage cost, lead time cost and fill rate

In Fig. 1 ~ Fig. 4, G=0 (blue points) represent individuals in the initial population, G=200 (green points) represent the 100th generation and G=500 (red points) represent the 500th generation or the final population. Through these figure we can see that the evolution goes well and there exist clear fronts for each generation. Therefore our algorithm can solve the problem fast and effectively.

5. CONCLUSIONS AND FUTURE SCOPE

NSGA-II used to study multi objective model with four objective variables such as, total cost, shortage cost, lead time cost and fill rate and a well converged set of Pareto optimal solutions are presented in this paper. It is observed that for a given set of input values of Srinivas and Rao (2010), the developed model of mutual benefit strategy gives fill rate of above 84% and the joint total cost is more compare to consignment stock strategy of Srinivas and Rao (2010) wherein the model is for single vendor and five buyers with single echelon where as our model is for single supplier – single retailer – five customers with two echelons. A three dimensional projection of chosen variables from four dimensional archived Pareto set obtained by NSGA-II is given through Fig.1~Fig.4. It can be noticed that as the number of objectives increases, a large population would be required to cover uniformly the multidimensional Pareto optimal.

Future studies have to be made with multiple products and can be extended to multiple retailers.

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DISTRIBUTED INNOVATION AS AN ENABLER OF LONG-TERM CUSTOMER SATISFACTION AND SUSTAINED COMPETITIVENESS UNDER TURBULENCE

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ABSTRACT

This paper investigates the subject of distributed innovation under the influence of turbulence. Distributed innovation is defined as a practice that leverages external and internal sources of innovation, as well as, external and internal paths to develop new products and processes. We view distributed innovation as consisting of three different types of external innovation relationships: customer collaboration; supplier collaboration; and ad-hoc innovation networks. In this research, the performance of the three different types of external innovation relationships is evaluated under different levels of market and technology turbulence to determine the most effective innovation practice under each market condition. We perform the analysis using data generated from agent-based simulation experiments. The research demonstrates that the choice of external innovation relationship is an important factor in product success, customer satisfaction, and long-term competitiveness of a firm. We also find that the nature of customer and technology turbulence in the environment has a significant impact on the effectiveness of the external innovation relationship that a firm employs.

Keywords: innovation management; supply-chain management; technology strategy; strategic management; business turbulence

INTRODUCTION

Product design and innovation is the first step often used by companies to achieve high perceived product quality [1]. Increasingly many companies are realizing the potential benefits that can be gained by leveraging external sources of innovation within the supply chain, with customers, or through partnerships with external organizations. At a recent summit, thirty executives unanimously agreed that leveraging the talent and technologies within their supply chain was a key to improving their firm's product development potential [2]. Supplier and customer integration has been identified as an important variable in creating successful new products [3] or reducing risk associated to market introduction [4]. With open innovation companies are entering into ad-hoc collaborations with external organizations to solve difficult problems and develop breakthrough innovations [5]. Distributed innovation is an integration of knowledge and expertise residing in different organizations [6]. In supply chains with highly distributed innovation patterns, the supplier can be a major driver of the innovations related to their systems or components [7],[8]

Many markets have business environments characterized by unpredictable and relentless change, and this condition of high volatility is referred to as business turbulence [9]. Business turbulence causes drastic changes in business conditions that pose significant challenges to the survival of companies existing in those markets. Understanding the key factors for product innovation success under conditions of uncertainty has been a well researched area [10], [11], [12], [13], [14]. Turbulent business environments influence the product innovation process through the creation of uncertainties regarding customer needs and technologies [10]. In volatile business environments, the supply chain of the firm is an important external relationship that can be leveraged to provide a trigger for detecting environmental changes and a source of new competencies [15]. Distributed innovation has been suggested as a strategy for coping with a highly uncertain and dynamic business environment.

Distributed innovation consists of three distinct types of external partnerships: customer collaboration; supplier collaboration, and ad-hoc innovation networks. Increased rate of technology development has created a question on whether the innovation of products should be technologically driven or user oriented [16]. Companies faced with the choice of implementing distributed innovation needs to be able select or prioritize the type of external innovation relationship that will result in the highest product success and long-term competitiveness. It is also not known how the type and level of turbulence in the business environment should influence the choice of the external innovation relationship. In this research we investigate the performance of the distributed innovation practices under customer and technology turbulence. The overarching question we sought to answer in this research is:

> *What type of external innovation relationship will maximize the strategic fitness of the firm operating under a specific level of customer and technology turbulence?*

The following research questions were developed to answer the primary research question:

Research Question 1 (Q1)
Does the use of an external innovation relationship provide a competitive advantage to a firm?

Research Question 2 (Q2)
Does the existence of customer or technology turbulence influence the results achieved by a firm using external innovation relationships?

Research Question 3 (Q3)
Is there an external innovation relationship that performs better than the other external relationships under specific business turbulence conditions?

This paper is organized as follows. We begin by briefly reviewing literature regarding distributed innovation and the different external innovation relationships. We then formulate our hypotheses regarding the effects of the different types of distributed innovation, customer and technology turbulence on the competitiveness and viability of the firm.

We expect our research to demonstrate a link between the type of external innovation relationship and the success of its products in the market, and that this relationship is moderated by the position of the market on the customer-technology turbulence quadrant. We expect to identify the type of external innovation relationship that performs best in each of the customer-technology turbulence quadrants.

LITERATURE REVIEW

Most products and services are developed and delivered through the actions of many collaborating organizations [7]. The process of innovation very often involves different collaborative relationships amongst different participating and cooperative firms, and the nature of these relationships have not received due attention in literature [7].

User-Centered Design and Customer Collaboration

Increasingly users are able to innovate for themselves [17]. User-centered innovation has many advantages over manufacturer centered innovation because users can develop exactly what they want [17]. User-centered innovation can complement the traditional manufacturer-centered model where manufacturers develop products and services in a closed system, and users exist only to provide their needs [17]. Veryzer et al. [16] define user-oriented design as a "sensitivity towards user/consumer design considerations in the context of extreme technology-based genesis and functional multiplicity/complexity of products". Vredenburg et al [18] define user centered design as composed of the following practices, active involvement of users to obtain clear understanding of user and task requirements, iterative design and evaluation, and an involvement of a multi-disciplinary team. Veryzer er al. [16] suggest that user-oriented design will result in products that are more readily accepted by the users because they are more appropriate to the needs of the users. Identifying new novel beneficial uses for products can be a challenge [19]. Von Hippel [19] identifies lead users as being a solution to identifying new uses and innovative attributes for products, and proposes a method for identifying lead users. Lead users are defined as those users that are ahead of the rest of the market in respect to changing desirability or newness of the attributes of the product [19]. Von Hippel [19] argued that although the needs of lead users could differ from the future needs of the rest of the market, market research data from lead users is richer and more accurate in "solution content" that data from non-lead users.

Supplier Innovation and Collaboration

In their analysis of the automotive supply chain Von Corswant and Tunälv [8] identified three levels of supplier involvement in innovation:

- "detailed controlled" part where the development is performed entirely by the manufacturer, for example the auto manufacturers;
- "black-box" parts where the auto manufacturer provides the functional requirement and the supplier performs the detailed engineering;
- "supplier proprietary" parts were the entire development is carried out entirely by the supplier.

Proactivity was also identified as a necessary characteristic of suppliers participating in collaborative product development partnerships [8]. One of the requirements of proactive

suppliers is the ability to develop key pertinent technologies themselves [8]. Kaufman et al. [20] defined a typology for classifying supplier collaboration relationships based on the level of collaboration with the supplier and the level of technological advancement of the supplier. Kaufman et al. [20] defined innovative collaborative suppliers as the "Problem-Solving Supplier" having characteristics of a black-box supplier and high differentiation. Schiele [21] identified 10 characteristics of innovative suppliers.

Open Innovation

Chesbrough [22] identified a shift in the pattern of innovation in companies, from the closed model that had served most large corporations well through the most part of the 20th century to a new open innovation model. Economic, strategic and environmental factors occurring in the later part of the 20th century was forcing many companies to adopt a more open approach to developing and commercializing technology [22], [23]. Unlike the closed innovation model where a company generates develops and commercializes its own ideas, under the open innovation model a firm commercializes both its own innovations, as well as, innovations by external sources, and it uses both internal and external pathways to bring innovations to market [22]. Companies practicing open innovation can use different means to acquire and bring innovations to the market including, subcontract / supplier relations, licensing, consortia, strategic alliances, joint venture, and networks [23], [24]. Gassman and Enkel [25] identified three process archetypes of open innovation. Companies practicing open innovation have demonstrated the ability to compete in the market place, as well as, in their rate of generation of innovation. Dahlander and Gann [26] provide an extensive survey of open innovation, and argue, using empirical data, that open and distributed innovation is not a new phenomenon, but that change is occurring to the more qualitative aspects of the innovation process affecting the ways in which external actors are involved.

RESEARCH METHODOLOGY

Our research investigates the influence of the type of distributed innovation distribution on product innovation success, customer satisfaction, long-term enterprise competitiveness and viability under the moderating influence of customer and technology turbulence. Our research methodology utilizes simulation experimentation and analyses. We develop a model for distributed supply chain innovation which we use in the rest of the research in exploring the different patterns of distributed innovation present in the supply chain. Next we conduct simulation

MODEL OF DISTRIBUTED SUPPLY CHAIN INNOVATION

In this research we classify distributed supply chain innovation according to the different approaches a firm can choose to combine internal innovation sources of innovation with external sources of innovation to improve the attributes of products desired by its customers. For the purpose of our research we identify three types of distributed supply chain innovation [Table 1].

Type of Innovation	Attributes	Examples
Supplier Innovation	• Firms utilizing supplier innovation identify and form long partnerships with a few innovative suppliers supplying key modules • Innovative suppliers contribute significant modules or subsystems of the product • Supplied modules have distinct attributes that are observable by customers and influence their purchase decisions • Innovative suppliers identify those features of tis module desired by the lead users • Innovative suppliers are responsible for the innovation concerning the attributes of the module • Suppliers innovate technologies that can be used to enhance and improve the performance of the attributes of the modules they supply	PC manufacturers leveraging the innovation of suppliers of complex components and assemblies Automotive manufacturers sourcing highly complex sub assemblies from suppliers like Magna Steyr [25]
Customer Collaboration	• Firms using customer collaboration establish close relationships with a few lead users amongst its customer base to exchange information about future customer needs. • Lead users could be the users with the expertise to innovated or early adopters of new innovations • Lead users recognize and experience their needs ahead of most of the market[27], [28] • Lead users provide feedback on new innovations to the innovating firm	Intuit [22]
Ad-hoc Innovation Networks	• Firms explore internal and external sources of innovation in the development of products • Technologies developed in partnership with external sources of innovation are made available to the environment without a goal of financial return[29] • External innovation paths are combined with internal innovations capabilities to improve the attributes of products • Duration of the partnerships are short-term often lasting the duration of a project • External innovation partners return to the environment with the knowledge and know-how gained from the partnership	IBM [22], Intel [8] P&G[8], [22] Philips [8] Pfizer [22]

Table 1: Types of Distributed Innovation

Our model of distributed supply chain innovation is an extension of the Enterprise Viability Analysis Test-bed (EVAT), an agent-based model of product innovation, brand marketing, and enterprise viability [30]. The purpose of the innovator agents in a business environment is to develop very attractive products and services that fulfill the needs of customers in the market. In most markets, each customer has a choice of products, which can represented by a set C_p consisting of the set of products that the customer will consider during each purchasing of that product. A customer agent's awareness of a product *b* from a particular innovator can be represented by the inclusion of that product *b* in the customer's choice set:

$$b \in C_p \qquad \text{(a)}$$

For this research we assume that the size of the choice set of each customer is finite, and that the customer's choice set C_p is a subset of all brand choices available in the environment:

$$C_p \subseteq C_E \qquad \text{(b)}$$

Where C_E is the set of all brands in the business environment

Each product consists of different multidimensional attributes [31], [32]. The perceived utility of a product to a customer agent is the sum of the perceived utility of each attribute weighted by the importance of the attributes to the customer agent:

$$U_{p,b} = \sum W_{p,i} X_{p,i,b} \qquad \text{(c)}$$

Where:
U = Utility of product p to a customer c
I = a product attribute
$W_{c,i}$ *= preference weight of customer c for attribute i*
$X_{p,i,b}$ *= perceived utility of customer c about attribute i for product p*

The customer's knowledge of each product's attributes is defined in terms of the perceived utility of all the attributes of the product which represent the product features that are important and provide some utility to the customer. The perceived utility of a product *p* to the customer agent is the total sum of the utility the customer associates with each of the attributes of the brand. The decision by a customer to select a product from the multiple products in its choice set is conceptualized as a multi-attribute utility theory choice process [31], [33], [32]. The customer's decision making process is assumed to be based on immediate utility maximization, in which each purchase decision is made to maximize the expected utility from the purchase, as opposed to a forward looking objective maximization where a customer could purchase a product to gain information about its quality for future purchases [33].

Technology Innovation

In product innovation a technology can be conceptualized as a resource that can be applied in the development of one or more product-related attributes. Each technology is created and made available in the business environment by one of the different innovator agents, which could be companies, universities, or research organizations. Traditionally one of the benefits to the innovator of a technology comes from the period of appropriability during which the innovator has exclusive access to the technology, and can make use of the technology to gain competitive advantage in the innovation of its products. At the end of the appropriability period, technologies can be acquired by other innovators for application to the development of their products. Not every technology can be applied in the improvement of every product attribute, so in our model we introduce the concept of the technology attribute applicability t_a as a global variable that defines the applicability of a technology *t* to the development of a particular product attribute *a*. The technology attribute applicability t_a is a binary variable, in

which a value of *false* implies the technology cannot affect the product attribute *a*, and value of *true* implies that the technology has some effect on, and can be used to improve the product attribute *a*. Even after acquiring a technology an innovator agent needs to have the knowledge required to apply the technology to the improvement of the applicable attributes. The concept of the technology expertise represents the experience and skills that an innovator agent acquires through its cumulative investment of time and resources to the application of a particular technology to the development of a specific attribute. It is based on an inductively derived theory of the potential for technological improvement, which suggests that the magnitude of improvement in the performance of a product attribute in a given period of time, or resulting from a given amount of engineering effort, differs as technologies become more mature [34], [35]. We assume that during product innovation the cumulative level of technology expertise that has been gained over time is directly applied to improving the utility ($U_{q,t,a}$) of a product attribute, and that utility increase takes the form of a technology *S*-curve [Illustration 1].

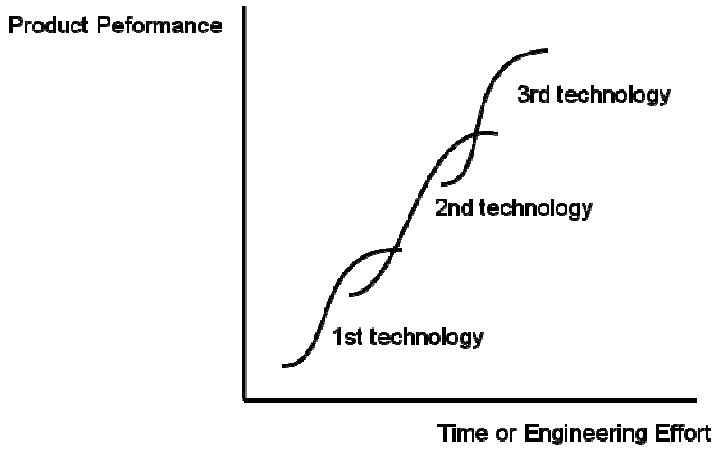

Illustration 1: Technology S-Curve and Product Performance (Adapted from [35])

The impact of each technology on the attribute of a product is represented by the *S*-curve line for that application of the technology, and it shows an initial period of relatively slow rate of improvement in product performance from the technology, followed by a region of rapid improvement in product performance that occurs as the technology is better understood. This is then followed by a region with a slowing rate of product performance as the limits of the technology on that product attribute are reached [34]. Over the life of the product the impact of *S*-curve of multiple technologies on the utility of an applicable product attributes forms a set of intersecting *S*-curves as firms switch from more mature technologies to less mature technologies in search for improved product performance. We use a Sigmoid function to model the technology *S*-curve, where the utility derived from the application of that technology on the product attribute ($U_{q,s,a}$) at a point *r* in the technology *S*-curve is modeled by:

$$U_{q,s,a} = G_{s,a}\left[\frac{1}{1 \square e^{R-2r}}\right] \qquad \text{(d)}$$

Where, r is the cumulative amount of resources invested by an innovation agent (q) in developing a technology expertise that enables the improvement of an attribute (a) using a technology (s). The maximum improvement potential of the technology (t) on the utility of the attribute (a) is $G_{s,a}$ and R is the maximum amount of research and development investment resources required to achieve the full development potential of the technology expertise on the attribute. R is a randomly assigned global variable. For this research, we assume a purely additive effect between technologies being applied to the same attribute, with no interaction between any two technologies.

Product Innovation

As stated previously every product has multiple functional attributes that enable it to fulfill the requirements desired by the customer agents. Each customer agents places a level of importance to each attribute, and this importance is used to weigh the utility that attribute contributes to the product. The ability to develop products that perform strongly on those attributes salient to the customer agents is critical to the competitiveness and success of the product in the market place, and it is a critical aspect of product innovation. We assume that the amount of resources (consisting of technology, time, and people) that an innovator agent allocates to the development of a particular product attribute is proportional to the importance the customer agents associate with that attribute. Innovator agents determine the importance that should be associated with each attribute through information obtained from market research surveys of customer agents. The importance of each attribute to the customer agents is estimated from the mean importance weight for that attribute taken from a sample of customer agents. The proportion of resources (W_a) allocated to the development of a product attribute is based on the attributes relative importance compared to other functional attributes, and it is computed as:

$$W_a = \frac{\frac{\sum_p S_{p,a}}{n}}{\frac{\sum_p \sum_n S_{p,a}}{n}} \qquad \text{(e)}$$

Where:
$S_{p,a}$ *= preference weight given to attribute a by customer p*
a *= a product attribute*
p *= number functional attributes*
n *= number of customer surveyed*

Customer collaboration can improve the ability of an innovator to satisfy the needs of its customers by enabling them to quickly identify the needs of its lead users and be able to improve those attributes critical to satisfying those needs [17].

During each tick of the simulation, each innovator agent applies an allocated proportion of its resources to a technology expertise for the purpose of improving an attribute of its product. To achieve the maximal improvement in the utility of the product per unit resource expended,

each innovator agent selects from a "menu" of available technologies one expertise area that will yield the largest amount of improvement to the attribute given the amount of expended resource. The most effective technology expertise is selected by estimating (via computation) the expected gains that will be achieved by investing the resource each of the technology expertise. Once the most appropriate technology expertise has been selected, the innovator agent applies the resources to developing the technology expertise, and the utility gain achieved from the improvement of the technology expertise is applied to the improvement of the attribute of the product under development. Periodically, on a schedule determined by a fixed product release frequency (a simulation parameter), the innovator agent releases a newly developed product (or module) to the market (or a supply chain partner). The release of the improved product into the market makes it available to be purchased by customer agents.

SIMULATION EXPERIMENTS

The first question in this research was to determine if the use of external innovation relations provided a competitive advantage to a firm. To answer this question we formulated the following three research hypotheses:

Hypotheses 1 (H1):
A firm utilizing customer collaboration will experience higher perceived quality, market share, and viability than one not using customer collaboration under similar market conditions.

Hypotheses 2 (H2):
A firm utilizing supplier collaboration will experience higher perceived quality, market share, and viability than one not using supplier collaboration under similar market conditions.

Hypotheses 3 (H3):
A firm utilizing ad-hoc innovation networks will experience higher perceived quality, market share, and viability than one not using ad-hoc innovation networks under similar market conditions.

The fourth hypothesis (*H4*) was developed to answer the second research question (*Q2*), which was to determine if the existence of market or technology turbulence had any influence on the results of a firm using either one of the external innovation relationships.

Hypotheses 4 (H4)
Under conditions of high market turbulence or high technology turbulence a firm utilizing external innovation will have a higher perceived quality, market share, and viability than firms in a similar market-place not utilizing external innovation.

Our final hypothesis (*H5*) was developed to identify whether one external innovation relationship performed better than the other two external relationships.

Hypotheses 5 (H5):
A firm utilizing customer collaboration exclusively will perform better than one utilizing supplier collaboration or ad-hoc innovation networks.

Each of the simulation experiments was modeled with one innovator agent representing the focus enterprise and ten homogeneous innovator agents representing competing enterprises. All enterprises in the experiments were competing for demand created by a small representative sample of 1,000 customer agents. The simulation experiments in this research were designed as non-terminating simulations. Non-terminating or steady state designs are utilized when interest is in the long-run performance of the system [36]. From our initial experiments we determined that a run length of 7,200 ticks was sufficient for the simulation to attain a steady-state and yield an acceptable results. At the end point of each run (of 7,200 ticks) data was collected for each of the response variables [Table 2]. Each of the viability scenarios was performed with 30 replications for each factorial point.

Variables	Description	Values
Independent Variables		
Use of supplier Collaboration	Indicates whether the focal enterprise engages in supplier collaboration	True/False
Use of customer collaboration	Indicates whether the focal enterprise engages in customer collaboration	True/False
Use of ad-hoc Innovation networks	Indicates whether the focal enterprise engages in ad-hoc innovation networks	True/False
Moderating Variables		
Market turbulence	The frequency in which the tastes of the customers are changing	Low turbulence / High Turbulence
Technology turbulence	The rate of technology change in the market over a given time period	Low turbulence / High Turbulence
Response Variables		
Perceived quality	The customer's belief about the levels of utility for attributes of the product made the focal company	
Market share	The market share of the focus company at the end of the simulation	
Viability	The probability of survival of the focus enterprise at the end of the simulation, where its survival is defined as it having a market share greater than zero at the end of the simulation	

Table 2: Simulation Experiment Variables

The agent based simulation model was developed using the Repast Agent Modeling toolkit [37]. Different simulation scenarios were developed and executed in the experiments to generate the data required to test each of the hypotheses. All simulation experiments were subject to the following conditions:

- The focus enterprise and the competitor enterprises were all introduced into the market at the beginning of the simulation, and began advertising to customers and

developing products immediately.

- There is no restriction on competition between the focus enterprise and any of the competitor agents.
- Other than a seed amount to begin the simulation, all resources for product innovation and advertising came from sales to the customer agents.
- All resources owned by the focus enterprise or its competitor enterprises were invested either in advertising or product innovation.
- All customer agents could equally be reached by the advertising of the focus enterprise and the competitor agents.
- A customer agent had the resources to purchase a product whenever it had a demand for it.
- The customer agents did not incur any switching cost or penalty for switching from one product to another.

RESULTS AND DISCUSSION

The results of each experiment was analyzed using the following steps:

1. ANOVA tests were performed to determine the influence of the choice of external innovation network and turbulence on market share and perceived quality of the focus firm.
2. Logistics regression tests were performed to determine the influence of the choice of external innovation networks and turbulence on the probability of survival of the focus firm.
3. Systems dynamics models were developed to analyze the dynamic behavior of the focus enterprise.

All ANOVA and logistics regression tests were performed using the ***R*** system, an environment for data exploration and analysis [38].

Customer Collaboration

Hypotheses 1 (H1): *A firm utilizing customer collaboration will experience higher perceived quality, market share, and viability than one not using customer collaboration under similar market conditions*

The effect of customer collaboration on the perceived quality, market share, and viability of the firm was tested through an experiment in which the use customer collaboration was used the only factor and market and technology turbulence were moderating variables, taking on *high* and *low* levels. From the ANOVA results we

Source of Variance	SS	DF	MS	F
Use of customer collaboration	0.03580	1	0.03580	6.5889^
Market turbulence	0.00012	1	0.00012	0.0229
Technology turbulence	0.00246	1	0.00246	0.4530
Use of customer collaboration x Market turbulence	0.00869	1	0.00869	1.5995
Use of customer collaboration x Technology turbulence	0.02049	1	0.02049	3.7707
Market turbulence x Technology turbulence	0.00144		0.00144	0.2655
Use of customer collaboration x Market turbulence x Technology turbulence	0.00419	1	0.00419	0.7706
Error	1.26056	232	0.005433	
Total		**238**		
*** = significant at 0; ** = significant at .001, * = significant at .01, ^= significant at .05				

Table 3: ANOVA: Influence of Customer Collaboration on Firm Perceived Quality

From the ANOVA we observe that the user of customer collaboration has a highly significant effect (.01) on the market share of a firm. From the ANOVA showed no interaction effect between customer collaboration and either technology and market turbulence on the final market share of the focus enterprise.

Source of Variance	SS	DF	MS	F
Use of customer collaboration	1.0059	1	1.0059	9.6464*
Market turbulence	0.0217	1	0.0217	0.2083
Technology turbulence	0.0195	1	0.0195	0.1874
Use of customer collaboration x Market turbulence	0.0025	1	0.0025	0.0240
Use of customer collaboration x Technology turbulence	0.0377	1	0.0377	0.3611
Use of customer collaboration x Market turbulence x Technology turbulence	0.2309	1	0.2309	0.7717
Error	24.1918	232	0.1043	
Total	**25.5100**	**239**		
*** = significant at 0; ** = significant at .001, * = significant at .01, ^= significant at .05				

Table 4: ANOVA: Influence of Customer Collaboration on Firm Market Share

The lack of interaction effect between customer collaboration and both types of turbulence is visible by plotting the predicted market share of the focus enterprise from the ANOVA against the use of customer collaboration [Illustrations 2, 3]. Although, the presence of technology turbulence changes the gradient of the predicted market share line, it is not sufficient to have a significant effect on the use of customer collaboration [Illustration 3].

Illustration 2: Interaction of Customer Collaboration and Market Turbulence on Predicted Market Share

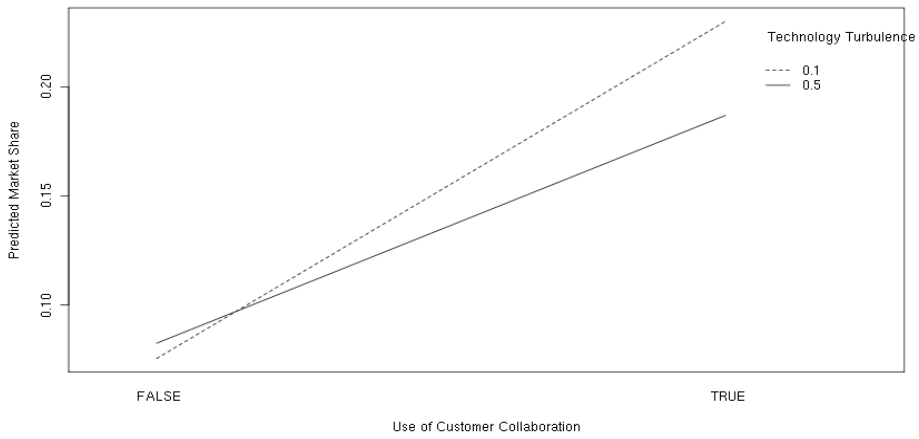

Illustration 3: Interaction of Customer Collaboration and Technology Turbulence on Predicted Market Share

Comparing the mean observed final market share of the focus enterprise when it is not using

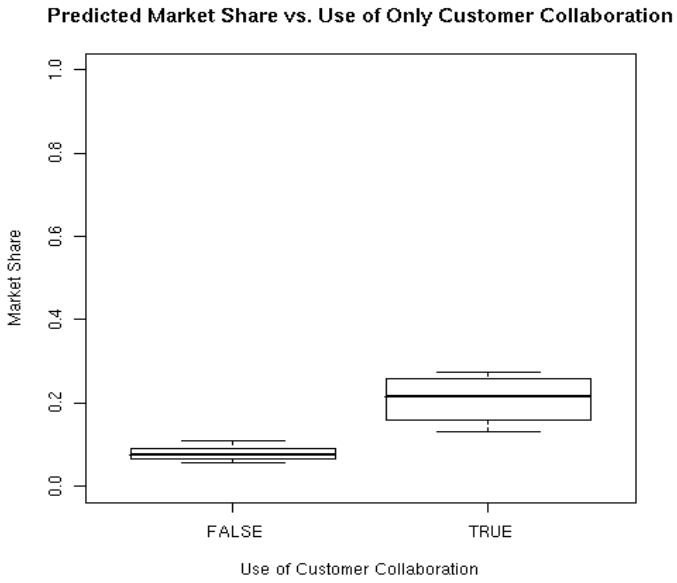

Illustration 4: Predicted Market Share With and Without Use of Customer Collaboration

customer collaboration to when it is using customer collaboration we observe an increase in market share at levels and combinations of market and technology turbulence. With the use of customer collaboration the focus enterprise is able to increase its competitiveness which translates into increased market share [Illustration 4].

An interesting area is the turbulence region of *High Technology* turbulence and *Low Market* turbulence [Table 5], which is the least competitive region for the focus enterprise when it is operating without customer collaboration. The reason for the lack of competitiveness of the focus enterprise is that under a high technology turbulence environment its competitors have an high rate of technology development which they are able to use in the improvement of product attributes, which results in higher perceived quality and market share for the competitors. When the focus enterprise utilizes customer collaboration it is able to increase its competitiveness by being first to identify the attributes important to customers, and by focusing its resources on the development of those attributes is able to achieve a higher perceived quality resulting it improved competitiveness which results in the doubling of its final expected market share [Table 6].

Market Turbulence	Technology Turbulence: Low	Technology Turbulence: High
Low	0.08	0.06
High	0.08	0.11

Table 5: Average Market Share without use of Customer Collaboration

Market Turbulence	Technology Turbulence: Low	Technology Turbulence: High
Low	0.27	0.13
High	0.19	0.24

Table 6: Average Market Share with use of Customer Collaboration

Customer Collaboration and Firm Viability

To analyze the impact of customer collaboration on the potential viability of an enterprise, a logistics model *(a)* was formulated to assess the impact of significant factors (on firm market share) on the viability of the firm.

$$\log_e\left[\frac{p(Survival)_{Enterprise}}{1-p(Survival)_{Enterprise}}\right] = B_1 \times Customer\,Collaboration_{NO} + B_2 \times Customer\,Collaboration_{TRUE} \quad (a)$$

The results of fitting the logistics regression model to *(a)* are shown in Table 7 below. The use of customer collaboration is found to be highly significant to the viability of the firm at a .01 level, which is an expected result given its significant impact on firm market share. From its coefficient in the logistics regression model, the change in probability of survival of the focus enterprise as a result of using customer collaboration is:

$$\Delta P(Survival)_{Enterprise} = e^{B_2} = e^{.8473} = 2.334 \quad (b)$$

This implies a more than doubling of probability of survival of the enterprise as a result of using customer collaboration.

Source of Variance	Coefficient	Standard Error	Z Value	Pr(>|z|)
Intercept	-1.7346	0.2557	-6.785	1.16e-11 ***
Use of customer collaboration: *TRUE*	0.8473	0.3251	2.606	0.00916 **
*** = significant at 0; ** = significant at .01, * = significant at .05				

Table 7: Logistics Regression: Influence of Customer Collaboration on Firm Viability

Supplier Collaboration

Hypotheses 2 (H2): A firm utilizing supplier collaboration will experience higher perceived quality, market share, and viability than one not using supplier collaboration under similar market conditions.

The effect of supplier collaboration on the perceived quality, market share, and viability of an enterprise was tested using a simulation experiment in which the focus enterprise using (or not using) supplier collaboration competed with other enterprises under different conditions of market and technology turbulence. The results of the experiment were evaluated by performing ANOVA tests to determine the influences of supplier collaboration and turbulence on perceived quality and market share of the firm. The ANOVA results of the market share test are shown below [Table 8]. The use of supplier collaboration was found to be highly significant (at a 0 level) to the perceived quality and final market share of the enterprise.

Source of Variance	SS	DF	MS	F
Use of supplier collaboration	1.2071	1	1.2071	12.7391***
Technology turbulence	0.0136	1	0.0136	0.1432
Market turbulence	0.3011	1	0.3011	3.1783
Use of supplier collaboration x technology turbulence	0.0774	1	0.0774	0.8166
Use of supplier collaboration x market turbulence	0.0086	1	0.0086	0.0911
Use of supplier collaboration x Market turbulence x Technology turbulence	0.1163	1	0.1163	1.2271
Error	21.9827	1	0.0948	
Total	**23.7068**	**232**		
*** = significant at 0; ** = significant at .001, * = significant at .01, ^= significant at .05				

Table 8: ANOVA: Influence of Supplier Collaboration on Firm Market Share

An analysis of the impact of supplier collaboration on the average observed market share reveals that the use of supplier collaboration increases the average market share over all levels and combinations of turbulence [Table 9].

Market Turbulence	Technology Turbulence: Low	Technology Turbulence: High
Low	0.20	0.19
High	0.20	0.31

Table 9: Average Market Share with use of Supplier Collaboration

Supplier Collaboration and Firm Viability

The logistics model was formulated to analyze the influence of supplier collaboration on the viability of the firm.

$$\log_e\left[\frac{p(Survival)_{Enterprise}}{1-p(Survival)_{Enterprise}}\right] = B_1 \times Supplier\ Collaboration_{NO} + B_2 \times Supplier\ Collaboration_{TRUE} \quad (c)$$

The results of the logistics regression *(c)* reveals that the use of supplier collaboration is highly significant (at a level of 0) on the probability of survival of the enterprise [Table 10].

Source of Variance	Coefficient	Standard Error	Z Value	Pr(>|z|)
Intercept	-1.6024874	0.3560267	4.501	6.76e-06***
Use of supplier collaboration: *TRUE*	1.3407923	0.2903909	4.617	3.89e-06***
*** = significant at 0; ** = significant at .001, * = significant at .01, ^= significant at .05				

Table 10: Logistics Regression: Influence of Supplier Collaboration on Enterprise Viability

Supplier collaboration is found to increase the probability of survival of the viable enterprise by a factor of 3.822, which is significantly higher than the factor of 2.332 that was computed from the use of customer collaboration.

$$P(Survival)_{Enterprise} = e^{B_2} = e^{1.3408} = 3.822 \quad (d)$$

Ad-hoc Innovation Networks

Hypotheses 3 (H3): A firm utilizing ad-hoc innovation networks will experience higher perceived quality, market share, and viability than one not using ad-hoc innovation networks under similar market conditions.

The analysis of results of a similar experiment evaluating the use of ad-hoc innovation networks reveals that the use of ad-hoc innovation networks is a highly significant factor to the market share and viability of an enterprise [Table 11, 12]. The use of ad-hoc innovation is also seen to increase the probability of survival of an enterprise by a factor of 3.25 *(e)*, which is significantly higher than what is computed from the use of customer collaboration.

$$P(Survival)_{Enterprise} = e^{B_2} = e^{1.1787} = 3.2501 \qquad (e)$$

Source of Variance	SS	DF	MS	F
Use of ad-hoc innovation networks	3.8101	1	3.8101	34.0555***
Technology turbulence	0.0015	1	0.0015	0.0135
Market turbulence	0.0424	1	0.0424	0.3792
Use of ad-hoc innovation networks x technology turbulence	0.0186	1	0.0186	0.1659
Use of ad-hoc innovation networks x market turbulence	0.0617	1	0.0617	0.5517
Use of ad-hoc innovation networks x Market turbulence x Technology turbulence	0.0101	1	0.0101	0.0906
Error	25.9557	232	0.1119	
Total				
*** = significant at 0; ** = significant at .001, * = significant at .01, ^= significant at .05				

Table 11: ANOVA: Influence of Ad-hoc Innovation on Market Share

Source of Variance	Coefficient	Standard Error	Z Value	Pr(>|z|)
Intercept	-1.8718	0.2685	-6.97	3.16e-12***
Use of open innovation: *TRUE*	1.1787	0.3311	3.56	0.000371***
*** = significant at 0; ** = significant at .001, * = significant at .01, ^= significant at .05				

Table 12: Logistics Regression: Influence of Ad-hoc Innovation on Enterprise Viability

Evaluating and Comparing the Different Types of External Innovation

Hypothesis 4 (H4): Under high market or technology turbulence a firm utilizing external innovation will have a higher perceived quality, market share, and viability than firms in a similar market-place not utilizing external innovation.

Hypothesis 5 (H5): A firm utilizing customer collaboration exclusively will perform better than one utilizing supplier collaboration or ad-hoc innovation networks.

From the results of the three experiments performed for each of the different types of external innovation relationships it is observed that the use of any one of the three external innovation relationships will increase the experienced quality, market share, and viability of an enterprise. We found that *Hypothesis 4* was supported by the results of the experiments which showed that all three types of external innovation relationships increased the perceived quality, market share, and viability at all levels and combinations of market and technology turbulence. We also observed that customer collaboration provided the least improvement to the viability of a firm, when compared to the other types of external innovation networks. Both supplier collaboration and ad-hoc innovation networks provided the highest improvement to the viability enterprise, with small difference between both of them. The results of the experiment do not support *Hypotheses 5*, and to the contrary suggest that the use of customer collaboration provides the least improvement in potential viability of the firm. We argue that the reason why customer collaboration performs weakest out of the all forms of external innovation relationships is because although customer collaboration enables a firm to quickly identify the salient product attributes and focus resources on the development of those attributes, it does not provide as many paths in the improvement of those attributes. This is especially key when the performance improvements that can be attained from applying a technology to an attribute begins to plateau over the long-term (as a result of reaching the upper end of the *S*-curve), the only means of improving the attribute will be using another technology that is applicable to the attribute. This is the option that supplier collaboration and ad-hoc innovation networks provide that is absent in customer collaboration, and which we believe accounts for the performance difference.

CONCLUSION

We have presented a typology for the categorization of distributed innovation in the supply chain. Our typology identifies three sources of innovation, the customer, the supplier, and those external to the supply chain. We posited market and technology turbulence as environmental factors affecting the performance of the different patterns of distributed supply chain innovation. We compared the performance of the three types of distributed supply chain innovation through the use of simulation experimentation to assess the impact of the type of distributed supply chain innovation on enterprise performance, as measured by, perceived quality, market share, and long-term enterprise viability. The results of our experiments indicates that the use of any type of distributed improves the perceived quality, market share, and viability of the enterprise. Our results do not indicate that either market or technology turbulence has any interaction with the influence of any of the types of distributed supply chain innovation. Our results however do show that over the long-term both supplier collaboration and ad-hoc innovation networks perform better that customer collaboration, and we attribute this behavior to higher impact of the technology *S*-curve plateau on firms employing only customer collaboration, who have limited access to external technologies that they can utilize to overcome this performance plateau.

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OUT-INNOVATING THE INNOVATORS: REPLICATION AND SUCCESS OF LOW-COST CARRIER MODEL IN INDIA

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ABSTRACT

Innovation can be the introduction of improved goods or services through the enhancement in attributes. According to a 2007 National Knowledge Commission report on "Innovation in India" 17 percent of the large firms rank Innovation as the top strategic priority and 75 percent rank it among the top 3 priorities. Service innovation can occur through an offering not previously available to a firm's customers resulting from additions to the service concept (Menor et al., 2002). Several service industries have seen a surge in competition due to innovation schemes, and airlines are no exception. Although the main service provided by airlines is transport, considerable innovations have taken place to make it a profitable proposition.

While considerable literature is available specifically on Innovation, this paper is an attempt to develop an understanding on Innovation in an emerging market like India, implications for airline services and impact of Low Cost Carriers on the competition landscape.

Keywords: Innovation, Airline Industry in India, Low-Cost Carrier Model

INTRODUCTION

In creating competitiveness, the most important dimension is imagination. The Economist, in an article on 4th December, 1999, pointed out why, in the global context, the bigger companies are afraid of the smaller companies. It said:

"Innovation has become the buzzword of American management. Firms have found that most of the things that can be outsourced or re-engineered and have been (worryingly, by their competitors as well) the stars of American business, tend today to be innovators such as Dell, Amazon, and Wal-Mart, which have produced ideas or products that have changed their industries."

With liberalization and globalization, organizations are facing incessant change and competition. To sustain in this ever changing environment, it is imperative for organizations to innovate at every level, be it technology, processes, or products. Innovation has become an essential component of organization development. It initiates and focuses change in organizational action within the range of possibilities created by innovative potential. It is thus a strategic element of organizational survival and development.

In today's environment, every business wants to be more creative in its thinking. According to a study, 75 percent of Chief Executive Officers of the fastest growing companies claim that their strongest competitive advantage is unique products and services and the distinct business processes that power them to market- innovation by another name (Smith, 2005). In another survey, Boston Consulting Group reported that 90 percent of organizations believed innovation to be a strategic priority for 2004 and beyond. Leading companies continuously seek out and institutionalize the insights and tools they would need if they were to stay at the leading edge and be top-rated stars in their sector. Some companies build enduring capacities for breakthrough innovation.

The airline industry has been plagued by several factors such as overcapacity, commoditization of offerings, cut-throat rivalry exacerbated by the entry of low-cost carriers, and intermittent periods of disastrous under-performance (Costa et al., 2002). In 2006, the global airlines industry suffered a net loss of USD 500 million or 0.1 percent of revenues, accumulating net losses of USD 42 billion between 2001 and 2006 (International Air Transport Association, 2007). In 2007, the airline industry made a modest net profit of USD 5.6 billion on revenues of USD 490 billion, equivalent to less than 2 percent margin (International Air Transport Association, 2008). The outlook from 2008 onwards remains bleak. Not surprisingly, the industry is regularly rated as one of the worst performing industries in the Fortune Global 500 rankings (Heracleous & Wirtz, 2009).

WHAT IS INNOVATION?

Innovation is an old but evolving phenomenon. And it has accelerated with the Industrial Revolution of the 21st century (Caraca et al., 2007). It may be defined as "the process of bringing new problem-solving ideas into use" (Glynn, 1996). It is an application of new ideas to the products, processes, or any other aspect of a firm's activities. It is concerned with the process of commercializing or extracting value from ideas; and is in contrast with "invention" which need not be directly associated with commercialization. In economic terms, "innovation" can refer to technological advancement, or to the process by which companies create new economic value by using resources more effectively (Randolph, 2006). Innovation is a process by which organizations use their skills and resources to develop new goods and services or to develop new production techniques and operating systems so that they can better respond to the changing needs of the customer (Burgelman & Maidique, 1988). Innovation is a specialized kind of change. It is a new idea applied to initiating or improving a product, process, or service (Van de Ven, 1986).

Bubner (2001) defines innovation in organizations as a series of processes that are designed and managed to create and apply ideas and knowledge, directed at value creation, and capture and lead to new and different products or services, processes, technologies, ventures, and business systems. His assertion is that innovation is a process and not an object or an outcome and hence, it refers to both ideas and knowledge.

All innovations involve change, but all changes do not necessarily involve innovation. All organizations should innovate as innovations can result in spectacular success for an organization. Apple Computers changed the face of the computer industry when it introduced its personal computer. Honda changed the face of the small motor bike market when it

introduced small 50 cc motorcycles. Toyota revolutionized the car production system to increase product quality. The importance of innovation is increasing through shorter product life cycles, increased competition, changing customer behaviour, and technological progress (Leimeister & Glauner, 2008).

If Innovation becomes successful, it can drastically change the organization. But, it also involves a high level of risk because the outcome of research and development activities is often uncertain. Most innovations are costly and the cost of faulty assessment of innovation may prove to be fatal for the organization. Therefore, the organization needs to weigh each idea carefully. Of all kinds of revolutionary change, innovations have the best prospects for long term success but also greatest risks. Therefore, the way in which organizations can stimulate innovation, and can manage the innovation process to increase the chance of successful learning taking place is very important.

Service industries are sometimes characterized as low-value, low-skill sectors that do little to advance the economy's competitive position. The service sector, of course, encompasses a broad range of highly diversified activities (Gellatly & Peters, 1999). Some innovations involve new products; others involve new processes (Baldwin & Gellatly, 1998). The fact that a firm claimed to have 'innovated' need not mean it developed its own innovation(s). According to a study of innovators (Howells & Tether, 2004), about half the firms claimed that they had mainly developed their own innovations, with a third declaring the innovations were developed jointly with others, and about a fifth admitting they were mainly developed by others. These proportions differed significantly between sectors, with the external development of innovations being most common in transport services.

Innovation is the successful exploitation of new ideas. Firms innovate in order to gain an advantage over competitors, perhaps by becoming more cost-efficient, by tailoring products to meet unique customer requirements, or by improving access to service in remote areas (Gellatly & Peters, 1999). This applies to all firms in the economy and is equally relevant to innovation in the airline industry (Xinhui, 2008). Although the main service provided by airlines is transport, considerable innovations have taken place to make it a profitable proposition. Stiff competition has made innovation as an everyday occurrence, and has resulted in the emergence of Low-Cost Carrier (LCC) model. These cheap, no frill carriers (Ryanair, EasyJet) have revolutionized the airline industry, making air travel affordable for all and forcing the established carriers to reengineer their operations. The LCC model has surely been one of the most successful things to happen in the airline industry. Innovation is particularly important for airline services, as one of the key features of successful experiences is considered to be continuous renewal or refreshment of the experience to keep exceeding customer expectations.

The first LCC to rival major carriers was Southwest in the United States of America. Introduced in 1971, it implemented the low-cost model comprising low fares, high frequency service, no free food on board, no assignment of seat during check-in; and flights to secondary airports (Anon, 2006). However, it was in 1990s that the European airlines started to catch up when EasyJet and Ryanair entered the market. After this time, there was a surge of competition as LCCs became a common phenomenon. Air travel had been synonymous with luxury and catered to upper class of the society but this was redefined by the low-cost

airline model, because one key objective of low-cost carriers has been to increase their reach to a larger segment and provide services at an affordable rate.

INNOVATION- AN INDIAN PERSPECTIVE

India's recent growth has been impressive, with real GDP rising by over 8 percent a year since 2004; accompanied by an increase in innovative activities. Growth has been driven by rapid expansion in export-oriented, skill-intensive manufacturing and, especially, skill-intensive services. The literature on Innovation in India has largely been silent on the specific experiences of the services sector with Innovation. With the changing composition of the Indian economic growth to be increasingly services led, National Knowledge Commission sees Innovation playing a crucial role in this growth.

Today, India is acknowledged as an innovator at a global scale particularly for services. However, there is heterogeneity in the Indian economy and therefore innovation in Indian context demands a broader definition of innovation. This definition could refer to innovation that distinguishes between "new to the world" innovation (creation and commercialization), "new to the market" knowledge (diffusion and absorption), and explicit promotion of innovation to reduce poverty (inclusive innovation). India is emerging as a global hub of Innovation. Recent acquisitions by Indian companies in the global market also signify an increasing trend in Indian companies to leverage the various possibilities of Innovation that the global market offers. The inherent reasons for India's innovative activity are the existence of an open society, a technology base, democracy, diversity, an environment that allows experimentation, a vibrant capital market, availability of young population necessary as human capital to fully reap the demographic dividend, full and free competition in the private sector, opportunities for technological leapfrogging as well as the availability of necessary infrastructure.

AIRLINE INDUSTRY IN INDIA

The history of Civil Aviation in India started with its first commercial flight on February 18, 1911. In December 1912, the first domestic air route was opened between Delhi and Karachi by the Indian State Air Services (in collaboration with Imperial Airways of the UK). This marked a new beginning in India. Three years later, Tata Sons started a regular airmail service between Karachi and Madras. At that time, there were a few transport companies operating within and also beyond the frontiers of the country, carrying both air cargo and passengers. Some of these were Tata Airlines, Indian National Airways, Air Service of India, Deccan Airways, Ambica Airways, Bharat Airways, and Mistry Airways. The Tata Airlines was converted into a public limited company in the year 1946 and renamed Air India Limited. In 1948 a joint sector company, Air India International was established by the Government of India and Air India, which was headed by J.R.D. Tata. In 1953, the Parliament passed the Air Corporation Act. Air India International and Indian Airlines Corporation came into formal existence and Air India International was nationalized. In 1991, the Indian economy began to liberalize. It became more open and market-oriented, and the process of deeper integration with the world economy had begun. These reforms were extended to the civil aviation sector in 1994 when the Air Corporations Act of 1953 was repealed. This enabled the entry of private carriers who could now offer scheduled services.

The market did not grow large enough for all these players to compete. There was a shake-out and many airlines went bankrupt. Jet Airways and Sahara Airlines (which became Air Sahara in 2000) were the only surviving carriers (Natarajan & Sridevi). These developments in Indian Airline Industry can be divided into three stages (Anon, 2009b):

Stage I: Till mid 1990s
Although several private players like Jet Airways, Air Sahara, ModiLuft, Damania Airways, NEPC Airlines, and East West Airlines entered the market, but still the primary motive was the protection of national airlines. Tremendous restrictions put on these carriers led to the collapse of the entire airlines industry. All the players died except Jet Airways and Air Sahara.

Stage II: Period of Inaction (1995-2003)
This was a period when no attention was given to the airline sector. It was marred by too many regulations and total neglect. Even national airlines faced the shortage of capital. Aircraft purchases of these flag carriers were suffering and at the same time there was no infrastructure development carried out. During this phase, Europe saw the emergence of low-cost carriers, which transformed the airline travel and initiated a period of traffic boom in other markets. This period was marked with a clear lack of strategic intent and this put India far behind the rest of the world.

Stage III: Period of rapid action (2004 onwards)
It was a period when the airline sector got the attention it deserved. India's first low-cost, no frill carrier Air Deccan was allowed to start operations in South India. Kingfisher Airlines, SpiceJet, GoAir and Paramount Airways entered the industry. Open skies agreements were established with many countries allowing Indian carriers more access abroad. Now, aircraft carriers with a minimum of 5 years of operation and 20 aircrafts can operate on international routes.

According to India Brand Equity Foundation (Anon, 2009a), the Indian aviation industry is one of the fastest growing aviation industries in the world having a growth rate of 18 percent per annum. The government's open sky policy has led to many overseas players entering the market and the industry has been growing both in terms of players and the number of aircrafts. Today, private airlines account for around 75 percent share of the domestic aviation market. India has jumped to 9th position in world's aviation market from 12th in 2006. The scheduled domestic air services are now available from 82 airports as against 75 in 2006.

LOW-COST CARRIERS (LCC'S) IN INDIA

In 1970s, the low-cost carrier model was introduced by Southwest Airlines, a major carrier in the United States. Later, in 1990s, this business model was introduced in Europe, and in India, the model was introduced in 2003 by Air Deccan. Much to the detriment of traditional network airlines in North America, Europe, and Asia, well-capitalized start-ups have entered the low-cost carrier market, and existing no-frills carriers have grown rapidly. These carriers are exploiting a powerful, previously-untapped market opportunity to leverage low unit costs to stimulate demand among more price-sensitive travellers with lower fares; and to seize market share from less agile competitors saddled with legacy labour and infrastructure costs.

According to the IBM Business Consulting Services Report released in 2004, the LCC model has demonstrated its ability to consistently deliver operating margins exceeding those of full-service airlines. Even if they continue their downward trend toward Southwest's long-term average of 10 to 15 percent, this remains an unreachable territory for the majors in all but the best years. Low-cost carriers have been able to demonstrate consistent profitability- 31 years of consecutive annual profits for Southwest, 13 for Ryanair, 6 for EasyJet, and 3 each for both JetBlue and Virgin Blue.

Until about a few years ago, there were only three scheduled domestic carriers in India- Jet Airways, Indian Airlines, and Air Sahara. Then, on August 25, 2003, India's first low-cost airline, Air Deccan started service with its maiden flight between Bangalore and Hubli. It was launched by Gorur Ramaswamy Gopinath, an ex-Army officer who ran Deccan Aviation Private Limited, India's largest private heli-charter company. Deccan Aviation did reasonably well in selling the concept of chartering private helicopters as a means of transportation, and had built a reputation for providing speedy and reliable heli-services for company charters, tourism, medical evacuation, and off-shore logistics. Gopinath launched the airline with a clear focus: offer rock-bottom fares, fly to every destination possible (including Kandla, Pathankot, Tuticorin, Vijaynagar, Raipur), and make the common man fly (Chowdhury, 2008). Within three years, Deccan covered 65 airports, was operating 350 flights a day with 43 aircraft, and had captured 20 percent of the market.

On board the Air Deccan flights, food was not free and travellers had to pay for their meals. The tickets did not carry seat numbers, so those who came first could opt for the best seats. The inaugural fare for the Delhi-Bangalore route was 30 percent less than those offered by its rivals such as Indian Airlines, Air Sahara, and Jet Airways on the same route. The cheap tickets became the unique selling proposition and the fares offered were half of what were offered by all its competitors. The travellers had never seen such low fares before and as a result, air travel started to be looked upon as a substitute to train travel. But, other carriers including Jet publicly declared that the low-cost model was sure to fail. Unlike the United States and Europe, India did not have separate low-cost airports with cheaper landing and parking charges, which are essential to cut costs. Another argument these airlines gave was that cutting out on meals would save some money, but not enough to offer such low prices and still make money.

Later in 2007, Jet acquired Air Sahara for Rs 1450 crore and turned it into a 'value carrier' called JetLite. It further went on to launch a new all-economy, no-frill service called JetKonnect which was another low-cost service with low-cost fares. The services were the same except that no food was served on flight. In 2008, Kingfisher Airlines, which had positioned itself as a premium service provider, bought Air Deccan and renamed it as Kingfisher Red; thus retaining its low-cost identity.

The success of Air Deccan spurred the entry of more than a dozen low-cost airlines in India, including Kingfisher Airlines, SpiceJet, GoAir, Paramount Airways, and IndiGo.

RIVALS AS PARTNERS- MERGER OF AIR DECCAN AND KINGFISHER

A wholly owned subsidiary of Deccan Aviation, Air Deccan, is considered to be India's first low-cost carrier. It had a vision to enable every Indian to fly and adopted the mascot of the common man of Cartoonist Laxman. The common man identity represented the airline's simple and no frills approach. Tata Motors recently created a stir in the Automobile industry by launching Nano; the world's cheapest car, priced at USD 2500. Air Deccan did a similar thing long before, by revamping the Aviation industry in India and shifting people from rail travel to air travel. This was made easy by the drastic reduction in prices of air tickets and introduction of a new segment of travellers, the first time travellers.

Air Deccan airlines merged with Kingfisher Airlines and decided to operate as a single entity from April, 2008. This came to be known by the name Kingfisher Aviation and Air Deccan after merger with Kingfisher came to be known as Kingfisher Red. The merger was based on recommendations of Accenture, the global consulting firm. KPMG was asked to do the valuation and the swap ratio was decided accordingly. The merger came through as Vijay Mallya from Kingfisher airlines bought 26 percent of the stake in Air Deccan. The unification of the two carriers had to be sanctioned not only by the two panels, but also by the institutional investors, independent directors, and other shareholders.

After the merger, the company had a combined fleet of 71 aircrafts, connected 70 destinations, and operated 550 flights in a day. The combined entity had a market share of 33 percent. Gopinath continued as the Executive Chairman and Mallya took charge as Vice Chairman. The charter service of the respective airlines was hived off and operated as a separate entity. Post merger, Kingfisher would operate as a single largest (private) airline in the sub-continent. Besides, operational synergies (engineering, inventory management and ground handling services, maintenance, and overhaul), the management, and staff of both the airlines would be integrated. They would be stronger vis-à-vis lesser aircraft manufacturers (Airbus in this case), and will also spend less on training and employees.

Costs associated with maintenance of aircraft would also reduce. The savings in cost would be lower by about 4-5 percent (Rs 300 crores), which is a large sum. It would result in a saving of 3 billion in the first year itself through the sharing of aircraft and workers. Further, by devising a more optimal routing strategy it could help in rationalizing the fares. Before the merger, Air Deccan recorded a net loss of Rs 213.17 crores on revenue of Rs 437.82 crores for 2006-07.

FUTURE OF LOW-COST CARRIERS

As the profits of traditional carriers evaporate, so does their ability to invest in the next generation of aircrafts and systems that might go some way to helping them out of their misery by providing lower running costs as well as a better experience for passengers. By contrast, low-cost carriers know exactly what they are offering and to whom. They know their customers are willing to forgo the traditional 'frills' of flying in exchange for a much cheaper ticket (Manning, 2006).

The scenario where the consumer was the king with fares hitting a new low everyday while the airlines continued to incur losses has changed over the past year. Despite the bullish traffic growth estimates for India, past experiences suggest that it is extremely difficult for a market to absorb as many new entrants as the sector was witnessing in India (Shukla, 2007). The first mover advantage enjoyed by Air Deccan was short-lived, and soon several carriers emerged. But, the costs for their management increased due to the poor airport infrastructure and manpower shortage. The real trigger for the consolidation process for airlines came after the acquisition of Air Sahara by Jet Airways.

According to the Centre for Asia and Pacific Aviation's (CAPA) India unit, India is potentially a ten airline market, consisting of two-three full service carriers, two-three large national low-cost carriers operating a fleet of more than 70 aircraft each, and three-four niche regional operators with aircraft of less than 80 seats. The growth that the sector will see in near future will come from International routes. Airlines in India are bound by limitations as to where they can fly within the country. There are a few big airports which can handle Boeing 737s and Airbus A320s. For the smaller airports, aircraft like the turboprops or the regional jets make sense and the key metro routes like Mumbai-Delhi are already saturated. On the other hand, airlines can command better realizations and margins on international routes. International traffic will grow at a rate of 15 percent till the end of this decade. Domestic traffic is expected to grow at a higher rate and is expected to grow between 25 to 30 percent per annum.

With Air Deccan's low-cost strategy experience having seen results, the concept is seen as a strategy that will work in the Indian skies. Jet Airways developed JetLite (Air Sahara) as a value carrier with frills that offers low fares on some of its domestic routes. SpiceJet points out that the 15 percent of the cost savings for low-cost carriers come from utilizing the aircraft better compared to full service carriers and another 8 percent from cost-effective ticket distribution. All LCCs sell most of their tickets on the Internet and do not have to spend on providing commission to agents. In contrast, full-service carriers sell only 23-30 percent of their tickets online. LCCs are paranoid about their costs. While Kingfisher will shift some aircraft to Kingfisher Red, some of them will still have entertainment systems and other frills which will increase the weight of the aircraft and thereby the costs. IndiGo uses a lighter exterior paint to keep the weight of its aircraft as low as possible (Gupta and Chowdhury, 2009). The industry further forecasts that LCCs will have a market share of 70 percent by 2010, which would probably be the highest in the world.

CONCLUSION

Different low-cost airline operations around the world- Southwest Airlines in the United States, Ryanair in Europe, AirAsia in Malaysia, Gol in South America, and AirArabia in the United Arab Emirates; are not just a new business model, but a distinct structure of policies and procedures. Typically, airlines are required to take a long-term investment approach and to place greater importance on the inherent loyalty benefits of a frequent flier program. Maintaining a competitive edge is also an early and important factor in the decision making process and is used to evaluate whether or not to launch a program (Sorensen, 2006). The influx of low-cost airlines across the globe has roiled the industry, and incumbents are scrambling to respond. In Asia, the most recent region to confront this disruption, new

entrants and traditional carriers alike can profit from assessing the successes and failures of their North American and European counterparts. Clear success factors include an innovative customer experience, balanced growth, simplicity and efficiency from route structure to fare structure, and effective corporate governance. In a far more volatile environment than ever before, three new imperatives emerge for winning the airline margin game: refine the core value proposition, achieve a greater variable cost component, and improve infrastructure responsiveness.

Every worker's performance is affected by the constant interplay of perceptions, emotions, and motivations, which is triggered by everyday events though; it remains elusive and invisible to management. Nowadays, all companies talk about innovation, and the importance of "doing" innovation, many actually try to "do it", and only a few actually succeed in doing it. The success of companies is based on creating a culture of innovation, developing structures, and human resource pool necessary to support, and nourish a climate of creativity and innovation, and above all, bench marking the best innovative practices to gain competitive edge in the market place. Organizations should understand by now that the skills of human resources and the motivational level make possible involvement of people, creative suggestions, different proposals, and research activities to build up innovations.

Low-cost carriers are shedding their "no frills" personalities and are adding amenities as competition increases with established airlines and even other LCCs. These airlines are reaching out to capture business travellers with services normally associated with legacy airlines. These added value services include premium cabins, seat assignments, airport lounges, meal service, and frequent flier programs. Other regions of the world, where the LCC phenomenon is in its infancy, show less loyalty marketing activity. Most frequent flier programs begin as a cost centre for the airline. The expense of developing and operating programs will initially exceed the partner revenues generated by a just-launched program. Surprises do exist in the marketplace and LCCs can sometimes negotiate attractive signing bonuses with banks wishing to secure a co-branded relationship with a growing airline.

The Indian Civil Aviation market grew at a compound annual growth rate (CAGR) of 18 percent, and was worth USD 5.6 billion in 2008. The Centre for Asia Pacific Aviation forecasted that domestic traffic will increase by 25 percent to 30 percent till 2010 and international traffic growth by 15 percent, taking the total market to more than 100 million passengers by 2010. By 2020, Indian airports are expected to handle more than 100 million passengers including 60 million domestic passengers and around 3.4 million tonnes of cargo per annum. Moreover, significant measures to propel growth in the civil aviation sector are on the anvil. The government plans to invest USD 9 billion to modernize existing airports by 2010. The government is also planning to develop around 300 unused airstrips.

The success of LCCs depends on the formula of innovation, adaptation, and flexibility. The low-cost carriers are developing outside the traditional view of what a low-cost carrier should look like. Some are of the view that the changes taking place act as a sign that this model has run its course. However, extending the geographic reach and expanding diversity of this model is a sign of strength. It is a step forward in the transformation from a closed, one-dimensional industry to an open, competitive multi-dimensional industry.

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HRM PRACTICES AND ORGANIZATIONAL LEARNING: A CRITICAL REVIEW AND RESEARCH AGENDA

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ABSTRACT

The purpose of this paper is to establish a conceptual model to examine the different dimensions of human resource management (HRM) and its influence upon organizational learning. The theory of HRM principles and the concept of organizational learning provide as preliminary points to construct the integrated conceptual model, connecting HRM practices and organizational learning aspects. Using a wide-range of literature review, five practices of HRM (i.e. recruitment and selection, compensation, performance appraisal, teamwork and; training and development) and three practices of organizational learning (i.e. knowledge acquisition, knowledge dissemination, knowledge interpretation) are linked in a structured manner to investigate the impact of HRM upon organizational learning. This study should be beneficial to managers in any organization desire to enhance the level of learning in their firms through effective implementation of the relevant HRM practices.

Keywords: Human resource management, organizational learning, knowledge acquisition, knowledge dissemination, knowledge interpretation.

Paper type Conceptual paper

INTRODUCTION

As firms go global and metamorphosized into multinational entities, the business environment will become increasingly competitive. Firms not only have to compete with other firms locally, but also firms from the international arena. To be able to survive and gain an edge in such a challenging environment, firms need to be innovative and creative in their strategies, continuously improving their processes and producing products and services that is beyond customers' expectations. Thus, there needs to be continuous learning in an organization (Grant, 1996; Lei *et al*., 1996, 1999), to create, share, disseminate and institutionalize tacit knowledge which is rare and valuable (Snell *et al*., 1996). Unfortunately, some firms still fail as their focus

lies on the technical issues of the company, rather than on the human resource factor (Cross and Baird, 2000; Ruggles, 1998). Yet, the ability of an organization to learn is directly related to the firm's human capital (Nonaka, 1994; Kamoche and Mueller, 1998; Probst and Buchel, 1997). Past research studies have proven that human resource strategies, such as employee empowerment in the decision-making process, rewards (Garvin, 1993; Goh and Richards, 1997; Nonaka, 1991; Snell *et al*., 1996; Ulrich *et al*., 1993), training and employee selection are strategies to encourage learning in the organization, which helps in the continuous improvement of firm effectiveness.

LITERATURE REVIEW AND FORMULATION OF HYPOTHESIS

Organizational learning

Organizations learn when people in the organization learn. In other words, a learning organization entails employees in the organization who learn (Hurley, 2002). According to Nevis *et al*., (1995), organizational learning is defined as the ability or methods of a firm to sustain or enhance company's performance based on its experience. There are mainly two types of learning, which are single-loop learning (corrective) and double-loop learning (generative). Several researchers, such as Argyris and Schon (1978) and Senge (1990) have argued that double-loop learning has a more significant presence compared to single-loop learning in terms of the importance in the level of learning. Senge (1990) commented that corrective learning portrays a more common role as compared to generative learning. Hence, in order for a firm to differentiate itself from the rest, it requires more than just depositing knowledge into the company databases; it entails a shift towards generating impactful knowledge that can be embedded within organizational values, having a positive effect on firms' performances (Cross and Baird, 2000; Davenport and Prusak, 1998).

Furthermore, organizational learning is termed as a dynamic process that incorporates the shifting between the different levels of action – individual, group and organizational level (Huber, 1991; Crossan *et al*., 1999). According to Tippins and Sohi (2003) and Perez Lopez *et al*., (2006), organizational learning can be conceptualized into four dimensions: acquiring information, distributing information, interpreting shared information and the development of organizational memory. In other words, organizational learning can be analyzed according to three core aspects. Firstly is the attainment or creation of knowledge, as well as its distribution and incorporation of knowledge within the firm. This can serve as one of the main strategic assets for a firm (Zander and Kogut, 1995; Teece *et al*., 1997), the basis of a firm's learning ability. Secondly, the development and distribution of knowledge within a firm can also have an effect on firms' internal changes, affecting both the cognitive and behavioral aspects of a firm (Fiol and Lyles, 1985). Thirdly, the changes in organizational learning can also lead to a continuous improvement in firms' processes that improves and maintain the firms' performance (Fiol and Lyles, 1985; Garvin, 1993; Slocum *et al*., 1994), ensuring the achievement of competitive advantage through firms' ability to learn and mature (Mahoney, 1995; Brenneman *et al*., 1998).

The relationship between HRM practices and organizational learning

Several scholars have suggested that by having a set of well designed human resource practices, the ability for firms to learn can be improved, creating tacit organizational knowledge (Barney, 1992; Reed and DeFillippi, 1990). However, not every HRM practice can enhance learning in an organization. As Currie and Kerrin (2003) have demonstrated in their studies, incorrect HRM practices can be detrimental towards the sharing of knowledge. Hence, it is essential to choose the proper HRM practices that facilitate organizational learning. After reviewing numerous research papers on the practices of HRM, this paper has narrowed down five human resource activities (recruitment and selection, recognition and reward, performance appraisal, teamwork and training and development) which the authors think are most relevant in the relationship with organizational learning.

Recruitment and selection

According to Davenport (2000), one of the main concerns of human resource management relating to organizational learning is the recruitment and selection of valuable workers. When new employees are employed, management needs to consider the knowledge, skills and attitudes (KSA) of employees before taking them in, to determine whether their KSA is compatible with the company working environment strategy. Also known as the person-organization (P-O) fit, the purpose of the "fit" is to find similarity between company and individual values (Chatman, 1991).When new employees perceive their values fit with that of the firm, they will find contentment in the working environment, enabling them to contribute to the productivity of the organization (Goodman and Svyantek, 1999). Hence, the following hypothesis is developed:

P1: Recruitment and selection have a positive relationship on organizational learning.

Recognition and reward

According to Cabrera and Bonache (1999), the reward system signifies the organizational values of a company and hence has an effect on individuals' behaviors and attitudes. Recognition and reward, related to any job, should be linked to organizational learning, in which knowledge is transferred (Lei *et al.*, 1999; Lepak and Snell, 1999). By having the right reward system, it can help ensure that ever person in the company acquires, shares and disseminate knowledge (Ooi *et al.*, 2009). Recognition and reward should be in place to promote a risk-taking attitude among employees, so that they will be creative in solving problem issues that occur daily in the company (Garvin, 1993; Goh and Richards, 1997; Snell *et al.*, 1996; Ulrich *et al.*, 1993; Yahya and Goh, 2002). The recognition and reward should be able to encourage and promote the exchanging and sharing of knowledge among the individuals in an organization (Pil and MacDuffie, 1996; Yahya and Goh, 2002). Hence, the following hypothesis is proposed:

P2: Recognition and rewards have a positive relationship on organizational learning.

Performance appraisal

Performance appraisal is a formal system of review, where supervisors evaluate the performance of those under them (Mondy, 2010). In order to develop a company of skilled and competent employees, appraisal is deemed to be one of the important contributors (Khoury and Analoui, 2004). A performance appraisal system that is well designed to recognize the importance of organizational learning is believed to also support the knowledge management activities of a company (Cabrera and Cabrera, 2005).

According to Jaw and Liu (2003), there is a need for organizations to relate the performance appraisal results to the workers, and subsequently, enforce corrective action to improve unfavorable results for underperforming employees. In other words, performance appraisal serves as motivator for employees to perform better in the future (Jaw and Liu, 2003), hence encouraging employees to engage in organizational learning activities. Hence, the following hypothesis is developed:

P3: Performance appraisal system has a positive relationship on organizational learning.

Teamwork

According to Katzenbach and Smith (1993), the definition of a team comprised of a small number of people, with skills that can complement one another, and who work enthusiastically together to attain a common goal for which they hold themselves jointly accountable. Past research has found that a high level of employee participation, commitment and job fulfillment are fundamentals for organizational learning. “Empowerment” is one of the vital ingredients in establishing a learning organization (Marquardt and Reynolds, 1994). According to Yahya and Goh (2002), working in teams helps create a sense of empowerment in employees, driving them to create and discover new ways of doing things. Without employee participation, employee would not have the opportunity and the desire to learn themselves; hence organizational learning will be disadvantageous (Dixon, 1994).

Therefore we propose the following hypothesis:

P4: Teamwork has a positive relationship on organizational learning.

Training and Development

Training and development can be defined as a set of tools and methods designed to enhance and develop the knowledge, skill, capability and attitude of employees (Hemdi *et al*., 2003). Firms that value knowledge as a competitive tool should place a strong emphasis on the mechanisms that ensures continuous learning (Leonard-Barton, 1992). The importance of training programs has been highlighted in numerous studies by renowned researchers (e.g. Perez Lopez *et al*., 2006;

McGill and Slocum, 1993; Ulrich *et al*., 1993; Nonaka and Takeuchi, 1995; DiBella *et al*., 1996). In order to stay at the forefront of the playing field, organizations need to be aware of the developments that are taking place around them and develop activities that can help in the personal development of their own employees (Robertson and O'Malley Hammersley, 2000).

Training, regardless of whether it is through formal training sessions or informal interactions between two or more individuals, provides opportunity for people to gain as well as to share knowledge (Ipe, 2003). Hence, it serves as an essential tool that would assist the communication between workers, by providing a common language and a common set of values, in which creative ideas and best practices can be shared to prevent stagnation of knowledge (Leonard-Barton, 1992; Ulrich *et al*., 1993). Receiving extensive training enables the workers to acquire and generate new knowledge and expertise, thus enhancing the level of openness towards new ideas (Leonard-Barton, 1992; DiBella *et al*., 1996; Garvin, 1993; Lei *et al*., 1999; Leonard-Barton, 1992). Hence, the construct of the following hypothesis:

P5: Training and development have a positive relationship with organizational learning.

Conceptual Framework

Based on the discussions in the literature review section, a conceptual model is developed to investigate the impact HRM practices can bring on organizational learning. Figure I explains the relationship between HRM practices and organizational learning. According to the research framework, HRM practices are the independent variables and organizational learning is the dependent variable. In this model, it is proposed that the greater the presence of HRM practices in organizations, the higher the level of learning will be in firms.

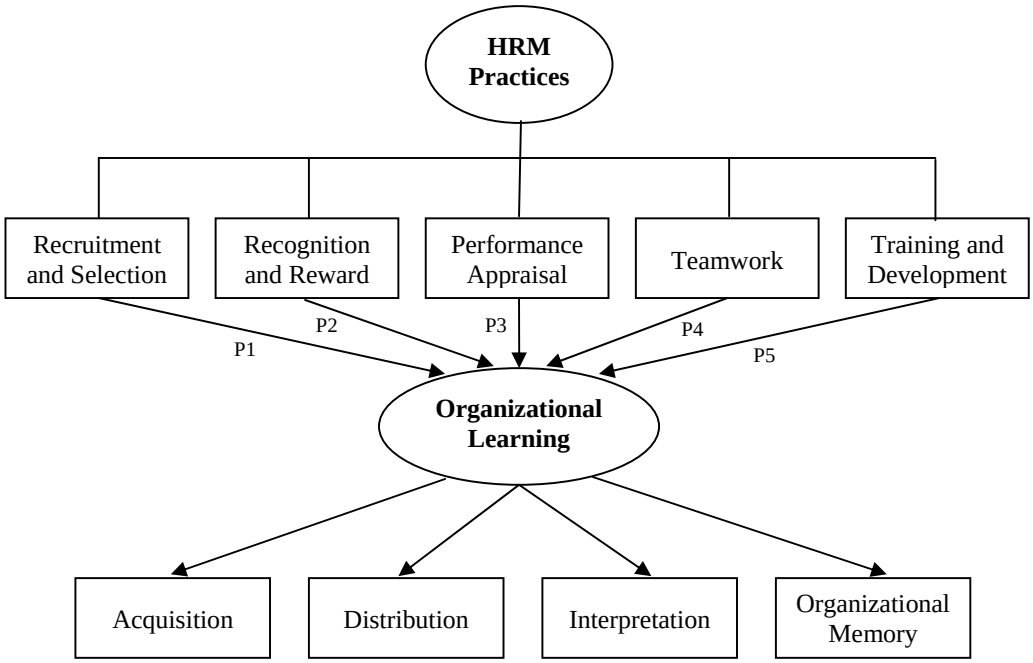

Figure I: Conceptual Research Framework

Managerial implications

One of the industrial applications of this research is that organizations will know which HRM practices positively impacts on the learning ability of the organization. This paper would present opportunities to identify precisely which aspects of HRM are suitable to be applied at the organizational level to enhance organizational learning. Furthermore, it is believed that by instilling more effective HRM practices, it may lead to more desired organizational learning outcome. Even though many companies have implemented both HRM and organizational learning activities, it is essential to construct a conceptual model, so that an empirical research can be conducted on which HRM practices contribute most towards the learning activities of a company (Ooi *et al*., 2009).

Theoretical implications

Based on this study, a revised model based on these five HRM practices (recruitment and selection, recognition and reward, performance appraisal, teamwork and training and development) has been proposed in this article to investigate if such practices can contribute towards the learning activities of an organization (Ooi *et al*., 2009). Furthermore, this conceptual study contributes to the literature world, giving additional insights as to what are the HRM practices that facilitate organizational learning (Bapuji and Crossan, 2004).

CONCLUSION

When an organization is headed by the right HRM practices that promote learning, organizational change will take place in the office and this appears to benefit the firm, as such practices help the firm to incorporate its vision, mission, objectives and practices. There may be an improvement in the performance for both individuals as well as the organization as a whole.

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AN APPLICATION OF PROJECT MANAGEMENT FRAMEWORK IN PRODUCT DEVELOPMENT: CASE STUDY: BICYCLE MANUFACTURER

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ABSTRACT

Project management for international organizations employs two knowledge management systems, namely, the Project Management Institute (PMI) and the International Project Management Association (IPMA), both of which have clearly defined constructs regarding project management items, processes, areas, and methods. However, in practical application, various industrial attributes differ, and thus, requires various developmental components. For example, the construct of the Industry Development Construction project management system; it is based on researched information of the target industry, and then developed to create an information management system applicable to a wide variety of projects.

At present, the Taiwanese industrial sector has not matured, and lacks an overall resource standard for business models and project management, hence, each company has only their own efforts and personal experiences to depend on, without the benefit of a learning project management model for a practice mode. This study targets a R&D project, on bicycle products for young consumers, based on empirical evidence, conducted by the Taiwan Project Management Association (TPMA), a D-class International Project Management Body of Knowledge (IPMBOK), which is a method that processes product development plans, contingent on practical validation, to assess the applicability of the TPMA D-class International Project Management Body of Knowledge system in an actual R&D case study. The findings indicate that the new bicycle of this product design has the following features: fashionable image integrated in design, multi-purpose designs of portability, environmentally friendly, and integrated security design. This project obtained verification and confirmation from the client, and was then successfully completed through manufacturing. This study also found that, the D level property tool of the IPMBOK theory, property of the TPMA, is able to solve problems inherent in product research and development.

Keywords: Project Management, TPMA, IPMBOK, Research and Development.

INTRODUCTION

In order for business projects to run smoothly, individual management of project is important. Recent research shows that good project management is the key to business process (Jamieson and Moerris, 2004); today has become a very popular research topic (Qureshi, Warraich and Hijazi, 2009). The main purpose of this study is to explore the TPMA

D-class International Project Management, Body of Knowledge for practical validation. The research team selected a target group of adolescents (12 years of age to under 18 years old), familiar with the riding functions of the products, the overall ride comfort, and the preferred components and capabilities of the bicycle products. The aim of this project is to analyze the current preferences of adolescent groups in order to develop the design elements of new bicycle products, which are in accordance with the preference principles of the product design, and fully in line with the physical and psychological needs of the users in the target age group. It also aims to seek an innovative direction for a R&D project through degrees of preference. The ultimate goal is to provide target consumers with a product that is.

LITERATURE REVIEW

Project Management

Project refers to the completion of a certain task, by a specific deadline, under technical complexity, dependent on continued coordination and control of progress, costs, and performance (Meredith and Mantel, 1989), which are defined as businesses, though their scheduled time for activities is designed to produce a ‘one-time’ output or service (Barad and Raz, 2000).

Project management has following advantages:(Taiwan Project Management Association Editorial Board , 2008):

1. The one-time events will not be repeated.
2. The ad hoc implementation of start and end dates.
3. There are pre-set goals of a model project.
4. The amount of resources is limited.
5. Project completion meets the desired results.

The International Project Management Association (International Project Management Association, IPMA) was established in 1965, with the focus of supplying global project management expertise, and is the world's oldest project management organization. In the 1990s, the project matured, and the two main organizational systems are implemented in advanced countries, such as Europe and the United States. The locations are as follows: Pennsylvania, headquartered in the United States Association for Project Management (Project Management Institute, PMI), headquartered in The Hague with the International Project Management Association(Fan,M., Xiong,P.L. and Huang,C.M., 2006). Taiwan obtained the IPMA membership through the Taiwan Institute of Project Management in 2004 to offer project management knowledge and practical expertise in Taiwan.

Project management approaches applications with a focus on time, cost, performance, and clearly defined work management (Cleland and King, 1983). Berkley and Saylor (1994) stated that project management is a management philosophy, a guiding principle, and methodology, aimed at meeting product and service demands of customers delivery requirements through management techniques and tools. Kloppenberg and Opfer (2002) referred to project management-related research conducted in 1960, which focused on large government defense projects transferred to commercial applications (such as the construction industry, information systems, new product development, etc.). That study showed that project management increased business opportunities for future operations; in other words,

with good project management capabilities in an organization, its success in project management is almost guaranteed.

Product Research and Development

As product development can provide business opportunities for future operations, R&D projects are important organizational activities for an enterprise. Most product development requires step by step testing for the completion of a project, thus, a management approach for new product development is more beneficial (Pons, 2008), as product R&D analysis avoids wasting time on technical factors.

Product research and development must take into account of customer demand, market prices, and acceptable levels, rather than developing the most powerful commodity(Pai,K.H., 2003). Therefore, enterprises must first research customer demand for new products, because even if R&D ability is good, the developed product may not have a market demand, resulting in unwanted merchandise(Hu,S.C., 2008).

Overall, in the product development process, project management tools and technology have been successfully used on complex projects (Kwak and Anbari, 2009), and ,the rapid and effective development of project management for R&D projects of an enterprise will have a significant effect.

RESEARCH METHODS AND PROCEDURES

This study follows the International Project Management Body of Knowledge in project management steps(Taiwan Project Management Association Editorial Board, 2008), as shown in Figure 1, through the planning stages of a project in order to apply a number of ad hoc methods, making the project management system more effective, and the implementation of the project under a common communication language to facilitate this project.

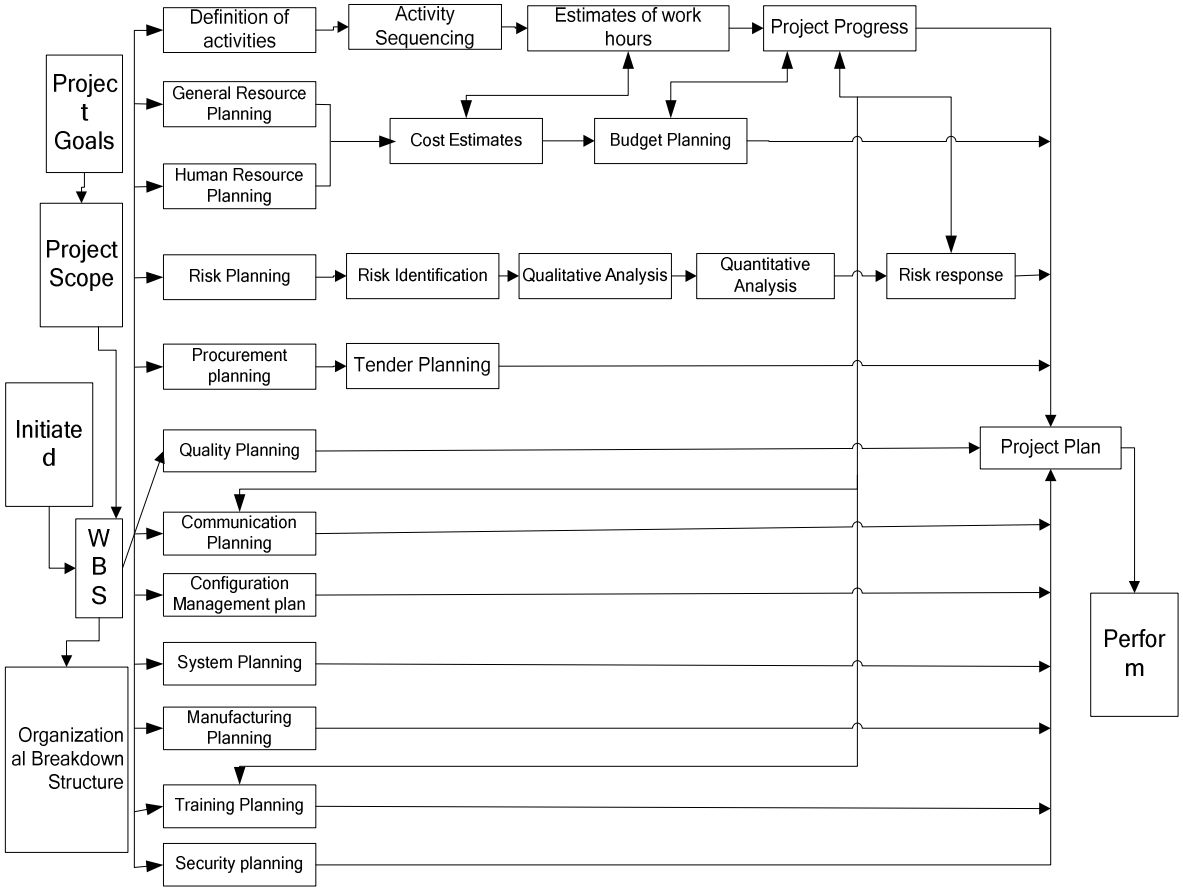

Figure 1 Project Management Steps

Set The Project Goals and Project Scope

Through this study, actual market surveys and consumer questionnaires are conducted to gather the preferences of a select population of contemporary youth, and analyzes the model preferred components and capabilities to determine the direction of the bike project. The designed elements are based on the analysis results, integrated through form, function, entertainment value, and practical principles of product design. Ultimately, the bike is expected to provide target consumers with a product in full compliance with their physical and psychological bike needs. The objective of this project must meet the SMART principles, including Specificity, which is Measurable, Achievable, Realistic, and Time-bound(Taiwan Project Management Association Editorial Board, 2008). Therefore, the project goals of this project are the following five points:

1. Create a breakthrough-type bike design criteria.
2. Completed design appeals to the purchase intentions of more than 20% of the target groups.
3. Research during an implementation period of six months, June 2, 2008 to November 28, 2008.
4. Study budget of 2 million NT dollars.
5. Progress and cost controls of this study are strictly enforced to progress according to plan.

Work Breakdown Construct and Responsibility Assignment Matrix

Work Breakdown Structure
WBS (Work Breakdown Structure) is the deliverable or functional elements of a collection-oriented research data set, from which all research areas are organized and defined, its function is to breakdown the areas within the scope of the study/project, then reassemble it into assigned work packages for easy task management with personnel assigned to planning and resource estimation. WBS, in accordance with the top-down approach of this study, is to establish a dismantling approach for process-oriented activities to organize the operational details necessary to the project, as shown in Figure 2

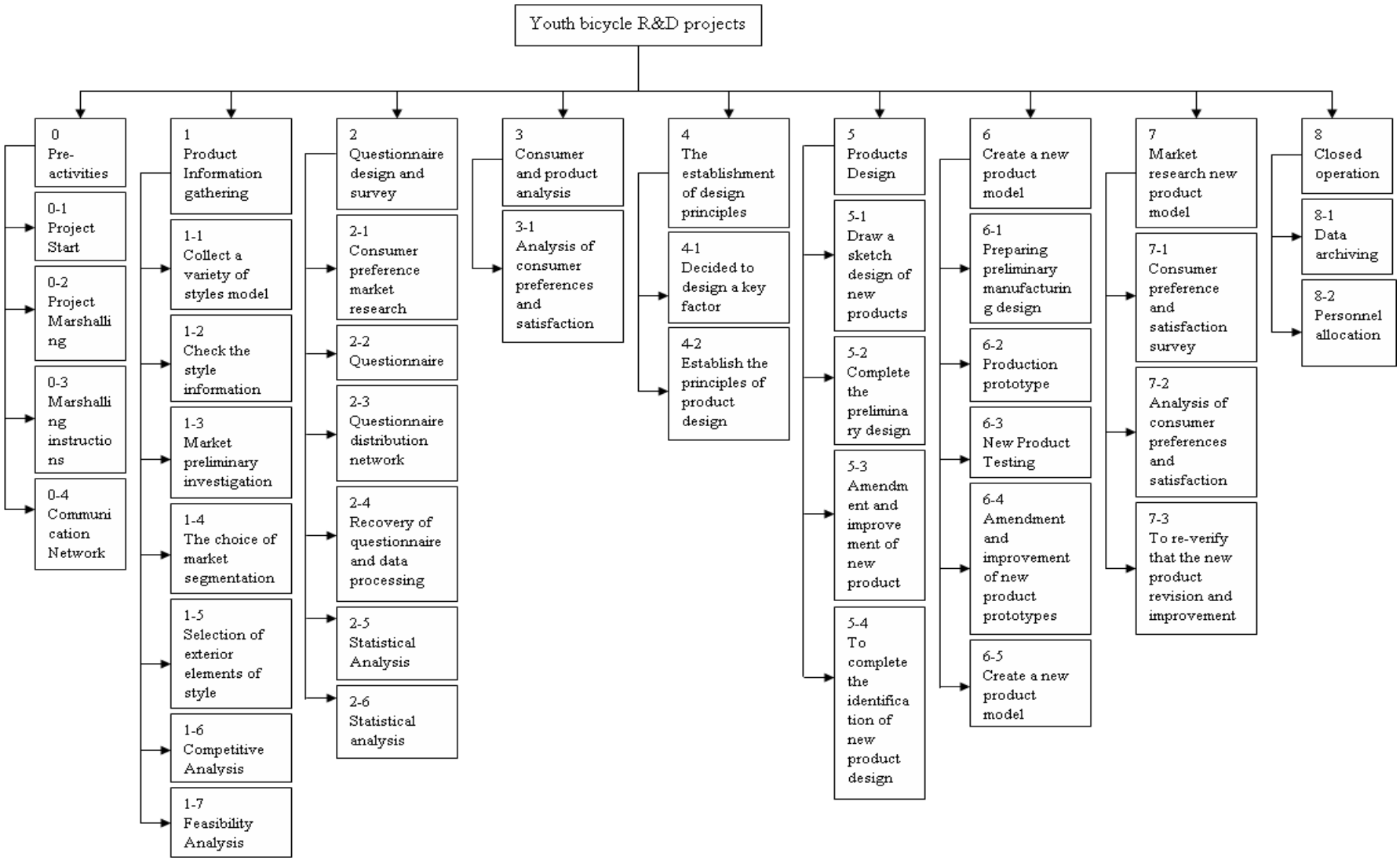
Youth bicycle R&D projects
0 Pre-activities
0-1 Project Start
0-2 Project Marshalling
0-3 Marshalling instructions
0-4 Communication Network
1 Product Information gathering
1-1 Collect a variety of styles model
1-2 Check the style information
1-3 Market preliminary investigation
1-4 The choice of market segmentation
1-5 Selection of exterior elements of style
1-6 Competitive Analysis
1-7 Feasibility Analysis
2 Questionnaire design and survey
2-1 Consumer preference market research
2-2 Questionnaire
2-3 Questionnaire distribution network
2-4 Recovery of questionnaire and data processing
2-5 Statistical Analysis
2-6 Statistical analysis
3 Consumer and product analysis
3-1 Analysis of consumer preferences and satisfaction
4 The establishment of design principles
4-1 Decided to design a key factor
4-2 Establish the principles of product design
5 Products Design
5-1 Draw a sketch design of new products
5-2 Complete the preliminary design
5-3 Amendment and improvement of new product
5-4 To complete the identification of new product design
6 Create a new product model
6-1 Preparing preliminary manufacturing design
6-2 Production prototype
6-3 New Product Testing
6-4 Amendment and improvement of new product prototypes
6-5 Create a new product model
7 Market research new product model
7-1 Consumer preference and satisfaction survey
7-2 Analysis of consumer preferences and satisfaction
7-3 To re-verify that the new product revision and improvement
8 Closed operation
8-1 Data archiving
8-2 Personnel allocation

Figure 2 WBS

Risk Planning

Risk is a measured uncertainty in research, and the main risk in research refers to the capacity of a project manager in predicting the output level. The risks that may be forecasted include: increasing the scope of the project design, not meeting the demands of manufacturers, delay of the project schedule delays, disputes regarding the projects, high prices of materials, poor integration between the materials and existing product, false answers filled out by the respondents, invalidity of the questionnaire, and failure of the product model test. The probability of each risk occurring and its impact are obtained by multiplying the product of the two, namely, the risk priority number (Risk Priority Number, RPN). This study selects risk items and risk response plan in the high-risk area and greatest risk area (i.e. RPN 40 to 100) for priority planning, as shown in Table 1.

Table 1 Risk Planning Table

No.	Work Package	Risk Project	Incidence	The impact of the size of	RPN	Risk response plan	Risk managers
1	Project Scope	Increase the scope of the project	8	9	72	Prior consultation with the client, the need to repeatedly confirm the scope of the study	Planning Team Leader
2	Design	Design does not meet the demand of the manufacturers	8	8	64	Repeated through recognition of the manufacturer specifications, requirements, and process variables	Production Team Leader
3	Project duration	The ad hoc time-delay	10	5	50	Research managers fulfill its oversight responsibility in order to reduce the number of hours in consideration of delays	Project Manager
4	Software purchase	Contractual disputes arising	6	8	48	Sufficient communication to establish an agreement to the terms of the contract	Project Manager, Finance Team Leader
5	Materials	Material prices are too high and materials are integrated with the existing non-performing product	5	8	40	Shop around for lower prices through special channels and select the quality and specifications consistent with an alternative	Finance Team Leader

RESULTS AND DISCUSSION

Market Feasibility Analysis

In this project, an ad hoc group investigation was conducted by questionnaire survey conducted on general consumption in regard to the research and development of a project

bike, in order to find out the purchase intentions of the consumers. The questionnaire results showed that:

(1) The reasonable price ranges perceived by young respondents

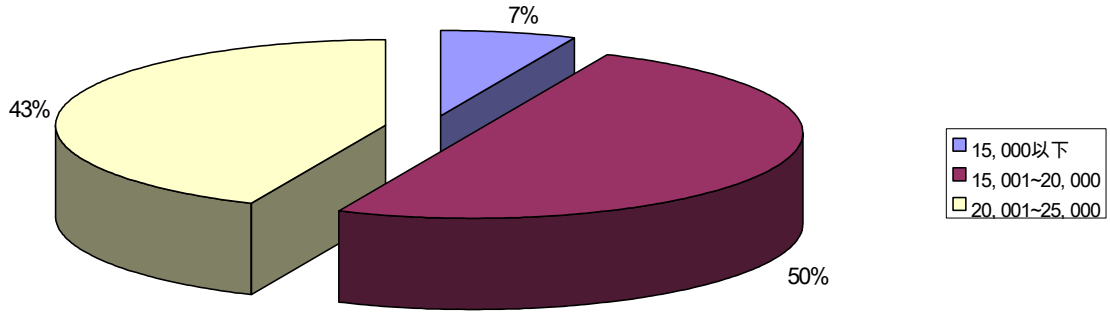

Figure 3 The reasonable price ranges perceived by young respondents

Most young respondents think a reasonable bicycle price is between 15, 000 ~ 20,000 NT dollar, and 43% of young respondents think a price between 20,001~25,000 NT dollar is a reasonable range. Very few respondents think the price should below 15,000 NT dollar.

(2) Survey of preferred bicycle styles of young respondents

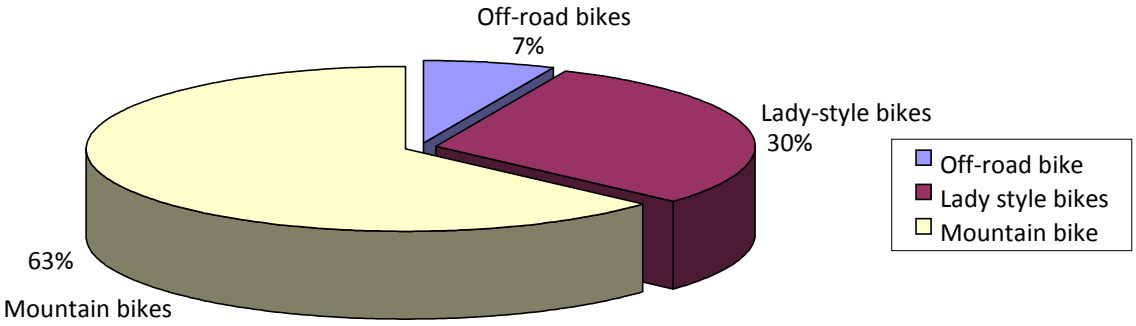

Figure 4 The preferred bicycle styles of young respondents

More than half of the respondents prefer mountain bikes, 30% prefer lady-style bikes, and 7% prefer off-roadbikes

(3) The main motivation to purchase, according to the findings

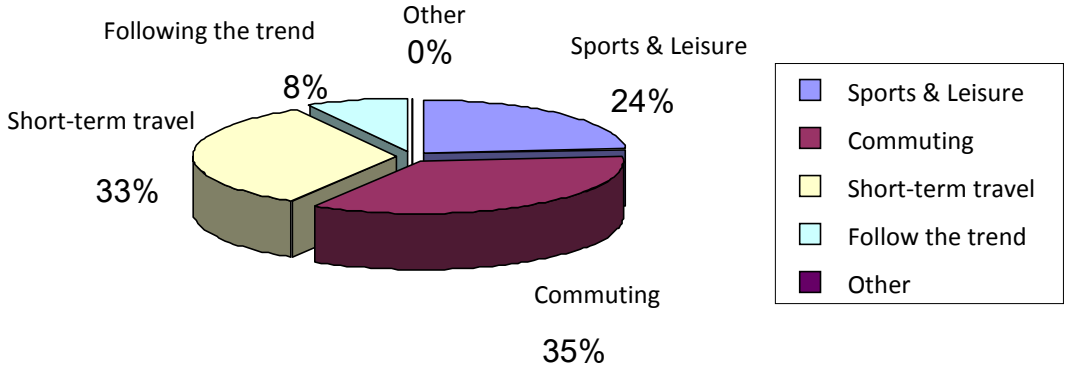

Figure 5 Main purchase motives

Most young people use a bicycle for commuting (35%), short-term travel (33%), sports and leisure (24%), and following the trend (8%).

(4) Factors of purchase intention

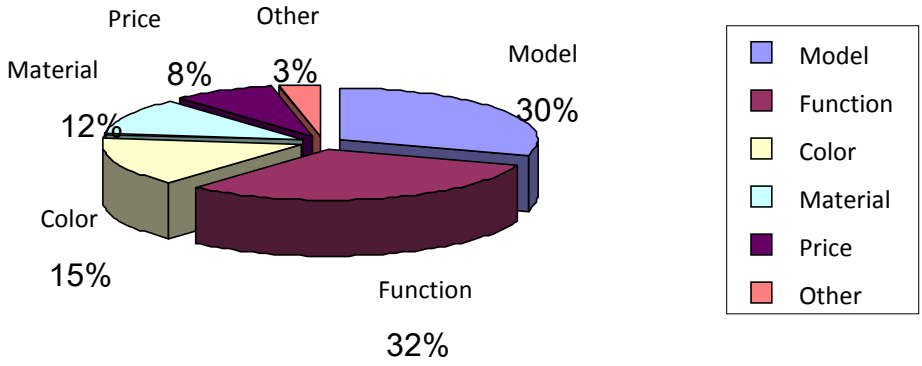

Figure 6 Factors of purchase intention

The main consideration is the functions (32%), followed by model (30%), material (12%), price (8%), color (15%), and other factors (3%).

(5) Main considerations when purchasing a bicycle

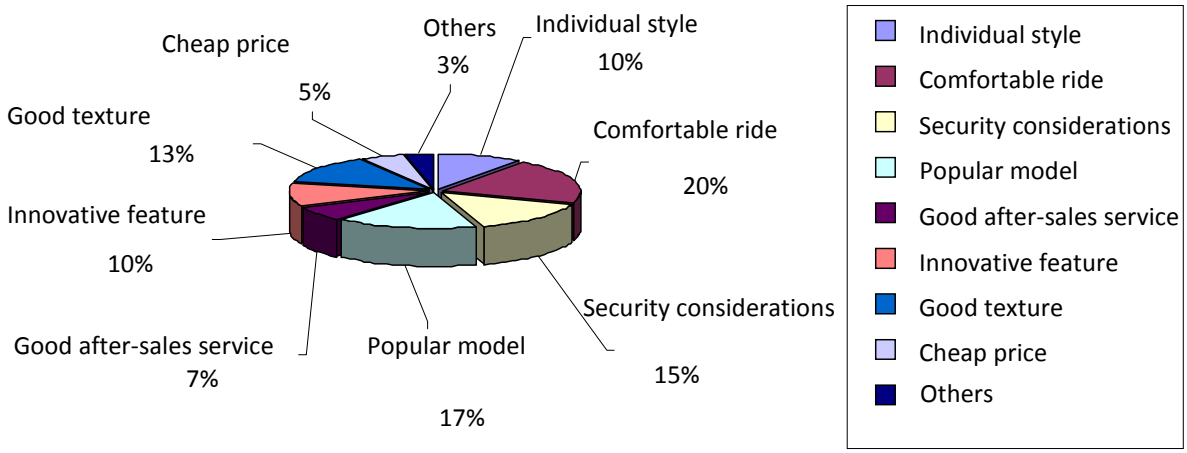

Figure 7 Important considerations when buying a bicycle

Important considerations when purchasing a bicycle include a comfortable ride (20%), popular model (17%), good texture (13%), innovative features (10%), and individual style (10%).

(6) Functions

Table 2 Survey on bicycle functions

Project on	Yes	No
Whether the bike has variable speed functionality	100%	-
Whether the bike is foldable	33%	67%
Availability of audio equipment	87%	13%

Survey of young people's preferences show that variable speed functions is a necessary condition, but the folding function is not (67%), capability of playing MP3 (87%) has a growing percentage in preference.

(7) Consumers' willingness to purchase

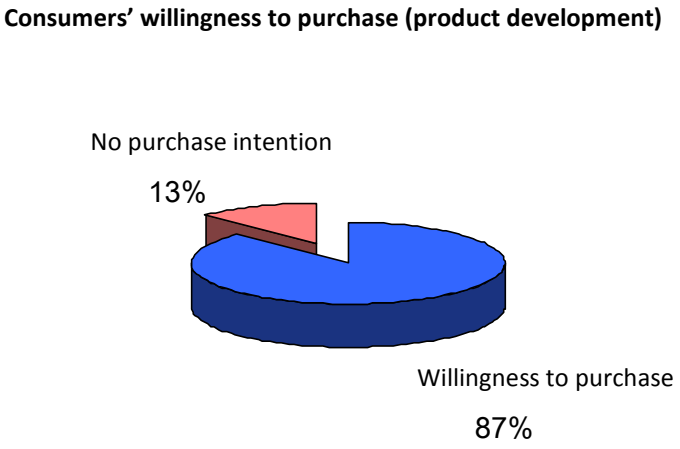

Figure 8 Willingness to purchase a bike with MP3 features

The preliminary investigation showed high willingness of consumers to buy a bicycle with new features (MP3 audio), which accounted for 87%, while no willingness to purchase accounted for only 13%.

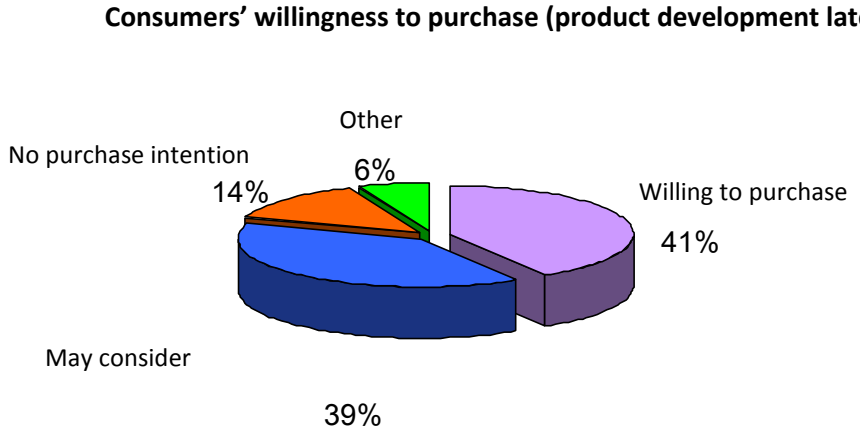

Figure 9 After purchase intention survey development

Product design is presented to the respondents to investigate their willingness to purchase, 41% showed willing to purchase, while 39% had no purchase intention

Product design drawings

Based on the results of investigation and analysis, consumer preferences in bicycles include that appearance, variable speed features, and seating comfort. The "MP3 audio" is the main design element in this study. According to the above results, the bicycle design principles are listed in Table 3. These principles serve as the basis for new bicycle development in this study. The new design is shown in Figures 10 and 11.

Table 3 The Principles of Bicycle Design

No.	Pattern elements	Design Type
1	Height	100cm
2	Length	143cm
3	Body Material	Aluminum
4	Variable function	Section 18 Transmission
5	Variable control	Handle rotation-type
6	Lighting	Embedded in the design and use of cell bodies
7	Audio equipment	Embedded design, waterproof design
8	Power Design	Renewable power generation and electrical functions
9	Handles	Ergonomic design
10	Handle Appearance	Streamlined
11	Seat Design	Ergonomic design
12	Pedals	Camber angle knee pedal twice
13	Tires	Wheel diameter of 26 inches
14	Tooth Chain Cover	Anti-involved in the design
15	Paint	Scratch-resistant high quality paint

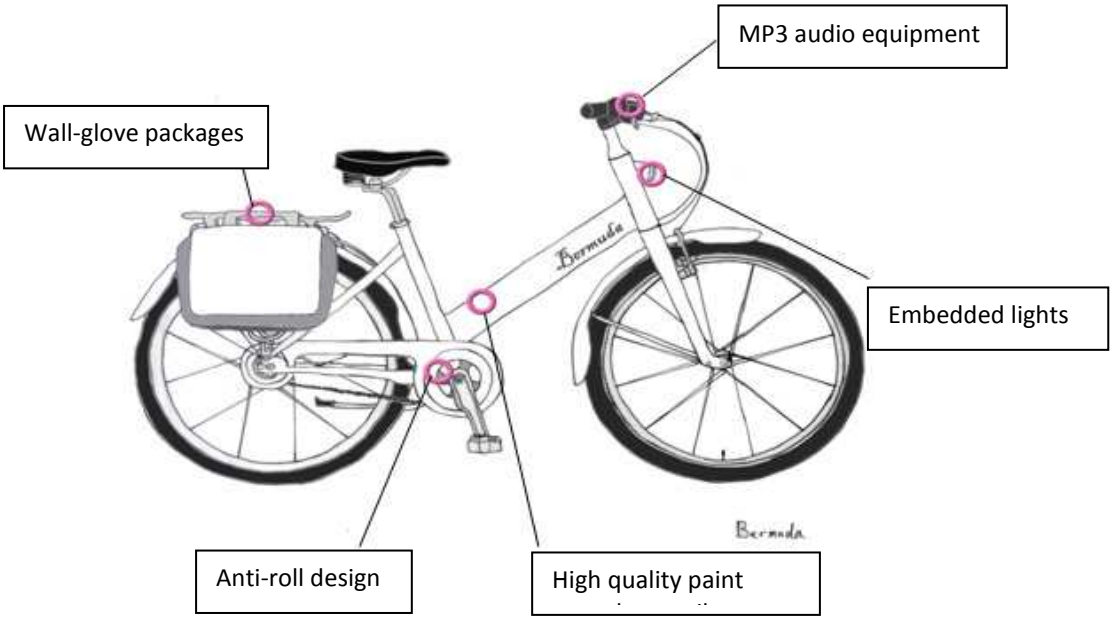

Figure 10 Bermuda Bicycle exterior design

Note: The appearance of a reference to the Giant bicycle web site (http://www.giant-bicycles.com/zh-TW/) Compilation made

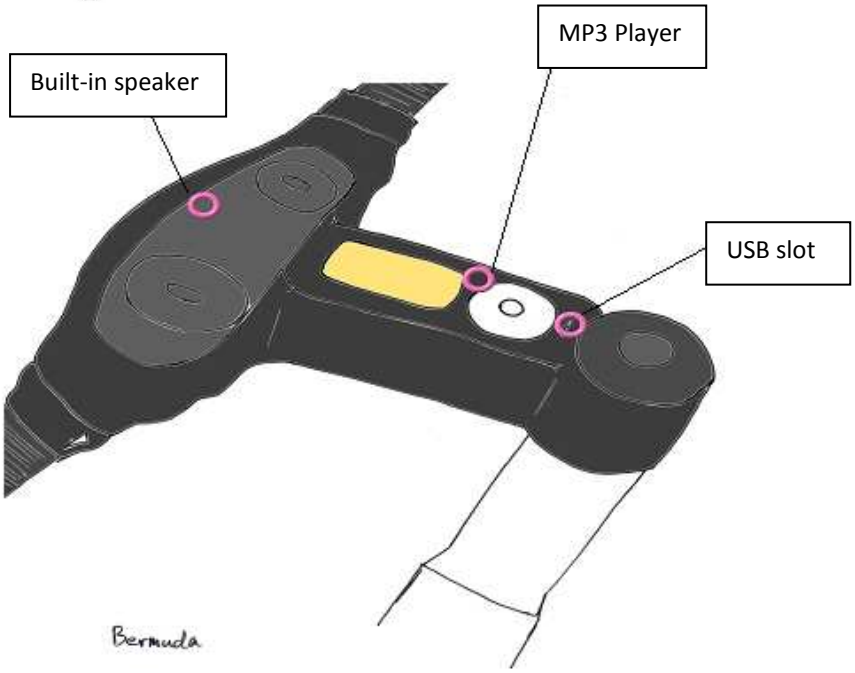

Figure 11 Bermuda bicycle headlights and special sound design

The Bermuda style bike shown above has the following characteristics:

1. Integrated design in a popular image
2. Portable multi-functional design
3. Environmental protection and anti-theft design

CONCLUSIONS AND RECOMMENDATIONS

This study used a systematic international project management approach for project management through implementation of control stages in order to ensure that research output meets the original plans. Continuous monitoring of the functions and quality of the researched output were carried out to prevent any standard reduction and frequently review the progress of the project, in order to complete the design of a bicycle for youth. The Bermuda bicycle designed by this study meets the features preferred by youth, including portable multi-functional design, integrated environmental protection, and anti-theft features.

This study employed a systematic project management model, developed based on the preferences of the youth group, in order to provide an established R&D model to manufacturers as design reference. This product is designed to target only individual bicycles, excluding third-party vehicles and other vehicle types. Future studies can adopt this design for actual production, functional testing, and the basis for market research on new product development.

Future studies can target other products or industries to implement the product development processes, and compare the R&D project management in different industries. Finally, the proposed implementation of a new project can refer to prior experience or knowledge as reference for the implementation of a follow-up project.

ACKNOWLEDGEMENT

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INTELLECTUAL CAPITAL MEASUREMENT AS A BENCHMARK TOOL OF LISTED COMPANIES: IMPLICATIONS ON COMPETITIVENESS

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ABSTRACT

The purposes of this paper are to review the background on the term intellectual capital and to further analyze some of its measurement tool. Given the increasing importance of knowledge in improving and sustaining organizational competitiveness, measuring intellectual capital has become critical for several firms. This paper examines ongoing measurement indicators that can be applied to measure and evaluate intellectual capital among the listed companies. The findings indicates that despite the inability to use the data directly, the adaptation can be made and result in useful information on intellectual capital.

Key words: intellectual capital, EVA, VAIC™, and competitiveness

INTRODUCTION

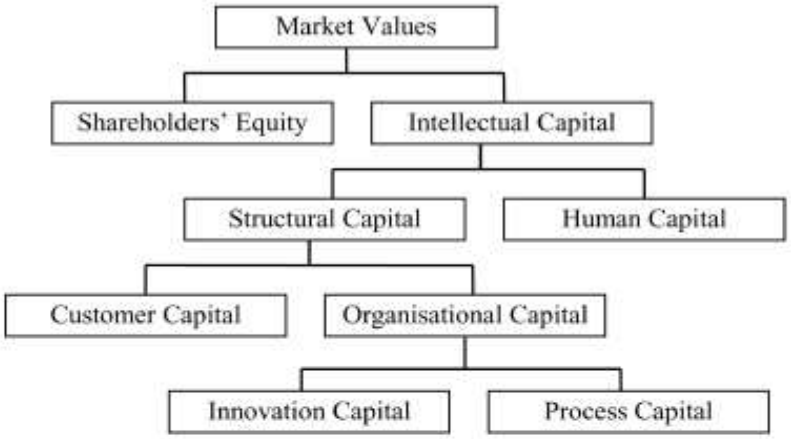
Intellectual capital become a widely topic both researchers and practitioner. Because intellectual capital (IC) is widely recognized as the critical source of true and sustainable competitive advantage (Marr et al., 2003). And the measurement of IC are also important for manage the company intellectual capital. Company would like to improve their performance by using the IC measurement tools. To measure where they are and then compare to the competitor who is thebest in class. Benchmarking is a widely used tool in many traditional areas of performance and is expected to be beneficial in transferring best practices in managing IC. It is seen a managerial technique to identify performance gaps and improve operational performance (Yasin, 2002).

Intellectual capital definition and classification

Edvinsson and Sullivan (1996) define intellectual capital as a knowledge that can be converted into value. Brooking (1997, p.12) define IC is the term given to the combined intangible assets which enable the company to function. Stewart (1998, p. XI) define IC as intellectual material, IC is knowledge, information, intellectual property, experience, that can be put to use to create wealth. Some of researchers are conclude IC is the knowledge that can be converted into profit (Harrison and Sullivan (2000)). Youndt et al., (2004) "IC is the sum of all knowledge that an organization is able to leverage in the process of conducting business to gain competitive advantage" and Roos et al., (2005) define IC as all non-monetary and non-physical resources that are fully or partly controlled by the organization and that contribute to the organization's value creation.

The definition of the IC are widely define as the intangible asset that can contribute to the company and sustainable the advantage competitive of the company. The definition of IC may not be clear and the classification of IC may help us to understand the component of the IC.

Edvinsson and Malone (1997): Intellectual capital consists of structural capital and human capital.

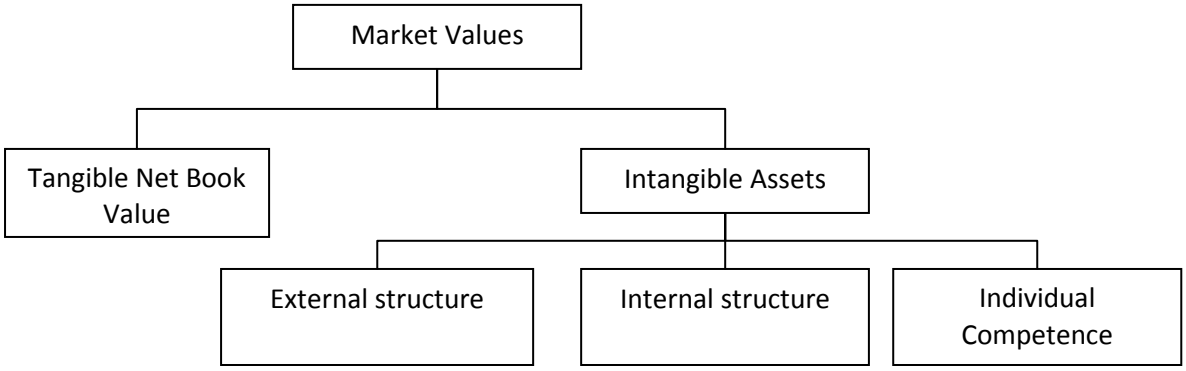


Structural capital consists of customer capital and organizational capital. And organizational capital consists of innovation capital and process capital.
The definition of each capital,

Human Capital is defined as the collective capabilities of employees to solve customer problems. This capital includes the collective experience, skills, and general know-how of all of the company's employees.

Structural capital includes customer and organizational capital that relates to the external and the internal focus of structural capital.
Customer capital is defined as the combined value of the relationships with customers, suppliers, industry associations and markets.
Organizational capital includes the organization philosophy and systems for leveraging the organization's capability.
Innovation capital is that which creates success in the future and includes intellectual assets and intellectual property.
Process capital includes the techniques, procedures, and programs that implement and enhance the delivery of goods and services.

Sveiby (1997): Intangible assets or IC consist of External structure, internal structure and Individual competence.



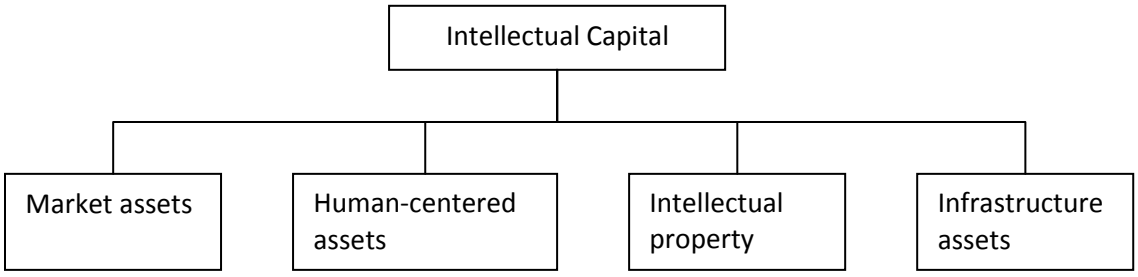
The definition of each component,

Internal structure consists of a wide range of patents, concepts, models, and computer and administrative systems.

External structure consists of relationships with customers and suppliers, brand names, trademarks and reputation, or "image".

Individual competence is people's capacity to act in various situations. It includes skill, education, experience, values and social skills.

Brooking (1997): Intellectual capital consist of Market assets, Human-centered assets, Intellectual property assets and Infrastructure assets.



The definition of each component,

Market assets are the potential an organization has due to market-related intangible. Examples include various brands, customers and their loyalty, repeat business, backlog, distribution channels, various contacts and agreements such as licensing, franchise and so on.

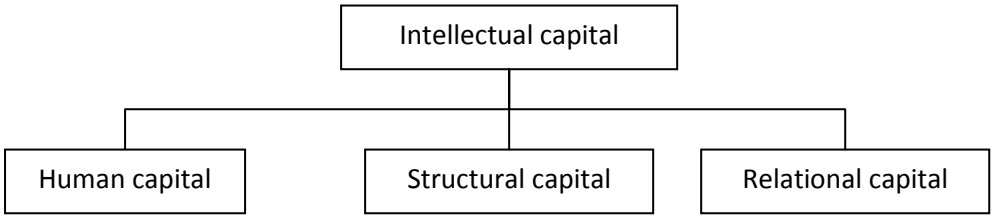
Human-centered assets comprise the collective expertise, creative and problem solving capability, leadership, entrepreneurial and managerial skills embodies by the employees of the organization.

Intellectual property assets include know-how, trade secrets, copy-right, patent and various design rights. They also include trade and service marks.

Infrastructure assets are those technologies, methodologies and processes which enable

the organization to function. Examples include corporate culture, methodologies for assessing risk, methods of managing a sales force, financial structure, database and communication systems.

Bontis (2000): Intellectual capital consists of Human capital, Structural capital and Relational capital.



The definition of each component,

Human capital is defined as the combined knowledge, skill, innovativeness, and ability of the company's individual employees to meet the task at hand. It also includes the company's values, culture, and philosophy.

Structural capital deals with the mechanisms and structures of the organization that can help support employees in their quest for optimum intellectual performance and therefore overall business performance.

Relational capital is knowledge of market channels, customer and supplier relationships, as well as a sound understanding of government or industry association impacts.

The classification of IC is link to the measurement method of each researcher to measure the component of IC and some tools can construct to IC value.

Intellectual capital measurement method

Measurement of IC and knowledge management practices will result in significant benefits to the organization that will help determine business strategy, process design as well providing competitive advantage. So we measure the IC for manage and increase the company value. List company are always publish the annual report to show overall performance and some information in the annual report can be use to define the IC value.

The benefit will become to the company who want to measure and compare their IC value to the best in class. Kamath (2008) had study the IC value in Pharmaceutical industry in India by using VAIC tool and the result show the domestic company do the performing better than the other and the human capital is the major impact on profitability and productivity. Kamath (2007) had study the IC value in banking sector in India by using VAIC and the result show the overall top performers in the value creation efficiency analysis were the foreign banks. Wang (2008) study IC value of the company in S&P500 and the conclusion is the IC has positive relate to the market value of the company. And US electronic companies are knowledge intensive and utilize IC to create their market capitalization. Chen, Cheng and Hwang (2005) also study IC value in the Taiwan list company by using the VAIC and the

result show the company's intellectual capital has a positive impact on market to book value and financial performance, and the R&D is the one component of structural capital which has a positive effect on the company value and the profitability.

Table I: IC measurement tool summary

Measurement tool	Developed by	Description of measure	Measurement metric
Skandia navigator	Edvinsson and Malone (1997)	Intellectual capital is measured by using 112 metrics to measure on five focus are Financial focus, Customer focus, Process focus, Renewal and development focus, and Human focus.	KPI to measure in each area as below sample, - Financial focus: revenues/employee ($) - Customer focus: days spent visiting customer (#) - Process focus: PCs/employee (#) - Renewal focus: average age of patents (#) - Human focus: annual turnover of staff (%)
Technology broker	Brooking (1996)	Provide the IC questionnaire audit in four area of asset and then transform to the ranking score. Four assets are market asset, human assets, intellectual property asset, and infra-structure assets.	Qualitative transform to score ranking.
IC-index	Roos et al. (1997)	Consolidates all individual indicators representing intellectual properties and component into a single index. Changes in the index are then related to changes in the firm's market valuation.	Single index by refer firm's market valuation.
Intangible asset monitor	Sveiby (1997)	Intellectual capital is measured by define measure metric on three assets. There are human competency, internal capital, and external capital. And each asset has three topics to measure. There are efficiency, growth/renewal and stability.	KPI to measure in each asset as below sample, - Growth/renewal: education level, investment in internal structure, profitability per customer. - Efficiency: value-added per professional, proportion of support staff, sales per customer. - Stability: Professional turnover rate, support staff turnover, proportion of big customers.

Measurement tool	Developed by	Description of measure	Measurement metric
Market capitalization method	Steward (1997)	Intellectual capital of company can be obtained by subtracting the company's net asset value from its observable market value.	Difference between market and book value.
Economic Value Added (EVA)	Stewart and Stern (1994)	EVA as "the difference between net sales and the sum of operating expenses, taxes and capital charges where capital charges are calculated as the weighted average cost of capital multiplied by the total capital invested".	EVA = Net sales - operating expenses - taxes - capital charges
Value added intellectual coefficient (VAIC)	Pulic (2000)	Measures how much and how efficiently intellectual capital and capital employed create value based on the relationship to the three major components. There are capital employed (CE), human capital (HU) and structural capital (ST).	VAIC = VACA + VAHU + STVA where VACA is indicator of value added efficiency of CE. VAHU is indicator of value added efficiency of HU. STVA is indicator of value added efficiency of ST.
Financial method of intangible asset measurement (FiMIAM)	Rodov and Leliaert (2002)	Measure how much and how efficiently intellectual capital in term of monetary value base on the relationship to the three major component. There are human capital, customer capital and structural capital.	There are six steps to calculate FiMIAM, Step 1: determining the "Realized intellectual capital" (Realized IC = market value - book value) Step 2: indentify the relevant components of IC. Step 3: assigning relative weights to IC component. Step 4: justification of the coefficients. Step 5: assigning value. The monetary value of IC components is calculated by multiplying the coefficients to the realized IC. Step 6: Finally a new "market to book value bottom line" is created by adding these IC value to the firm's book value.

Marr (2004) agree to do benchmarking on IC and benchmarking is seen as a tool for identifying, understanding, and adopting best practices in order to increase operational performance. So the benchmarking should be the one of the condition of the IC measurement tool capability.

Table II: IC Measurement tool benchmarking capability conclusion

Measurement tool	Benchmark capability
Skandia navigator	No
Technology broker	Limited
IC-index	Limited
Intangible asset monitor	No
Market capitalization method	Yes
EVA	Internal only
VAIC	Yes
FiMIAM	Yes

Benchmark column: modified from Rodov and Leliaert (2002)

The measurement tools that can use to benchmark are Market capitalization method, EVA, VAIC, and FiMIAM. However, in order to accurately calculate MCM, the historical financial statements must be adjusted for the effects of inflation or replacement costs. Therefore, using historical data may distort the measurement, particularly in industries with particularly large balances of old capital assets. By the way, EVA also can use as a benchmark tool if the company apply the same of the expected return rate of the company (Cost of equity). The explanation and analysis will do on EVA, VAIC, and FiMIAM method.

Economic Value Added (EVA)

Calculation formula: EVA = NOPAT - (WACC X INVESTED CAPITAL) ($)

Component of calculation

NOPAT = Net Operating Profit After Tax ($)
WACC = Weighted Average Cost of Capital = [(D/D+E) x Kd] + [(E/D+E) x Ke] (%)
Where
D = Company's long-term loans ($)
E = Market value of company's equity ($)
Kd = Cost of Debt: Average interest rate of loans or debt Outstanding (%)
Ke = Cost of Equity: Opportunity Cost: Required Return on equity (%)
Invested Capital = Investment in Working Capital + Investment in Non Current Assets + Other assets ($)

Source of data (Base on Thailand Stock Exchange)

Data	Available data
NOPAT	Annual report
Company's long term loans	Annual report
Market value of company's equity	Annual report
Cost of Debt	Annual report
Invest capital	Annual report
Cost of Equity	Base on company

For benchmark between companies, the cost of equity is the risk premium rate.

Value Added Intellectual Coefficient (VAIC)

Calculation formula: VAIC = VAHU + STVA + VACA (No unit)

Component of calculation

VACA is indicator of VA efficiency of capital employed = VA/CE

VAHU is indicator of VA efficiency of human capital = VA/HU

STVA is indicator of VA efficiency of structural capital = SC/VA

Where
VA = Net sales revenue - Cost of good sold - Depreciation (Riahi-Belkaoui (2003))
CE = Physical capital + Financial assets
= Total assets - Intangible assets (Pulic (2000a, b) and Firer and Williams (2003))
HU = Total expenditure on employees (Pulic (2000a, b) and Firer and Williams (2003))
SC = VA - HU (Pulic (2000a, b) and Firer and Williams (2003))

Source of data (Base on Thailand Stock Exchange)

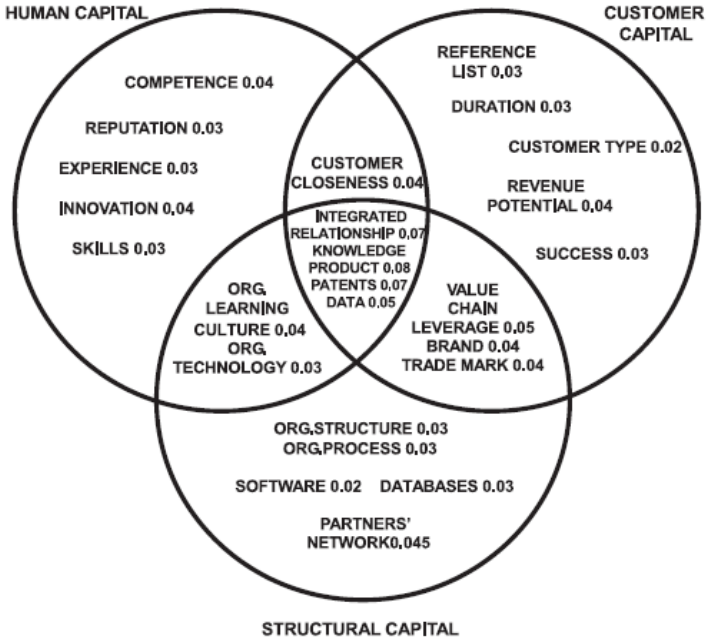
Data	Available data
Net sale revenue	Annual report
Cost of good sold	Annual report
Depreciation	Annual report
Total assets	Annual report
Intangible assets	Annual report
Total expenditure on employee's	Annual report

Financial method of intangible assets measurement (FiMIAM)

Calculation formula: Market value bottom line = IC component coefficient x Realized IC value

Component of calculation

Realized IC value = Market value - Book value
IC component coefficient = Based on Top management of company select IC components and coefficients value.
(Experience and understanding of value creation in their company)
Example (Rodov and Leliaert (2002))



Source of data (Base on Thailand Stock Exchange)

Data	**Available data**
Market value	Annual report
Book value	Annual report
IC component	Base on company
IC coefficient value	Base on company

Measurement tools calculation method

In this sections, the measurement tools are use to apply from the real world. The annual reports of electronic manufacturing company (International Company) in the list company of Thailand are use for the example calculation.

EVA

Unit: Baht

	Company A		**Company B**	
	Year 2007	Year 2006	Year 2007	Year 2006
Current assets	20,339,919,736	20,291,592,416	37,048,712,189	27,348,704,034
Excess Cash	9,181,580,042	6,798,019,213	1,724,502,786	976,939,902
Current asset exclude excess cash	11,158,339,694	13,493,573,203	35,324,209,403	26,371,764,132
Non-interest bearing Current Liabilities	5,006,497,328	6,215,881,640	18,992,828,472	14,583,677,011
Working Capital	6,151,842,366	7,277,691,563	16,331,380,931	11,788,087,121
Non-current asset	3,643,647,017	3,600,423,845	6,949,829,807	5,708,483,433
Other asset	941,508,693	1,064,472,658	373,999,355	411,848,251
Invest capital	10,736,998,076	11,942,588,066	23,655,210,093	17,908,418,805
Long term loans (D)	1,188,946,251	1,196,356,859	403,733,693	1,343,238,115
Market value of company (E)	15,328,998,616	13,793,779,053	11,293,911,319	9,956,454,221
- Share-holder equity	1,247,378,396	1,246,067,451	3,919,208,416	3,915,599,964
- Retained earning	14,081,620,220	12,547,711,602	7,374,702,903	6,040,854,257
Kd	14.50%	12.50%	6.50%	5.00%
Ke	6%	6%	6%	6%
WACC	6.61%	6.52%	6.02%	5.82%
NOPAT (Net Operating Profit After Tax)	2,990,491,500	2,275,816,552	3,257,400,210	2,752,048,802
WACC x Invest capital	709715572.8	778656741.9	1424043648	1042269974
EVA	2,280,775,927	1,497,159,810	1,833,356,562	1,709,778,828

VAIC

Unit: Baht

	Company A		Company B	
	Year 2007	Year 2006	Year 2007	Year 2006
Sale revenue	33,766,024,521	43,554,074,950	93,824,677,213	77,698,446,940
Cost of Good sold	26,247,690,894	35,457,445,341	89,150,610,318	73,752,397,433
Depreciation	853,899,041	1,043,340,344	764,587,104	659,474,477
Total expenditure on employee (HU)	1,984,000,000	2,003,000,000	1,966,361,000	1,803,470,000
Total assets	26,254,715,824	26,198,812,059	44,430,243,570	33,530,497,640
Intangible asset	941,508,693	1,064,472,658	373,999,355	467,970,903
VA = Revenue - Cost - Depreciation	6,664,434,586	7,053,289,265	3,909,479,791	3,286,575,030
CE = total assets - intangible assets	25,313,207,131	25,134,339,401	44,056,244,215	33,062,526,737
SC = VA - HU	4,680,434,586	5,050,289,265	1,943,118,791	1,483,105,030
Component of VAIC				
VACA = VA / CE	0.2633	0.2806	0.0887	0.0994
VAHU = VA / HU	3.3591	3.5214	1.9882	1.8224
STVA = SC / VA	0.7023	0.7160	0.4970	0.4513
VAIC	4.3247	4.5180	2.5739	2.3730

FiMIAM

Unit: Baht

	Company A		Company B	
	Year 2007	Year 2006	Year 2007	Year 2006
Book value	15,875,506,681	14,585,072,512	13,935,863,322	12,595,576,685
Share capital	1,247,378,396	1,246,067,451	3,919,208,416	3,915,599,964
Stock price (End year)	16.70	15.20	3.82	3.42
Market value	20,831,219,213	18,940,225,255	14,971,376,149	13,391,351,877
Realized IC value	4,955,712,532	4,355,152,743	1,035,512,827	795,775,192

Assign value, Human capital = 0.5 (Consists of Experience 0.15, Skill 0.1, Innovation 0.25)
Structural capital =0.2 (Consists of Org. process 0.08, Org. structure 0.05, Databases 0.07)
Customer capital 0.3 (Consists of Customer type 0.18, Revenue potential 0.12)

Human capital	2,477,856,266	2,177,576,372	517,756,414	397,887,596
Experien	743,356,880	653,272,911	155,326,924	119,366,279

ce				
Skill	495,571,253	435,515,274	103,551,283	79,577,519
Innovation	1,238,928,133	1,088,788,186	258,878,207	198,943,798
Structural capital	991,142,506	871,030,549	207,102,565	159,155,038
Org. process	396,457,003	348,412,219	82,841,026	63,662,015
Org. structure	247,785,627	217,757,637	51,775,641	39,788,760
Databases	346,899,877	304,860,692	72,485,898	55,704,263
Customer capital	1,486,713,760	1,306,545,823	310,653,848	238,732,558
Customer type	892,028,256	783,927,494	186,392,309	143,239,535
Revenue potential	594,685,504	522,618,329	124,261,539	95,493,023

Table III: Result of calculation

Year	Component	Company A	Company B	Component	Company A	Company B	Component	Company A	Company B
Year 2007	NOPAT	2,990,491,500	3,257,400,210	VACA	0.26	0.09	**Human capital**		
							Experience	743,356,880	155,326,924
							Skill	495,571,253	103,551,283
							Innovation	1,238,928,133	258,878,207
	WACC	6.61%	6.02%	VAHU	3.36	1.99	**Structural capital**		
							Org. process	396,457,003	82,841,026
							Org. structure	247,785,627	51,775,641
	Invest capital	10,736,998,076	23,655,210,093	STVA	0.70	0.50	Databases	346,899,877	72,485,898
							Customer capital		
							Customer type	892,028,256	186,392,309
							Revenue potential	594,685,504	124,261,539
	EVA	2,280,775,927	1,833,356,562	**VAIC**	4.32	2.57	**Realized IC value**	4,955,712,532	1,035,512,827
Year 2006	NOPAT	2,275,816,552	2,752,048,802	VACA	0.28	0.10	**Human capital**		
							Experience	653,272,911	119,366,279
							Skill	435,515,274	79,577,519
							Innovation	1,088,788,186	198,943,798
	WACC	6.52%	5.82%	VAHU	3.52	1.82	**Structural capital**		
							Org. process	348,412,219	63,662,015
							Org. structure	217,757,637	39,788,760
	Invest capital	11,942,588,066	17,908,418,805	STVA	0.72	0.45	Databases	304,860,692	55,704,263
							Customer capital		
							Customer type	783,927,494	143,239,535
							Revenue potential	522,618,329	95,493,023
	EVA	1,497,159,810	1,709,778,828	**VAIC**	4.52	2.37	**Realized IC value**	4,355,152,743	795,775,192

EVA
Result comparison

EVA of both company are increase in year 2007 compare to year 2006.
EVA of year 2006 and year 2007 of Company A are higher than company B (Compare year to year).

Performance improvement point of view

Equation**:** EVA = NOPAT - (WACC*Invest capital)
NOPAT = Sale revenue - total expend - tax ($)
WACC = Weighted Average Cost of Capital = [(D/D+E) x Kd] + [(E/D+E) x Ke] (%)
Invested Capital = Investment in Working Capital + Investment in Non Current Assets + Other assets ($)

If Company would like to increase the EVA, they should
- NOPAT (Net operating profit after tax) should be increased: Increase sale revenue and reduce cost.
- WACC should be reduced: Find the source of low interest rate and company should expect the rate of return very low.
- Invest capital should be reduced: Utilized the assets to increase more profit.
Main message**:** Company should be increase sale, reduce cost, find the good source of loan (Low interest rate), and spend low volume of money with the high return of income.

Recommendation

- The rate of equity come from the expect return rate of top management. It can be bias and effect to the EVA value.
- Interest of loan is change year by year and also effect to the EVA value. Example, NOPAT and Invest capital of year 2001 and 2002 are the same but the interest rate of year 2002 are increase base on the bank policy, then the EVA of year 2002 is lower than year 2001. The EVA of year 2001 is better than year 2002 and they cannot conclude the performance of year 2001 is better than year 2002.
- EVA provides only single value of indicator and main capital focus is on the capital employed.
- EVA can not use to benchmark if each company use the difference expect rate of return (Rate of equity).

VAIC
Result comparison

VAIC year 2007 of Company A is decrease if compare to VAIC year 2006.
VAIC year 2007 of Company B is increase if compare to VAIC year 2006.
VAIC of company A are higher than VAIC of company B.
Human capital of both companies is the major capital that contributes to VAIC value.
Performance improvement point of view

Equation: VAIC = VA/CE + VA/HU + SC/VA
VA = Revenue - Cost - Depreciation
CE = total assets - intangible assets
HU = total expenditure on employees
SC = VA – HU

If company would like to increase VAIC, They should
- Increase company value added: Increase sale revenue, reduce cost and keep asset generate value.
- Increase more intangible asset (Goodwill, brand etc.).
- Improve human performance by reduce cost of employee expenditure.
Main message**:** Company should be increase sale, reduce cost, keep asset generate value, improve human capital efficiency and increase more intangible asset.

Recommendation

- VAIC has only three main capitals to comparison. Another capital should be including in the model to see which capital has change and more effect to the VAIC. Other capitals are customer capital, innovation capital, process capital etc.

FiMIAM
Result comparison

Realized IC of company A are better than company B both two years.
Realized IC of both company are look improve in year 2007.

Performance improvement point of view

Equation: Market value bottom line = IC component coefficient x Realized IC value
Realized IC value = Market value - Book value
IC component coefficient = Based on Top management of company select IC component and coefficients value. (Experience and understanding of value creation in their company)

If company would like to increase the market value bottom line, they should
- Increase Realized IC value: Increase market value.
Main message**:** Company should increase market value to increase the market value bottom line.

Recommendation

- FiMIAM has many components but they are provided by the top management of each company.
- IC component coefficients are provided by the top management in company. If management team had changed, the coefficient may be change also.
- Company can't compare performance year by year due to stock price are always change day by day and more fluctuation.

CONCLUSION

Many Intellectual capital measurement tools are available to use but only three of them can be use as a benchmark tools, there are EVA, VAIC and FiMIAM. Each tool also has a different of good points and the researchers can apply these good points to development the new measurement tool. From all recommendation of all tools we can combine and summary the good characteristic that the Intellectual measurement tool should be has. The next generation of the Intellectual capital measurement tool should has got,

- Classification of the Intellectual capital should be defined and clear before measurement.
- Each classification should have elements and that element should be representing the performance of each classification.
- Avoid using data that can be bias from human judgment.
- Avoid using the fluctuation data that come from the outside environment (such as stock price depend on many factors and change day by day).
- The variable of calculation should be common and available in annual report for external benchmarking.
- The result of calculation should be reflected to the company performance (Same direction of numerical value and company performance).
- The result of calculation should be report in term of static and dynamic.

Intellectual capital becomes the important in the world of knowledge economy. The company can sustain advantage competitive and survive in the turbulence economy by manage the intellectual capital. So the intellectual capital measurement of company should be come before manage. And benchmarking of intellectual capital is also important for the company, they can compare the intellectual capital to the company best in class and they will know "where they are" and "what direction they should move".

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AN EMPIRICAL SURVEY TO VERIFY THE PROBLEMS OF TAIWAN'S DEFENSE SCIENCE AND TECHNOLOGY POLICY

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ABSTRACT

This paper reports a series of empirical researches results about the evaluation and the verification of the fitness of the present Taiwan's defense science and technology development policy. At first, the discrepancies between the formal policy guidelines made by the government and the suggestions made by the field experts are reported as contrastive reference. Successively, a empirical questionnaire survey of 59 ranking military officers' opinions about the strategic management of R.O.C. defense science and technology was conducted, the analyzed results is consistent with the suggestions made by the field experts, reveal again that the problems of present Defense S&T planning can not diagnose the affecting matters effectively, the policy formulation does not follow the proper processes of strategic planning, and the development of defense science and technology does not supporting the requirements of force buildup, and these problems are still stretching and need to be solved. This paper also explore the feasibility to construct the Balanced Scorecard approach performance evaluation model for the implementation of defense science and technology policies, by integrating the constructs from the US & Canadian Defense BSC models, further amendment needs to be verified.

Keywords: Defense science & technology policy, strategic management, Balanced Scorecard, empirical questionnaire survey

INTRODUCTION

From the discussions of the Seventh National Science and Technology General Assembly (NSTGA, 2005.1.10-13) [1], the National Science Council (NSC) issued two documents: "The Division and Control of Important Measures of National Science and Technology Development (2005-2008)" (National Science Council, 2009a) and "The White Paper of R.O.C. Science and Technology" (National Science Council, 2009b) as the policy guidance of R.O.C. science and technology (S&T) development for the next four years period. The Eighth NSTGA was also being conducted on 2009.1.12-15[2], the policy guidance documents is yet to being published.

Although the defense S&T policy was first time subsumed in the NSTGA discussions, the policy guidance documents released after the meeting also contains the strategy management keywords as "vision", "goal", "strategy", etc. But while we carefully scanned the expository writing of those policy guidance documents, there still have many deficiencies enumerate as following:

[1] Refer to the official web site of the 7th NSTGA: http://www.nsc.gov.tw/pla/tc/.
[2] Refer to the official web site of the 8th NSTGA: http://www.nsc.gov.tw/pla/tc/8th/formal.asp

1. **The vision statement should be specific and inspirational**: even in the strategy formulation writing of the policy white paper which states "to construct a force structure and major systems which can support future thirty years needs" (National Science Council, 2009b, p.40). Though "future thirty years needs" has the implication of visionary projection, it might turn to be a hollow slogan if without the clear specification and integration of short to long-term goals.

2. **The goal setting and the level of strategic planning should be re-clarified**: the goal setting described in the S&T White Paper "According to defense S&T development blueprint, specific plans ... long-range development of the critical technologies, middle-range system engineering and science research plans, and short-term performance upgrade projects …" turned and limited the goal/objectives to the level of strategy implementation. The S&T development blueprint, should be articulated base on how to achieve goal/objectives; not the reverse way.

3. **An effective mechanism should be constructed for the evaluation and control of strategy implementation performance**: although all the "important measures" have specified the responsible and assistance departments, but the control levels were only distinguished by Executive Yuan control and self-control two levels. The "player as referee" problem is unavoidable for the self-control measures, and the evaluation and control mechanism are also not been specified for those important measures controlled by the Executive Yuan.

Considering the importance and degree of emphasizing upon the national defense S&T policy, the level of discussion and concerns was lowering from the strategic topic of "strategy 6: Strengthening the national defense S&T system, promoting defense and military development" in the Seventh NSTGA, to the supportive issue of "issue 5.5: Strengthen homeland security and the development of national defense S&T R&D capabilities." in the Eighth NSTGA. It revealed an obscure altitude toward the development of defense S&T and of the government, and growing the concerns of defense-related stakeholders.

Although the development of national defense S&T is only a part of the complex of national defense buildup, but its implication and impact, will not only affect the healthy development of national defense industry, the ways or strategies to achieve the goal of defense self-reliance, etc, it also will have direct influence upon the overall national S&T and economic development. Since the magnitude and impact are quite profound, the improvement and perfection of the defense S&T policy needs the collaborative efforts of all the parties involved, to renovate the national defense industry, and to support the national security and economic development.

LITERATURE SURVEY

The Defense Science and Technology Policy, is only one part of the national strength to support the development of national science and technology policy. To explore the theory and implication practices of defense science and technology policy development, this article

categorizes the process development and the implication practices of developed countries as following.

The Defense S&T Development Practices of Western Developed Countries

To learned from the defense S&T planning process and the performance evaluation practices of the western developed countries, as a blueprint for R.O.C.' defense S&T development, as a reference for effective strategic management of the defense S&T. This paper summarized a few of the specific practices from United States, United Kingdoms, and Canada as followed.

The U.S. Planning Process of Defense S&T

According to the "Defense Science and Technology Strategy 2000" released from website of the U.S. Department of Defense Office of the Deputy Minister of Science and Technology, U.S. has following defense-related policy guidance documents:

1. National Security Science and Technology Strategy (NSSTS) (1995).
2. JV 2010/2020 (Joint Vision 2010, 1996; Joint Vision 2020, 2000).
3. Defense Technology Objectives (DTO) for the Joint Warfighting S&T Plan and the Defense Technology Area Plan (2000).
4. Strategic Research Areas (SRA) (Defense Technology Area Plan, 1999).
5. Defense Science and Technology Strategy (DSTS) (2000).
6. Basic Research Plan (BPR) (1999).
7. Defense Technology Area Plan (DTAP) (1999).
8. Joint Warfighting Science & Technology Plan (JWSTP) (2000).

To sum up the contents of the major policy guidance documents about U.S. defense S&T development, it is not difficult to find out that the U.S. defense S&T planning procedures, is actually following a strict strategic planning procedure. That is to say from the start of vision statement by JV2010/2010, the goal and objectives are defined by the DTO, the DSTS deploy the strategies, and the implementation plans are deployed through BPR, DTAP, and JWSTP, finally, the Program Objective Memorandum (POM) is incorporated in the Technology Area Review and Assessment (TARA) and Program Planning and Budgeting System (PPBS) (Augustus, 2005). If we rearrange those U.S. defense S&T policy guidance documents into the procedures of strategic management, it would look like as figure 1 showing.

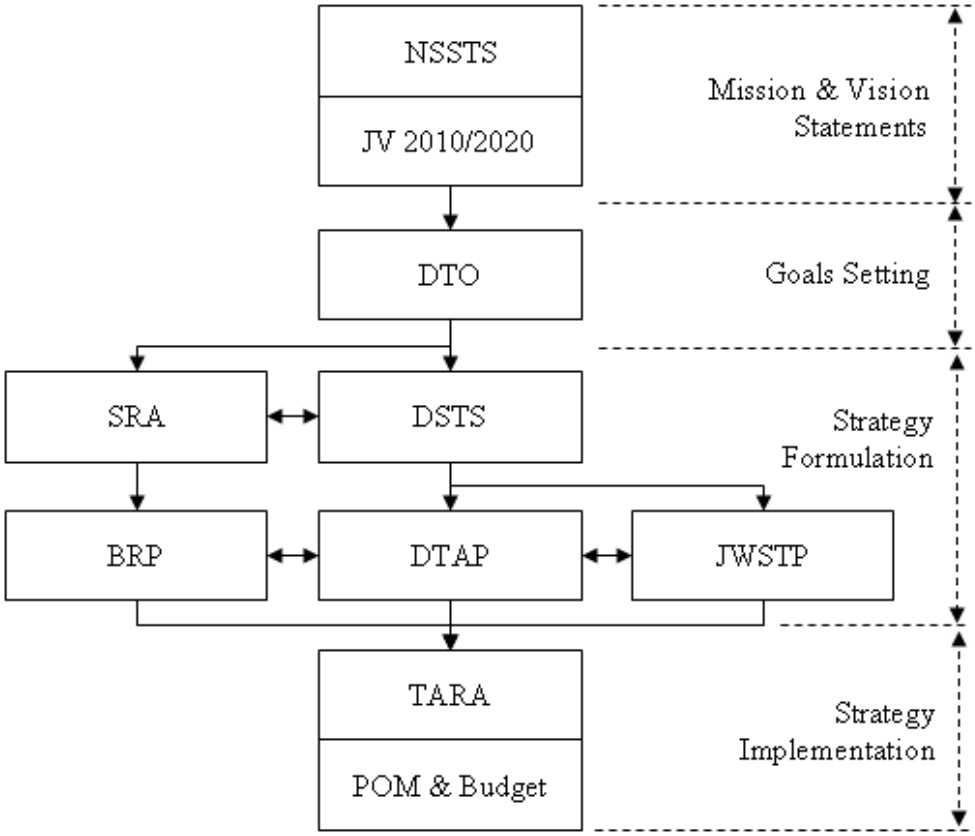

Fig 1. The Stages Model of US Defense Science & Technology Strategy Planning

US DoD Risk Framework Balanced Scorecard

Other than the complete strategic planning process for the defense S&T development, the every four years' Quadrennial Defense Review (QDR)[3] also apply the concept of Balanced Scorecard (BSC) to manage the risks of U.S. national defense.

During the Clinton administration, the law of Management Initiative Decision 901 (MID 901) regulates and defines the one-for-one relationship between the Kaplan and Norton BSC framework with the DoD Risk Framework for the QDR risk analysis and management (MID 901, 2002; Evolution of Performance Management, 2005)。

As in the risk areas of strategic objectives, performance measurement methods, expected performance results, and the actual implementation of the performance evaluation, are authorized each defense organizations to evaluate separately or in whole with questionnaire. The typical evaluation constructs and the related measurement criteria of the U.S. DoD risk framework BSC is illustrated in table 1.

[3] The official US DoD QDR website: http://www.defenselink.mil/qdr/.

Table 1 The US DoD Risk Framework Balanced Scorecard

Evaluation Constructs	Measurement Criteria
US1 Force Management Risk	1. Quality Workforce? 2. Reasonable Force Costs? 3. Able to Shape Future Force?
US2 Operational Risk	1. Are Forces Currently Ready? 2. Do We Have the Forces Available? 3. Successful Plan and Strategy Execution?
US3 Institutional Risk	1. Streamline the Decision Process? 2. The Readiness and Quality of Key Facilities? 3. Realign Support to the Warfighter?
US4 Future Challenges Risk	1. Drive Joint Operations? 2. Define Future Human Skills & Competencies? 3. Define & Develop Transformation Capabilities?

Note: Reproduce from The DoD Balanced Scorecard: Overview (2010)

Besides the U.S., The U.K. and Canada also uses BSC as its national defense strategic planning and strategic performance assessment tools, their assessment are summarized as follows.

U.K. MOD Defence Balanced Scorecard

Based on the Annual Report and Accounts 2004-2005 (2005) released by the U.K. Ministry of Defence (MOD), the concept of BSC is applied to evaluate, report, and manage the defense affaires of U.K MOD since 2000. There are four constructs such as purpose, resources, enabling processes, and future capability in the U.K. MOD BSC, the performance evaluation objectives or criteria of each constructs are shown in figure 2.

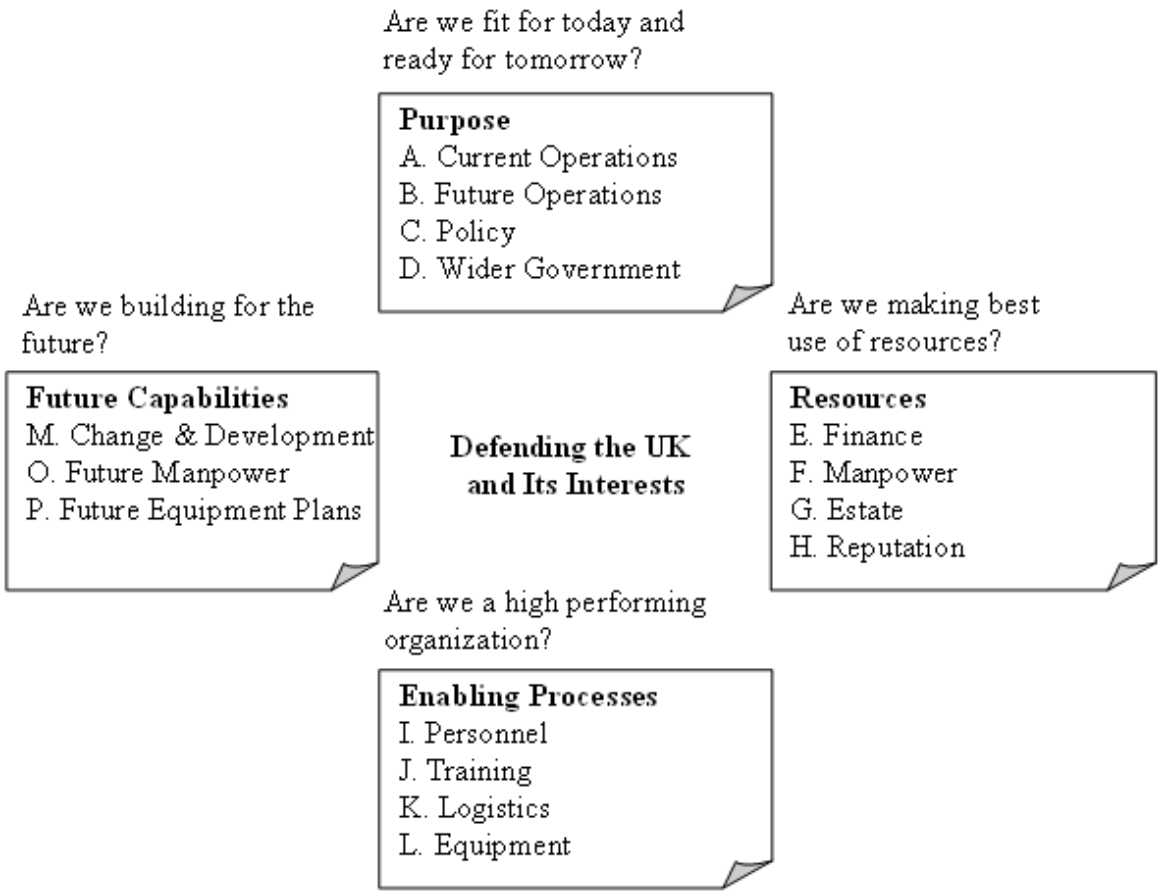

Fig 2. The 2004-05 Defence Balanced Scorecard of UK MOD
Note: Reproduce from Annual Report and Accounts 2004-2005 (2005)

The Canadian Force Strategy map and Balanced Scorecard

In formulating the future force buildup strategy, the Department of National Defense (DND) of Canada clearly stated that there are resource (allocation) conflicts between long-range strategic planning and short-term response to the fast changing environment. The short-term response should be focused upon the budget (resource) allocation on a yearly basis; while the long-range planning about force structure, defense policy, etc, are also influenced by the annual budget allocation. Therefore, the DND of Canada, responsible for the defense policy formulation and implementation, in responding to the changes of Revolution in Military Affairs (RMA) lead by the information age, must be prepared to face the fast changing international environment, the new threats challenging the national defense and homeland security, the unexpected risks of force buildup, etc, should pursuit a way to Revolution in Strategic Affaires (RSA) (National Defence and the Canadian Forces, 2009)。

The strategic planning and performance evaluation of the Canadian Defense is linking by the strategy map and its corresponding BSC. The strategic planning responsible of the Defence Management Council (DMC) using the strategy map to facilitate decision makers to focus on the strategic goals, the approaches (strategies) to achieve the goals, and the survey of the suitability of the implementation. According to the latest version of strategy map and its

performance evaluation BSC model, the DND and Canadian Forces (CF) BSC has 4 constructs and 13 related measurement criteria within each constructs as shown in table 2 (Department of National Defence Report on Plans and Priorities 2007-2008, 2009).

Table 2. The DND/CF Balanced Scorecard

Evaluation Constructs	Measurement Criteria
CA1 Shape the Force	1. Recruit and Retain 2. Promote Wellness and Health 3. Promote Continuous Learning 4. Foster Leadership & inclusiveness
CA2 Internal Process	1. Generate Forces 2. Foster Multi-agency Cooperation
CA3 Program Resources	1. Optimize Resource Utilization 2. Enhance Modern Management
CA4 Defense Outputs	1. Conduct Operations 2. Capable & Integrated Forces 3. Contributions

Note: Reproduced from Department of National Defence Report on Plans and Priorities 2007-2008 (2009).

To highlight and address the problems of the not yet establish of the domestic policy planning performance evaluation mechanism, the R.O.C. Government's decreasing emphasize upon the defense S&T development. This study applied the empirical survey by questionnaire, to expand the scope and verify the suitability of the suggestions made by field experts.

METHOD

Since the policy guidance documents issued after the Seventh National S&T Meeting did not respond and reflect the strategic planning process and suggestions proposed by the field experts, and for the purpose to verify and enrich the field experts' opinion, this study also refer to the US DoD and Canadian Forces Balanced Scorecard (BSC) models for performance evaluation of their defense science and technology policy implementation. To achieve the research objectives, this study used empirical questionnaire survey to verify the research objectives quantitatively.

Considering the subject sampling, since the subject of this research synthesized the professional features which including defense affaires, S&T development, and strategic planning, the suitable population is the ranking officers in the advance programs of military academics. With the assistance of the National Defense University instructors, we conducted voluntary anonymous questionnaire survey and collected 59 effective responds from the ranking officers. The questionnaires were surveyed in the whole month of March 2009.

This study used two questionnaires; the first was designed to explore the problems and suitability of the present strategy planning process of R.O.C. defense S&T development, by referred to the field experts' suggestions about the topics, issues, and background note to the Seventh National S&T meeting, the questionnaire was constructed by three questions sets distinguished as Q1: Problems Diagnosis, Q2: Strategic Planning Process, and Q3: Force

Buildup Requirements, the questions within each sets is given in table 3. as illustration purpose since the questionnaire was in Chinese. The entire questionnaire has a total of 18 questions including three overall rating of the constructs, all questions was given a 0-10 scales for reviewers to respond and rating their degree of recognition of that question, "0" represents the most positive recognition, "10" express the most negative of recognition, the middle point of "5" stand for no comment or neutral opinion.

Table 3. First Questionnaire Used to Explore the Problems of the Present Strategic Planning Process of R.O.C. Defense S&T Development

Constructs	Questions
Q1: Problems Diagnosis	Q11: Strategic Guidance
	Q12: Force Buildup
	Q13: Self-reliance Defense
	Q14: Acquisition Policy
	Q15: Defense Budget
	Q16: R&D Resource
	Q17: Culture of Research
Q2: Strategic Planning Process	Q21: Developing Strategy
	Q22: Planning Process
	Q23: Defense Analysis
	Q24: Support National Development
Q3: Force Buildup Requirements	Q31: Future Needs
	Q32: Formalism
	Q33: Applied Research
	Q34: Perceived Quality

The second questionnaire was design to explore the suitable evaluation constructs and measurement criteria for performance evaluation of the implementation of R.O.C. defense S&T policy. Since the US DoD Risk Framework Balanced Scorecard (Table 1) and the DND/CF Balanced Scorecard (Table 2) are more specific among the available literatures, we asked reviewers to rate their degree of recognition to each of the constructs and measurement criteria for comparison. The rating of each question is also on the 0-10 scales basis with same meaning as questionnaire's response scales.

For the data analysis, research team conducted the exploratory data analysis to assure the adequacy of the data collected, the internal consistency of the questionnaires was verified by Cronbach alpha value of each constructs and the whole questionnaire, ANOVA procedure and post-hoc Scheffe test were used for difference analysis of subject's demographic characteristics, and exploratory factor analysis was conducted to verify the construct validity of each constructs of the questionnaires and for item reduction, and finally, the stepwise regression analysis was used to explore possible prediction model between the constructs. The software used for the statistical analysis is SPSS 12.0 Chinese version.

RESULTS

There were 59 effective responses for both questionnaires, and the data analysis results are reported as following sections.

Exploratory Data Analysis

To verify that the response average of each question does not influenced by the outliers and extreme values, the first step of the data analysis procedure is to conduct the exploratory data analysis, when outliers and extremes were identified; they were tentatively treated as missing values, excluding their influence for normal parametric statistical analysis.

After the exploratory analysis, each of the questions contained no more than 5 % of the missing values, and the kurtosis and skewness checks were all fit to the premise of normal distribution for further statistical analysis.

The Internal Consistency of Questionnaire

The internal consistency of the questionnaire was verified by Cronbach α value of each constructs and the whole questionnaire, as listed in table 4. The Cronbach α value of all models were larger than .87, and the Cronbach α value of all composite constructs of the model were larger than .73. According to general judgment, the questionnaires used by this study have enough internal consistency.

The Descriptive Statistics

The descriptive statistics of each question about the diagnosis model questionnaire are listed as table 5. Interpretation of the constructs statistics showing that the general response of the subjects think the problems are quite serious of present R.O.C. defense S&T policy (Q1: 8.07 ± 1.20), the policy is not fit in with the strategic planning procedure (Q2: 7.14 ± 0.94), and concur that the defense S&T development should serve as a primary goal in support of the force buildup (Q3: 7.69 ± 0.82).

Table 4. The Internal Consistency Check of the Questionnaires

Questionnaire Models/Constructs	Cronbach α
Diagnosis Model	.87
Q1: Problems Diagnosis	.92
Q2: Strategic Planning Process	.88
Q3: Force Buildup Requirements	.88
BSC Models	.92
US Risk Framework Balanced Scorecard	.89
US1: Force Management Risk	.73
US2: Operational Risk	.73
US3: Institutional Risk	.87
US4: Future Challenges Risk	.76
Canada DND/CF Balanced Scorecard	.90
CA1: Shape the Force	.83
CA2: Internal Process	.75
CA3: Program Resources	.81
CA4: Defense Output	.75

Table 5. The Descriptive Statistics of the Diagnosis Model

Constructs/Questions	mean ± s.d.	Interpretation
Q1 Problem Diagnosis	8.07 ± 1.20	Serious
Q11 Strategic Guidance	8.44 ± 0.82	Not supported
Q12 Force Buildup	7.93 ± 0.98	Not supported
Q13 Self-reliance Defense	8.66 ± 0.71	Fail to implement
Q14 Acquisition Policy	7.50 ± 0.79	Supplant R&D resource
Q15 Defense Budget	7.53 ± 0.92	Unbalanced and supplant
Q16 R&D Resource	8.03 ± 1.13	Insufficient
Q17 Culture of Research	8.59 ± 0.65	Ignored
Q2 Strategic Planning Process	7.14 ± 0.94	Unsuitable
Q21 Developing Strategy	6.95 ± 1.07	Lack of sustainability
Q22 Planning Process	7.95 ± 1.01	Not followed
Q23 Defense Analysis	7.18 ± 0.81	Should be professional
Q24 Support National Development	7.10 ± 0.77	Concurrence
Q3 Force Buildup Requirement	7.69 ± 0.82	Should be supported
Q31 Future Needs	7.49 ± 1.09	Should be planned-in
Q32 Formalism	6.65 ± 0.95	Should be avoided
Q33 Applied Research	7.60 ± 0.75	Emphasized for now
Q34 Perceived Quality	7.81 ± 0.88	Should be assured

As for the subjects' concurrence to the BSC model constructs, the box-&-whisker plot comparing the statistics of U.S. and Canadian model constructs is shown in figure 3. Except the Construct of US1: Force Management Risk have the same degree of concurrence, Subjects of this study are more concurred to the Canadian model constructs than the constructs of U.S. model constructs.

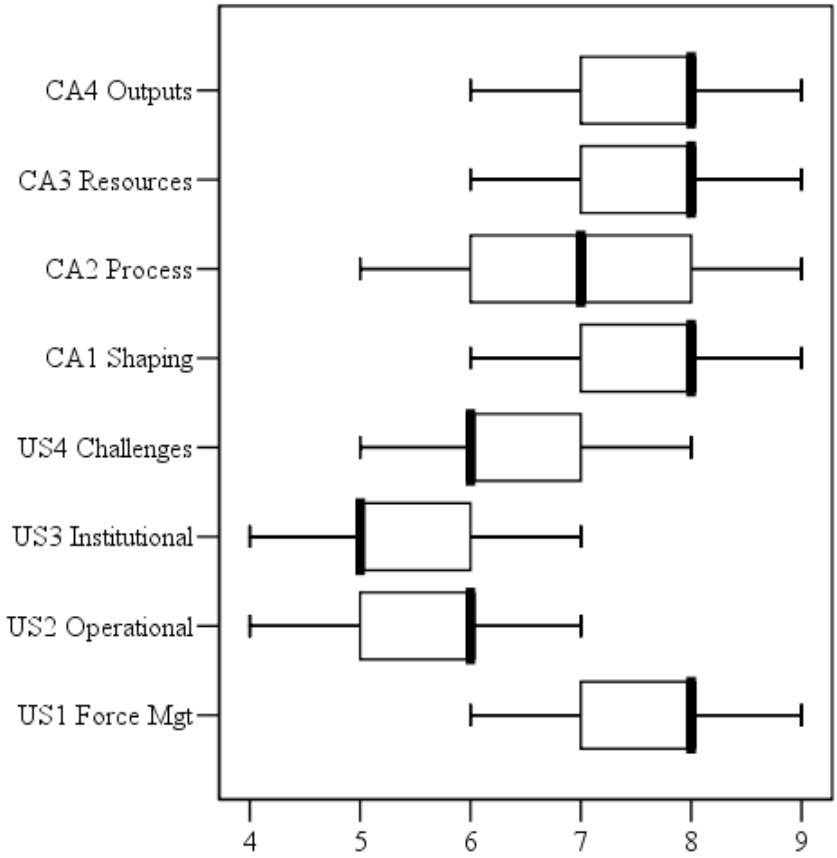

Fig 3. The Box Plot Comparing the Statistics of U.S. and Canadian BSC Model Constructs

The Regression Prediction Model

To explore whether the questioning items could reflect the construct or not, this study conducted the simple linear stepwise regression analysis for all the constructs of the Diagnosis model. The result is illustrated in table 6.

Table 6. The Regression Results of the Diagnosis Model

Constructs/Entry Items	Adjusted R^2	ANOVA Test
Q1 Problem Diagnosis	.82	$F_{4,51} = 61.80$, $p = .00$
Q13 Self-reliance Defense		
Q15 Defense Budget		
Q11 Strategic Guidance		
Q17 Culture of Research		
Q2 Strategic Planning Process	.77	$F_{2,53} = 91.86$, $p = .00$
Q22 Planning Process		
Q21 Developing Strategy		
Q3 Force Buildup Requirement	.80	$F_{2,48} = 102.61$, $p = .00$
Q34 Perceived Quality		
Q31 Future Needs		

From the regression results of the diagnosis model, it shows that the questioning items are suitable to reflect the constructs they constituted, and the degree of variance explanation (R^2) for constructs are all greater than 70 %, revealed that the questioning items designed had enough predictability to the construct they constituted. The regression models can be shown as following equations:

Q1 Problem Diagnosis = -6.31 + 0.37 (Q13 Self-reliance Defense)
+ 0.52 (Q15 Defense Budget)
+ 0.48 (Q11 Strategic Guidance)
+ 0.38 (Q17 Culture of Research)
$R^2 = .82$ (1)

Q2 Strategic Planning = 0.50 + 0.59 (Q22 Planning Process)
+ 0.28 (Q21 Developing Strategy)
$R^2 = .77$ (2)

Q3 Force Buildup = 1.06 + 0.54 (Q34 Perceived Quality)
+ 0.32 (Q31 Future Needs)
$R^2 = .80$ (3)

Although the US and Canadian BSC models and their constructs have different design considerations, we also conducted the correlation analysis with the diagnosis model to explore if there have any possible relationships exist. The Pearson correlation coefficients of those have significant correlation constructs are listed in table 7.

Table 7. The Pearson Correlation Coefficients of Significant Correlated Constructs

Pearson γ p	US1 Management	US4 Challenges	CA1 Shaping	CA2 Planning	CA3 Buildup
Q1 Problem Diagnosis		.59** .00	-.33** .01		
Q2 Strategic Planning		.87** .00	-.31* .02	.34* .01	
Q3 Force Buildup	.72** .00				.51** .00

* $p < .05$, ** $p < .01$

The significant negative correlation between the constructs of Q1: Problem Diagnosis, Q2: Strategic Planning with CA1: Shaping the Force indicated that the more serious of the defense S&T development problems, and the unsuitable strategic planning process, the more incompetence to shaping the force, consistent with the research expectation. Moreover, the significant positive correlations between the construct of Q3: Force Buildup Requirement with the BSC construct of US1: Management Risk and CA3: Force Buildup indicated that the more concurrence that the force buildup requirement should be supported by defense S&T

development, the more requirement for the force management risk analysis, the result is also in consistence with the research expectation.

Having the understanding of the correlations between the constructs of diagnosis and BSC models, the research team also conducted the stepwise linear regression analysis. The three constructs of the diagnosis model were treated as the regressors while the eight constructed of US/Canada BSC models were treated as the predictors. The regression result is shown in table 8.

Table 8. The Regression Results Between Models

Regressors/Entry Predictors	Adjusted R^2	ANOVA Test
Q1 Problem Diagnosis	.37	$F_{2,56} = 18.23$, $p = .00$
US4: Future Challenges		
CA1: Shape the Force		
Q2 Strategic Planning Process	.77	$F_{2,56} = 95.83$, $p = .00$
US4: Future Challenges		
CA3: Program Resource		
Q3 Force Buildup Requirement	.58	$F_{3,55} = 27.87$, $p = .00$
US1 Force Management Risk		
CA3: Program Resource		
CA1: Shape the Force		

From the regression result, it shown that the US/Canada BSC models' constructs did not have the predictive power for the diagnosis construct Q1: Problem Diagnosis (R^2 = .37); but the other two constructs of the diagnosis model Q2: Strategic Planning Process and Q3: Force Buildup Requirement, could be well predicted by parts of the US/Canada BSC models' constructs, and the predictive power were all greater than 50 %. The regression models can be shown as following equations:

Q2 Strategic Planning = 2.62 + 0.98 (US4 Future Challenges Risk)
- 0.21 (CA3 Program Resource)
$R^2 = .77$ (4)

Q3 Force Buildup = 0.51 + 0.77 (US1 Force Management Risk)
+ 0.45 (CA3 Program Resources)
- 0.27 (CA1 Shape the Force)
$R^2 = .58$ (5)

Data Reduction Factor Analysis

Except the exploration with correlation and regression analysis, the research team also conducted the factor analysis to explore whether the questioning items of each constructs of the diagnosis model could be further reduced or not.

The factor analysis with main component extraction, maximum variance rotation setting, and the results shown a well sampling adequacy measurement with KMO = .78, and the Bartlett

spherical test was significant (χ^2 (105) = 461.10, p = .00), indicated that the 15 questioning items had enough construct validity with respected to their constructs, and suitable for factor analysis.

Three components were extracted from the factor analysis, and the total variance explained was 70 %, the factor loading and the factor scores of the component matrix are shown in table 9.

Table 9. The Component Matrix after the Factor Analysis of the Diagnosis Model

	Factor Loading/Factor Scores		
Questioning Items	1	2	3
Q14 Acquisition Policy	.86/.23		
Q15 Defense Budget	.83/.27		
Q12 Force Buildup	.83/.21		
Q13 Self-reliance Defense	.76/.16		
Q16 R&D Budget	.75/.16		
Q11 Strategic Guidance	.71/.18		
Q17 Culture of Research	.66/.12		
Q22 Planning Processes		.85/.31	
Q23 Defense Analysis		.78/.32	
Q21 Developing Strategy		.74/.26	
Q24 Support National Development		.72/.28	
Q34 Perceived Quality			.89/.32
Q33 Applied Research			.85/.30
Q32 Formalism			.81/.27
Q31 Future Needs			.81/.27

The three components extracted from the factor analysis are identical with the original diagnosis model questionnaire, and the factor loading of all the questioning items are larger than .66, indicated again that the diagnosis questionnaire was well designed to reflect the fact.

DISCUSSION

This study conduct an empirical questionnaire survey to investigated the general opinion of the ranking officers with respect to the present national defense S&T policy development. The purpose is to verify the strategic suggestions made by the field experts to the 7th NSTGA, and further enrich the research content by exploring the suitability of the US/Canada BSC models for the construct of performance evaluation model of R.O.C. defense S&T development.

After analyzed 59 effective questionnaire responses, the research team concluded several major finding as:

The Questionnaire Survey Results are Consistent with Experts' Opinion

The (problem) diagnosis model of the questionnaire was designed to verify the opinion and suggestion made by field experts' focus group, the results of the questionnaire survey are echoed again the results of field experts' focus group that:

1. There are many serious problems yet to be clarified and resolved for the present R.O.C. defense S&T policy. The main issues of concerns including:
   (1). The self-reliance policy should be implemented exactly.
   (2). The culture of research should be prompted and continuously nursing.
   (3). The strategic guidance should be supported by defense S&T development.
2. The defense S&T policy is not following a normative strategic planning process that:

   (1). The defense S&T development policy should support the overall direction of national strength building.
   (2). The defense analysis should be conducted by the specified professional institution in the defense department.
   (3). The developed strategy should aim for long-term sustainability.

3. The development of defense S&T policy should serve as a facilitator to support the primary goal of force buildup. Therefore:
   (1). The force planning units should bring up their future force buildup needs proactively.
   (2). The force buildup requirements should avoid the formalism endorsement for the policy.
   (3). The priority is to allocate the resource in supporting the applied researches, avoid the resource dilution by the basic researches.

The BSC Models for the Performance Evaluation of Defense S&T Policy

From the exploratory analysis of the BSC models by combined the U.S. DoD Risk Framework and Canada DND/CF models, research team found that in order to construct a performance evaluation BSC model for R.O.C. defense S&T policy, it could be started from the constructs of future challenges risk (US4), force management risk (US1), force shaping (CA1), and the program resource (CA3).

As for the measurement criteria of each evaluation constructs, since we only referred and compared the US/Canada model constructs, did not consider the possible difference between national conditions, and the sample size (n = 59) are not sufficient to conduct the confirmatory analysis by Structural Equation Modeling. We suggest that the research efforts in the future, should incorporate the specific conditions of R.O.C. national defense, expand the scope of sampling, and applied the confirmatory Structural Equation Modeling analysis to develop a suitable BSC model for the performance evaluation of R.O.C. defense S&T development.

It is also noteworthy that in developing a BSC performance evaluation model, all the constructs and their containing measurement criteria, should support the core concept of the

BSC: the vision and the strategy. If ignored, it is easy falling to the trapping mud of "goal displacement" and/or "Strategic myopia" (Kaplan and Norton 1996; Gates 2001; Evolution of Performance Management 2005).

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POLISH COMPANIES' BEHAVIOR IN TIME OF A GLOBAL CRISIS – RESEARCH VIEW

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ABSTRACT

As a result of the financial crisis of 2008, companies around the world have had to cope with its effects. The Crisis and the rapid change implies the need for an active, forward-looking thinking and effective action. Every company, even in the face of adverse consequences compilation, may retain its competitiveness, undoubtedly. This requires the implementation of tools of financial restructuring and a new or redefine strategy of company behavior in the short and long term. Implementation of the only short term activities is purely a recovery, which could result in a rapid return of the crisis, whose effects will be difficult or impossible to overcome.

Polish economy deal with international crisis the most effective compare to other countries in Europe. So it is interesting, if the polish company have generated also financial success.

The aim of this study is to explain the influence of global crisis on financial standing of Polish companies (compare analysis in 2007 – 2009 - data form financial statements). Then, in a survey, through the questionnaire, major determinants of the nature of the crisis were analyzed, also their symptoms and adjustment activities taken, including the choice of tools for restructuring in the face of financial dilemmas. The study also shows how well the Polish companies are prepared to cope with crisis.

As a result of studies, it evaluated the influence of dysfunctional phenomena and their effects on the functioning of Polish companies. The financial condition of Polish companies due to the crisis have been quite badly damaged but only in 2008.. The research showed that in the Polish realities, the financial restructuring is carried out mainly using a very narrow, limited range of tools, only for improvement. Unfortunately, there is no forward looking thinking in companys' strategy. Furthermore, in many companies the process of restructuring is made only for temporary overcome the crisis. The Polish managers don't use some systems of early weak signals etc. , even that early diagnosis of the crisis is linked to potentially narrow the scope of the necessary organizational changes and a greater opportunity to conduct an effective restructuring.

Finally, it shows phenomena of polish companies' behavior in a the time of global crisis.

Keywords: crisis, crisis management, restructuring, finance.

INTRODUCTION

As a result of the financial crisis of 2008, companies around the world have had to cope with its effects. The Crisis and the rapid change implies the need for an active, forward-looking thinking and effective action. Every company, even in the face of adverse consequences compilation, may retain its competitiveness, undoubtedly. This requires the implementation of tools of financial restructuring and a new or redefine strategy of company behavior in the short and long term. Implementation of the only short term activities is purely a recovery, which could result in a rapid return of the crisis, whose effects will be difficult or impossible to overcome.

Polish economy deal with international crisis the most effective compare to other countries in Europe. So it is interesting, if the polish company have generated also financial success.

The main theses on the paper are:

1. Polish economy deal with global crisis on satisfactory level
2. The global crisis did not break the financial condition of Polish companies - only partially impaired
3. The Polish managers still recover their business more to survive less to develop.

The research result presents phenomena of polish economy and companies' behavior in a the time of global crisis.

Crisis – theoretical review

Changeability of environment causes that contemporary companies are more often vulnerable to functioning in a crisis. In reference books the view that a crisis is an inseparable element of business is quite common.

According to the research done by M. Porada – Rochoń[1] at the turn of 2007 and 2008 it is clear that 69% of Polish and as many as 81% American companies have already experienced a crisis at some point.

There are many definitions of a crisis in reference books and so far no uniform definition has been worked out.

"A crisis is a major occurrence with a potentially negative outcome affecting an organization, company, industry, as well as its publics, products services or good name" (Fearn-Banks, 1996, p.1)[2] In 1984 P. Lagadec offered a working definition of crisis "Crisis: a situation in which numerous organizations are faced with critical problems, experience both sharp external pressure and bitter internal tensions, and are than brutally and for an extended

[1] The author did carried out research in 2007 and 2008 on financial restructuring processes of 167 Polish and 115 American companies Presented results are some part of the result of research grant of Polish government. no 113.
Porada – Rochoń M.,Restrukturyzacja przedsiębiorstw w procesie adaptacji do współczesnego otoczenia. Międzynarodowa perspektywa. Difin. Warszawa 2009, p.25.

[2] Millar D. P., Heath R. L., Responding to crisis. A rhetorical Approach to crisis communication. Lawrence Erlbaum Associates, 2004 p. 5

period thrust to centre stage and hurled one against the other …all in society of mass communication, in other words in direct contact, with the certainty of being at the top of the news on radio and the television and in the press for a long time"[3]

Ch. F. Hermann, recognizes that the crisis is a condition that threatens the survival of the company achieving its objectives, limits the time available for remedial action and surprises with decision makers in your appearance, thus creating conditions of strong pressure. [4]

***It can be accepted that: A crisis in a company is a process determined by a range of events and situations synchronized in a specific period of time, and as a result leading to the dysfunctions of basic company actions*[5].**

We live in an era in which business-related crisis is relatively commonplace. For business managers who are responsible for seeing their business through crises, the questions are no longer whether they will experience crises, but rather when and in what form. Successfully navigating a crisis will depend on the actions a business takes in the time between accepting that crisis can happen and the actual crisis itself.

What seems particularly important is to prepare a company for a crisis, create the mechanisms of actions in case threats occur. Undoubtedly, careful and well-thought out activities can minimize the consequences of a crisis or even desist them from happening.
An interesting view on a crisis in a company is presented by Ian I. Mitroff[6].

The author suggests there are seven distinct competencies, or intelligences, that an organization must demonstrate to survive crises, including:

1. accepting that crisis can occur,
2. using creative thinking to consider types of crisis,
3. understanding that businesses are affected by challenges that are universal in nature,
4. seeing crisis and solutions as complex, but understanding that preparation can simplify the path to survival,
5. using controlled paranoia to discover where a business is vulnerable,
6. making crisis management central to all business activity,
7. understanding the connection between our work and our spirit.

Crisis management is a process of strategic planning for a crisis or negative turning point, a process that removes some of the risk and uncertainty from the negative occurrence than thereby allows the organization to be in the greater control of its own destiny.[7] Crisis

[3] M. Ogrizek, J. N. Guillery, Communicating in crisis. A theoretical and practical guide to crisis management. Presses Universitaires de France, 1999, p.xIV
[4] C. H. Hermann, Some Consequences of Crisis chich Limit the Viability of Organizations in: „Administrative Science Quarterly No8/1963 za: S. Slatter, D. Lovett, Restrukturyzacja firmy. Zarządzanie przedsiębiorstwem w sytuacjach kryzysowych. WIG- PRESS, Warszawa 2001, s. 45.
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[6] Mitroff Ian I. , Why some companies emerge stronger and better from a crisis. USA 2005.
[7] Fearn-Banks K. , Crisis Communications. A case book approach. Lawrence Erlbaum Associates. 2007, p 9

management represents a set of factors designed to combat crises and lessen the actual damage inflicted by the crisis. (Coombs 1999b, p.4)[8]

A rhetorical approach to crisis recognize that each crisis has an actual dimension and a perceived dimension. Some crisis are "perceived" to be bigger or smaller than actually are. One explanation for this difference in perception is ability of key spokespersons to communicate effectively before, during and after the crisis. Crisis managers, than, need to think in terms of the technical, managerial, and rhetorical dimension of a crisis. They need a mind set that motivate them to prepare for the crisis, as well as to prepare other for the crisis. The mind set leads them to respond and communicate during a crisis, as well as after the crisis. Thus, crisis has two dimensions: technical/managerial and communication. A crisis is created by choices and performances that have technical or managerial dimensions.[9]

Attention should be paid to the fact that a crisis should be considered through two ways. Firstly as a negative result of organizational perturbations caused by changes of an approaching crisis. The crisis perceived in this way is similar to the definition of a destruction, breakdown and the threat of the company existence.

On the other hand a crisis can be understood as a catalyst of an evolution.

From this perspective a crisis is perceived as a motor of obligatory transformations of a company, which in a global dimension forms new challenges, at the same time determining the requirements of free-market economy. Undoubtedly, it is up to the managers to exploit opportunities of company value increase and to take advantage of chances created by the market as well as to respond quickly to transformations in the environment.

Poland's place in a global crisis

The crisis which broke out in 2008 is not only the financial one since it encompassed other sectors of global economy. It is undeniable that the financial crisis initiated the restriction of global economy growth.

In free market economy assumptions there are successive, usually slow changes encompassing economic revival stages, financial boom, slump, sometimes sudden financial crisis and short-term recessions. Economy and the stock exchange are subject to permanent fluctuations, which mean growth and fall of some values resulting from economic business cycles.[10] Ch. Kindeleberger (1978, Manias, panics and crises. The history of economic crises)

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[8] Coombs, W.T. (1999b), *Ongoing Crisis Communication: Planning, Managing, and Responding*, Sage, Thousand Oaks, CA.

[9] D. P. Millar, R. L. Heath, Responding to crisis. A rhetorical Approach to crisis communication. Lawrence Erlbaum Associates, 2004 p. 8

[10] The theories by C.Juglar, N.D. Kondratieff, Kitchin are worth paying special attention. P. Samuelson, J. Hicks, A.Philipps and M. Kalecki, M. Friedman formulated the most famous theories on the reasons of cycles occurrence

indicated that crisis tend to occur when new markets and branches appear as a result of economic changes. Using of these new opportunities often lead to exaggeration on financial markets which in turn means crash at some point. Managing are usually accompanied by crises.[11]

Economic history of the world is relatively rich in crisis phenomena. Beginning from the greatest world economic crisis which occurred between 1929-1930, through the crisis in Japan in 1990, Asian crisis in 1997 or the crisis in Turkey and Argentina up to the financial crisis in 2008.

Although a large number of crises have occurred in recent decades around the globe, almost all of them have remained national or region al events – without a global impact. Actually, a new interest in the depression of 1930s, commonly classified as the Great Depression, has emerged as a result of today's crisis. By now, it is commonly used as a benchmark for assessing the current global downturn.

The financial crisis has had a pervasive impact on real economy of the EU, and this in turn led to adverse feedback effects on loan books, asset valuations and credit supply. But some EU countries have been more vulnerable then others, reflecting inter alia differences in current account positions, exposure to real estate bubbles or the presence of a large financial centre.

The crisis led to currency weakening, increase of unemployment, problems of banking sector as well as budget situation and atmosphere among companies and consumers got worse. Beyond the shadow of a doubt, the EU economy entered the steepest downturn on record Since 1930s.

Not surprisingly, the most seriously threatened European states are France, Italy, Greece and Hungary, each of which is running a serious budget deficit while also being burdened by high government debt.

Polish economy deal with international crisis the most effective compare to other countries in Europe. According to estimates by the European Statistical Office (Eurostat), in 2009 , it was the only country in the European Union to register economic growth last year, at 1,7%.

By the same (somewhat flattering) measure, which adjusts for the greater purchasing power arising from lower prices, Poland now has Europe's sixth-biggest economy.[12]

[11] Kindeleberger Ch., Manias, panics and crises. The history of economic crises. 1978 9 (in:) Otte M. Kiedy nadchodzi kryzys. Emka. 2009, p.47

[12] Horse power to horsepower Economic growth and a strong, stable government to boot: time to rethink old notions about Poland. Poland's strong economy. *The Economist* Jan 28th 2010

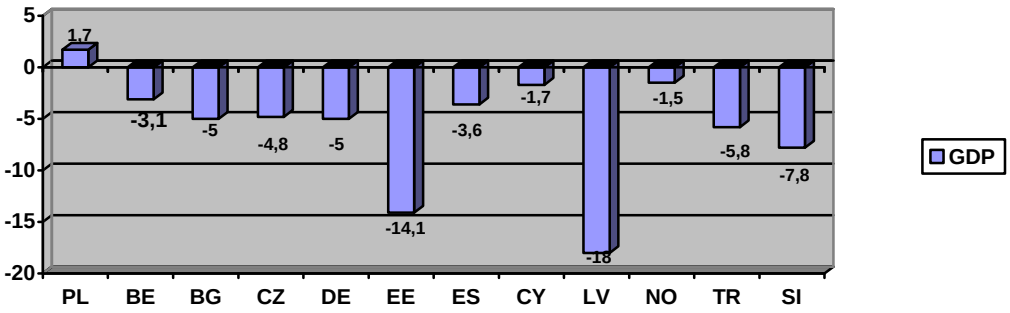

Fig. 1. Real GDP growth rate
Growth rate of GDP volume in 2009 - percentage change on previous year
Source: own elaboration based on Eurostat data

Poland entered the crisis with a delay and that was caused by a few factors. Firstly – going down with over 5% from a high growth rate. Secondly, Poland is a relatively small country with not big export but with a big share of domestic demand in a national demand, and with an economy of broad structure, without a narrow specialization. This traditional and not modern character of economy in the first period neutralized crisis phenomena.

The stability of banking and financial sector, which is relatively unaffected by exterior tremors should be emphasized at this point. Due to the smart economic policy: rigorist and disciplined monetary and financial policy on the macro level.

According to economists PricewaterhouseCoopers[13], the phenomenon of Polish economy is connected with its high competitiveness as a place of locating production.
On the one hand Polish manufacturers have unlimited access to the whole European market, on the other hand production costs are lower than in Western Europe. Another reason of success is the fact that economic policy of Poland was in previous years more "reasonable" than in other countries of the region.

Moreover, the important role of European funds[14] cannot be forgotten, which enabled many public investments to take place.

The chances of a crisis to finish and to enter a path of permanent path are not bright yet. Due to Polish economy being so resistant to external tremors one can enjoy reasonable optimism.

Polish companies in response to global crisis

Firms around the World had to cope with the effects of financial crisis that started in rich economies but led to the global economic downturn. Access to finance became more difficult. Demand for many products fell in domestic and international markets, and trade slowed globally.

[13] PricewaterhouseCoopers. Rok kryzysu. I co dalej. Report. 2009
[14] On 18 April subsidy contracts were signed at the worth of 127,1 mld PLN (30 mld EURO)

The year 2009 showed that Polish companies are able to adjust their activities to current business conditions. The year 2009 was said to bring a crisis which would lead to the loss of mld PLN and thousands of Poles were said to lose their jobs. Yet, the companies in Poland coped with this situation perfectly and financial results support it. However, according to A.T. Kearney, Poland can benefit from a global crisis – in their opinion Polish companies coped well with the first wave of a crisis but they should be prepared for a decrease of orders.

The results of research done by the author [15] indicate that as many as 51 companies out of 58 of those examined in 2008-2009 identified crisis or the state partially dangerous for further functioning of a company.

The most common reasons of dysfunctions in a company presents table 1.

Table 1 Determinants of crisis diagnosed in companies

Determinant	% of answers
Worsening of clients'/ business partners' financial condition	84,5%
Decrease of demand	67,24%
Difficulties in obtaining capital for current activities	84,5%
Loss/ worsening of financial liquidity	86,2%
Increase of inventories	44,8%
Increase of competition	50%
Incresing level of costs	82,7%
Recession in branch	36,2%
Decrease of market share	13,8%
Decrease of sales	84,5%

Sources: own elaboration based on own research

The results show that the reasons which significantly influenced the crisis situation are of internal and external nature. Fifty respondents (86,2%) indicated worsening of financial liquidity in a company as well as among clients and contracting parties. The research by Euler Hermes (05.2009)[16] show that payment morality of Westpomeranian entrepreneurs got significantly worse and the length of an average delay in paying debts was 29 days. As many as 49 respondents confessed that it was reducing sale that directly contributed to the occurrence of company dysfunctions.

Analyzing the connection between the reasons and results indicated by companies a logical sequel of events can be observed, causing negative consequences – the so called a spiral of the breakdown of a company, which means that one factor is followed by another leading to the worsening of the company situation and then finally to a crisis. It should be emphasized that each company indicated some or several reasons at the same time. It should also be

[15] M. Porada-Rochoń in January 2010 did some research in north-west Poland (Westpomeranian Voivodship), in 58 medium and small and micro companies.
[16] Euler Hermes Report : morality of paying by province in May 2009

noticed that majority of the reasons indicated are the typical range of the reasons the managers of the companies affected by a crisis showed.

Instruments and activities in restructuring process

The choice of appropriate kind of restructuring is determined by a specific need or needs resulting from a thorough diagnosis of threats, symptoms and the reasons of fluctuations within a company. The specificity of each subject and its condition means a choice of the most appropriate kinds of restructuring which in turn should lead to potential benefits.

On the basis of the choice of instruments and the implementation of activities, it can be concluded that financial restructuring was on the top, followed by activities within organizational restructuring and employment.

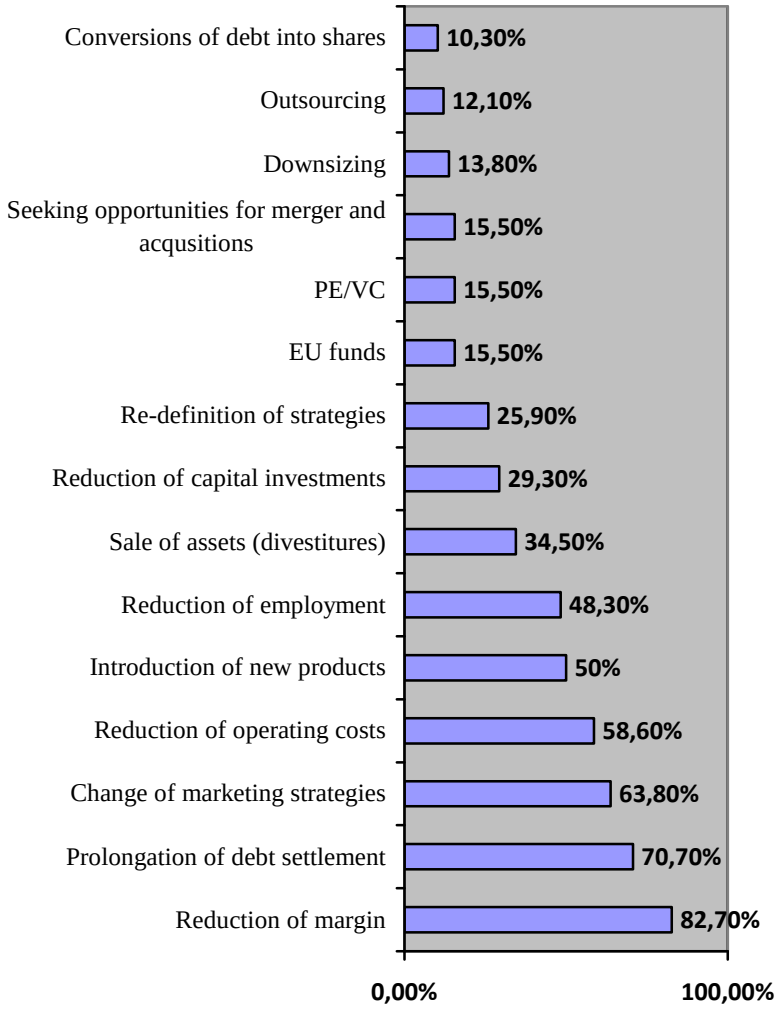

Fig. 2 Instruments and activities used by managers in the restructuring process
Sources: own elaboration based on own research

The companies examined concentrate their preferences on restructuring instruments determining survival on the market: prolongation of debt, reduction of margin and the reduction of operating costs.

Special attention should be paid to relatively very small percentage of companies implementing reduction strategies, i.e.: divestments and their derivatives, downsizing and outsourcing.

It is confirmed that Polish entrepreneurs incline towards traditional instruments of recovery[17] nature. Speed and unpredictability of changes forced companies to make quick decisions, often at the costs of the proper long-term ones, which laid foundations for company development.

It should be remembered that generally the implementation of only temporary activities does not lead to measurable effects. Short –term recovery activities are only able to contribute to cash generation and to pay off current liabilities. Activities undertaken in companies confirm that the crisis shall occur again but its consequences shall be much more complicated to level out.

It seems to be an specially worrying fact that only 15 companies undertook activities within partial or total re-definition of strategies. Meanwhile the research results by Economist Intelligence Unit[18] from 2005 showed that over 50% of managers hold the opinion that innovations within business model shall turn more significant in achieving success than creation of new products or services. The questionnaire by IBM carried out in 2008 in companies confirmed these results. Almost all respondents noticed the necessity of adjusting business models to current situation, and over two third confessed that their companies require changes on a large scale. In these difficult economic times some chairmen and managers are now looking for innovations in business model in order to effectively cope with changes that are occurring on the market.

Managers of the companies examined were asked a question concerning the mistakes made during restructuring processes. Among the most common answers were the following:

- ✓ Lack of motivating employees
- ✓ Lack of reliable information on the situation of the company
- ✓ Non-inclusion of employees in the restructuring process
- ✓ No redefinition of the business model
- ✓ Lack of implementation of property discounts
- ✓ Too fast decision on employment reduction
- ✓ Too late response to crises in the company.

One may be tempted to state that among Polish entrepreneurs there is significant stiffness within organizational structure hierarchy. It leads to the situation that there is no natural comparison of ideas, assessments and remarks between the managers and the employees.

[17] The author is doing third piece of research on crises phenomena in Westpomeranian companies. The first research was done in 2005 and 2006, the second one in 2007 and 2008.
[18] Economist Intelligence Unit (in) Johnson M.W, Christensen C. M., Kagermann H., Reinventing Your Business Model. Harvard Business Review. December 2008.

According to R. Beckharda and W. Protcharda "Providing employees access to reliable information and effective communication system are crucial in changing attitudes and behavior, the way labor relations. All of the above assumptions are probably equally important for success in the process of carrying out changes."[19]

Analyzing respondents' answers concerning using of systems or economic models used for early crisis detection, one can claim that only 5 companies take advantage of the integrated controlling system.

Surely it can be stated that Polish entrepreneurs do not posses rich experience and practice in using such solutions. However, the growing trend of controlling solutions can be observed.

Especially among big corporations as it shows, can be noticed increased awareness of the benefits of taking advantage of support in management. Due to their implementation, the identification of a crisis begins at an early stage and not much effort is needed in its anticipation.

Managers were also asked to indicate priorities for the upcoming quarters of the year. The most common are the following:

1. survive on the market
2. empower business / increase market share
3. diversify their range of products / services
4. use opportunities for expansion and growth
5. clients overtake of bankrupt companies

The last indicated the priority refers to the failure of companies. In West Pomeranian Voivodship showed an increase in year 2008 compare to 2007 in both the applications filed (Fig.4) and announced bankruptcies. According to announced bankruptcies, reported an increase by 22%.

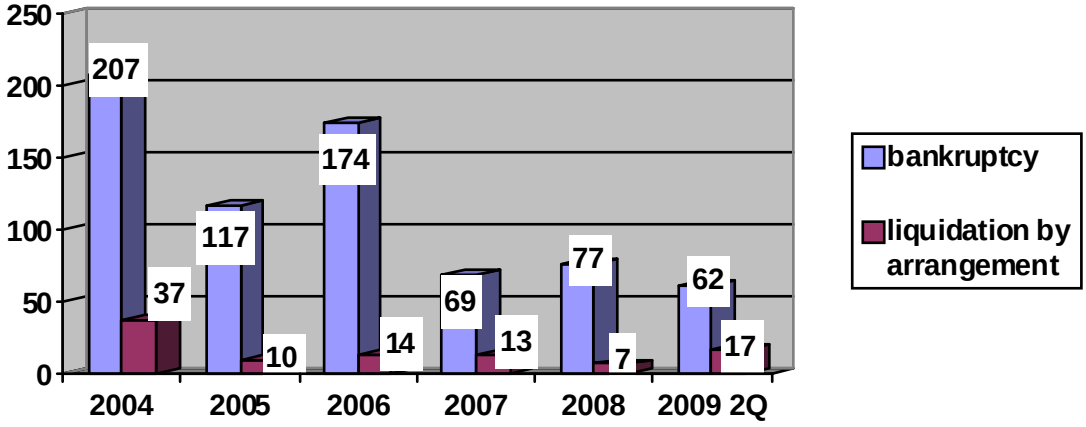

Fig. 3 The number of applications filed for bankruptcy
Source: own elaboration based on data of Bankruptcy Court in Szczecin

[19] Carr D., Hard K. Trahant W., Zarządzanie procesem zmian. Warszawa. PWN. 1998, s.80.

Although there has been no significant increase in the number of bankrupt companies, it must be borne in mind that bankruptcy is involved in the process. This means, that from the moment of submission until its bankruptcy may take up to two years. so the actual impact of the crisis on the bankruptcy of companies will appear in 2010 or even 2011 year. It should be expected upward trend for corporate bankruptcy.

Assessment of economic - financial conditions of Polish[20] companies

Impact of the global crisis did not affect significantly the deterioration of financial performance. This is supported by comparative analysis of the economic – financial condition of firms in 2007-2009.[21].

The year 2007 significantly influenced the development of the economic situation of enterprises. Since the beginning of 2007, Income from total activity regularly increased. Discernible deterioration in financial condition occurs in 4 q 2008.

Taking into account the Income from total activity and Costs of obtaining income from total activity can be noted that the costs increased slightly faster (increase in 2008 to 2007 by: 10,5% ;2009 to 2008: 6% than revenue 9,44% and 4,7% adequately, which is not favorable trend.

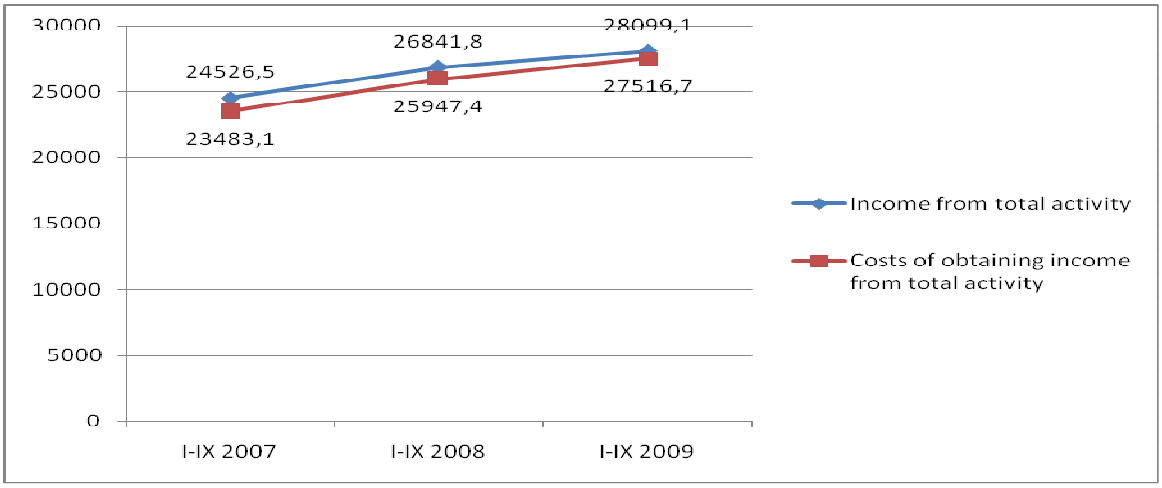

Fig.4 Value of Income from total activity and Costs of obtaining income from total activity in thousands PLN in 3rd Q 2007 – 2009.
Source: own elaboration based on data of Central Statistical Office

However, there was the global downturn, net sales of Polish enterprises was higher every year. The strongest impact of the crisis was evident in the financial decline in net financial result. Compare 3Q of 2009 to 3Q of 2007 reported 57% decrease, but compare 3Q of 2009 to 3Q 2008 was evident 40%. According to Polish economists forecast in 2010 net financial result is expected to increase.

[20] On example of companies from northwest part of Poland (Zachodniopomorskie voivodship) – Central Statistical Office. Number of enterprises covered by survey: 606 in 3td Q 2007, 627 in 3td Q 2008, 644 in 3td Q 2009
[21] takes into account the 3rd quarter of each year under

During the researched period there were no significant differences in share of number of enterprises showing net profit in total number of enterprises. Comparing 2008 year to 2007 year, it reported a slight decline from 74.6% to 72.7%, and then in 2009 increased to a level of 73.1%.

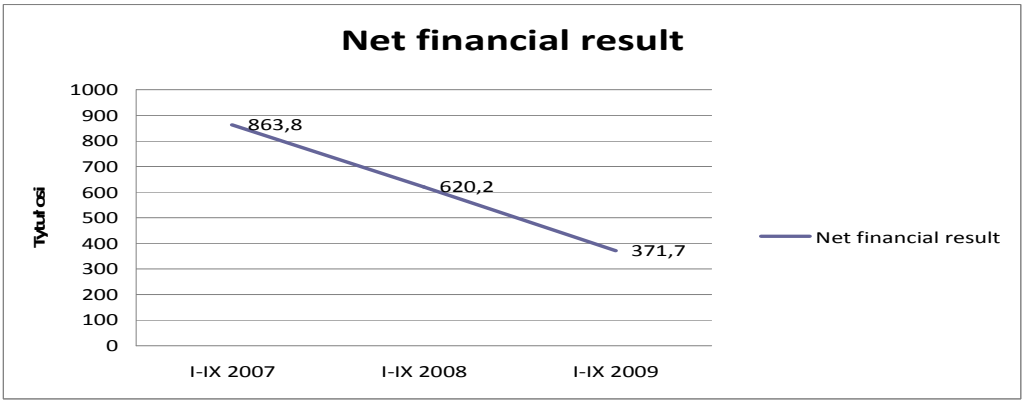

Fig. 5. Value of Net financial result in thousands PLN in 3rd Q 2007 – 2009.
Source: own elaboration based on data of Central Statistical Office

The company recorded a gradual decrease in rate of return on sales ROS - reaching levels: 4,2%; 4,6%; 3,2% - which is the result of reduced demand.

In addition, there were no major fluctuations in the levels of liquidity ratios. It should be noted, that financial liquidity ratio of the second degree was quite low in whole period.

Although the share of receivables and inventories in current assets grew steadily. In case of receivables, the first reason for this was the need to offer longer payment terms[22] to customers. Second, because of distortion of the liquidity of many companies, Account Receivable Management System works less efficiently.

It is clear that the crisis causes change capital structure. In the analyzed group of enterprises recorded a noticeable increase in current liabilities. In 2008 compare to 2007 the level of current liabilities increased by 23,6 %, in 2009 compare to 2008, by 15,7%. It requires monitoring of this situation of the policy of debt in the company, in order not to release congestion payments.

CONCLUSION

The financial crisis has caused a deterioration in key macroeconomic indicators of the economies around the world. In Poland, the biggest slowdown in GDP growth was noticed in 4Q 2008. The year 2009 brought the unexpected results of the binding of both the economy and businesses.

[22] Euler Hermes (05.2009) show that payment morality of Westpomeranian entrepreneurs got significantly worse and the length of an average delay in paying debts was 29 days.

Polish economy deal with international crisis the most effective compare to other countries in Europe. According to estimates by the European Statistical Office (Eurostat), in 2009 , it was the only country in the European Union to register economic growth last year, at 1,7%.

There has been no significant decline in consumption, even at reduced import demand in EU countries, did not cause a significant deterioration in business results.

Analysis of the financial condition of the companies surveyed showed that the end of 2008 was the period of dysfunction in their finances. The fourth quarter 2008 saw a marked decline in the profitability of sales and net financial result. The year 2009, especially the 3td and 4td Q showed improvement of some financial indicators.

Nevertheless, there was no a big difference in share of enterprises, which diagnosed crisis in year 2007, 2008 and 2009. [23]

Dysfunction diagnosed in financial condition forced companies to carry cut the restructuring process. The research showed that in the Polish realities, the financial restructuring is carried out mainly using a very narrow, limited range of tools, only for improvement, not for development. Unfortunately, there is no forward looking thinking in companys' strategy. Furthermore, in many companies the process of restructuring is made only for temporary overcome the crisis. The Polish managers don't use some systems of early weak signals etc., even that early diagnosis of the crisis is linked to potentially narrow the scope of the necessary organizational changes and a greater opportunity to conduct an effective restructuring.

But the year 2009 showed, that polish firms have a remarkable ability to adapt to changing environments.
Summarizing, the phenomena of polish economy and companies' behavior in a the time of global crisis are:

1. Smart economic policy: rigorist and discipline monetary and financial policy
2. Iimportant factor which helped to achieve the highest level of GDP was stable domestic demand.
3. Surplus in balance of payment
4. Eu funds which we decided to implement to infrastructure investment (unique impulse for economic growth (30mld Euro in 2009)
5. Polish business had a very difficult experience, when our economy were in process of transitions, in fact polish companies has very good practical skills how to fight with any threats and any negatives influences of economic and politic environment.

At the beginning of 2010, the company recorded a further improvement. Forecasts and expectations, including in particular the forecast demand and exports are characterized by a growing optimism. It translates into an ever smaller percentage of firms reducing employment and increasing participation by enterprises to increase them.

[23] See results of M. Porada – Rochoń research.

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CREATING SUPPORTING DATA FOR DECISION MAKING BY USING A SENSE AND RESPOND METHOD

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ABSTRACT

For several years the South East region of Finland, where the city of Kouvola is located, has been one of the world's largest forest industry concentrated areas. In recent years, the forest industry companies have restructured their outsourcing strategies which have affected local engineer offices and metal industry companies. This has created a challenging environment for Kouvola Innovation Oy since one of their main objectives is to develop the business operating environment in the area. Kouvola Innovation Oy sees that one potential new business for the area is renewable energy, especially bioenergy.
In this paper I will introduce the role of technology foresight in creating competitive advantage using sense and respond methods and use the Critical Factor Index tool in creating supporting decision making data for Kouvola Innovation Oy for developing existing strategies and new ones. The main idea behind the sense and respond method used in this paper was to gather information regarding relevant attributes that affect the company. Based on the information gathered critical factor indexes were calculated in order to determine which of the attributes are considered to be strengths and which attributes are needed to be focus on more. By calculating the critical factor indexes Kouvola Innovation Oy was able to have valid data to support their decision making and more importantly effectively distributing their resources which naturally are limited.
The data was gathered by using a questionnaire that had 27 different attributes. From each of these attributes were asked how important the company sees them for their selves, how well each attribute is carried out in their companies, how do they see themselves situating compared to competitors and how do they see each attributed developing in importance for them in the next five years. The results suggest that the companies see bioenergy as an interesting and potential new business for the area. The results also indicate that there is improvement needed in product and service development. To be able to create new businesses to the area, networks and value chains are formed to gain competitive advantage to the area.

Keywords: Technology foresight, competitive advantage, sense and respond method

1. BACKGROUND

For several years the South East region of Finland has been one of the worlds largest forest industry concentrated areas. Due to the global and rapidly changing business environment, the forest industry companies have been forced to carry out structural changes in their operations in order to remain profitable and being able to continue to offer added value for their interest groups. These companies struggle with increased energy, raw material and labor costs in Finland and this has meant reductions in production capacity and also production

limitations. This in turn has lead to lay-offs and reduced outsourcing and subcontracting. In a four year span starting from April 2004 and ending to April 2008, the amount of persons working in the forest industry in South East Finland has dropped approximately 35 % and currently the industry employs little less than 6000 persons and the trend is downward (Kymenlaakson kauppakamari 2009).

The region of Kymenlaakso is located in the South Eastern part of Finland and it has been the home of engineer and metal industry companies that have received a major portion of their turnover from contracts originating from the forest industry. And now that the industry is facing challenging times it has also meant challenging times for these small and medium sized enterprises (Later on referred as SME).

Kouvola Innovation Oy is a company that was formed in the beginning of the year 2009 and one of its purposes is to support and develop the business environment in the region of the city of Kouvola which is located in the northern part of Kymenlaakso. This paper has been derived from the company's need to develop and support new business opportunities for local companies that are facing challenging times due to the worldwide economical situation which has played a part in the previously mentioned constructive changes in the forest industry. Kouvola Innovation Oy sees that there are potential new business opportunities in the fields' bioenergy and wood based building. The main focus of this paper is to determine the current state of the engineer offices and metal industry companies regarding the previously mentioned areas of interest to give Kouvola Innovation Oy supporting data for their decision making processes. With the method used in this paper, I will determine the most important attributes that are considered to be strong and vice versa the ones that are needed to be stressed the most at this time.

Even though the forest industry is facing challenging times in Finland and their need for raw wood has declined, the wood that still exists and will exist in the forests, offers opportunities to develop new businesses. Bioenergy is a field that offers potentially new business opportunities since it is something that is becoming increasingly important. Reason for this is that in 2007 the EU has stipulated new regulations for energy consumption that have to be reached by the year 2020. These regulations are aimed to increase the use of renewable energy sources up to 20 % of the end consumption which equals to trebling the amount that was used in 2005. For Finland this has meant that the country has to increase their usage of renewable energy sources from 28, 5 % to 38 %. In Finland, wood and other wood based raw material possesses the greatest unused potential in terms of biomass (Finbio 2009). One other thing that makes bioenergy and related businesses an attractive option is that in year 2000 the refining value of wood in paper industry was 8, 8 times greater than it was in the energy industry that used wood as raw material. Last year it was only 1, 6 times greater (Jurvelin 2009).

The structure of this paper is quite straight forward – In the next chapters will be covered the theoretical background of how technological foresight can offer competitive advantage for companies that incorporate it to their strategies. After this will be discussed how companies can use sense and respond methods to support technology foresight. In the latter part of the theoretical section will be introduced how the Critical Factor Index tool in a sense and respond method is derived. The empirical part of this thesis will cover the data collection

process and analysis of it. This paper will be rounded off by conclusions and discussions of the results.

The research method used in this paper is based on the method introduced by Rautiainen and Takala (2003), which is a tool to measure the quality of service. Later on it has also been used as a basis for methods used in other studies like Latva-Rasku and Takala (2009) and Ranta and Takala (2007). Derived from these methods, the method used in this paper measures companies expectations and experiences and together with the deviation of the answers, determines the so called Critical Factor Index (later on referred as CFI) for each measured aspect. Based on the CFI, the attributes can be put in order of importance and determine which of them need to stressed first at this stage. To give further validation to the conclusions, the results will be put through a weak market test which is a part of constructive research.

2. TECHNOLOGY FORESIGHT

For years the forest industry has provided business opportunities for different kinds of service and manufacturing companies in Finland. These companies have been able to plan their own operations based on the fact that they have known that a certain amount and types of work will be coming their way from the forest industry. This in turn has created a stalemate where these service and manufacturing companies have not had to invest and focus on product and service development. Also they have not been forced to compete in the market for new business opportunities due to these static orders from the forest industry which in turn have kept the business attractive. As the forest industry is going through structural changes and reorganization of their operations, the service and manufacturing companies that have relied on businesses from it, should have also restructured their operations and focused on developing new business opportunities in order to maintain a profitable business. Campbell and Helleloid (2002) stated that no matter if you are a new industry or a mature industry company, keeping track of new technological breakthroughs is crucial. The same time as new technologies can offer companies new business opportunities, the same time it can also introduce new kinds of threats to existing business. The current economical situation is already in itself challenging and to avoid being squeezed even more in to a corner, keeping up with new technological and business opportunities is a must. As a part of a natural progress and elimination, the strongest will survive healthy and strong through the current economical slump. Technology foresight offers means for a company to be up to date with technological trends and therefore also to be part of the first wave in exploiting new business opportunities. Braun (1998) emphasized that including technology foresight to the overall corporate strategic planning of the company will benefit them in the long run. By doing this the company commits itself to an on-going process of technology foresight and as a result being able to take advantage of the cumulative knowhow that is gathered year in, year out.

Kanter (1997) also stressed in her book the role of technology foresight. There are four different things that are the basis of true sustainable competitive advantage:

1. Core Competence
2. Time Compression
3. Continuous Improvement
4. Relationships

All the above four elements are one way or another tight up to technology foresight. To be truly competitive as a small and medium sized company, you have to possess some kind of distinct service or product that no one else offers in the market or you have to able to deliver the service or product you are offering with more added value than your competitors. This determines your core competence and differentiates the company from rivals competing in the same market. Time compression has become more and more important in the past decade or so. Customers expect to have their products or services delivered to them as soon as possible from the point of order placement, i.e. reduced lead times without having to expect any lower quality or service. Cutting back on production and delivery times is a must and one way of doing this is being aware of new technological possibilities that are available. Of course companies can improve their current processes but this can only be done to a certain extent. Continuous improvement also requires technological awareness since to maintain a position in the market or even improve the company's status, the company must not be satisfied at any point in its current service or product range since there is always someone in the market who will try to overtake the customers by offering the same product/service at a lower price or faster delivery times or a combination of these, i.e. the competitors try to offer more added value to the customers. The fourth one in Kanter's (1997) list is relationships, which is also known as networking. As companies more and more focus on their core competences, having an efficient social network is something that can offer competitive advantage over your competitors. By forming networks and value chains companies are able to gain synenergy benefits by each company in the network bringing their own core competence to the table and thus creating a network of services and products that are together more than the sum of its parts. Tuominen, Rinta-Knuuttila, Takala & Kekäle (2003) also stressed the influence of networks in technology development in their paper. They introduced three main forces affecting technology development: Companies, universities and other institutes (Figure 1).

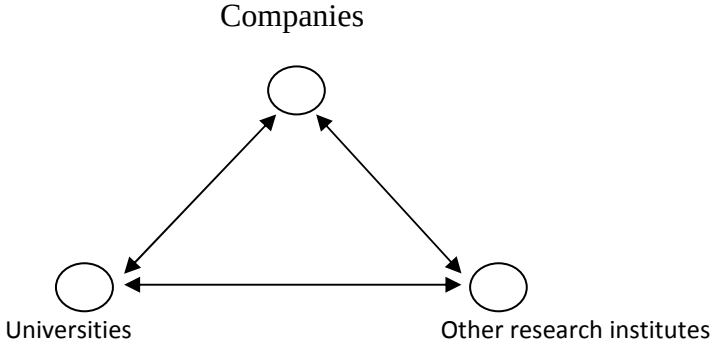

Figure 1. The main contributors of technology (Tuominen et al 2003: 2).

They stressed that each of the above three parties have a role to play in the development of new technologies. Companies focus on product development, universities focus on basic and applied research, and other research institutes – for example government's research institutes – focuses on implementation research and technology watch (Tuominen et al 2003).

2.1. Types of technologies

Depending on at which stage a technology is in its life cycle, different types of technologies can be identified that is typical for each stage. Tuominen et al (2003) indentified three different types of technologies in their research that can be seen from the following picture. The figure also illustrates the linkage to the technology life cycle (Figure 2):

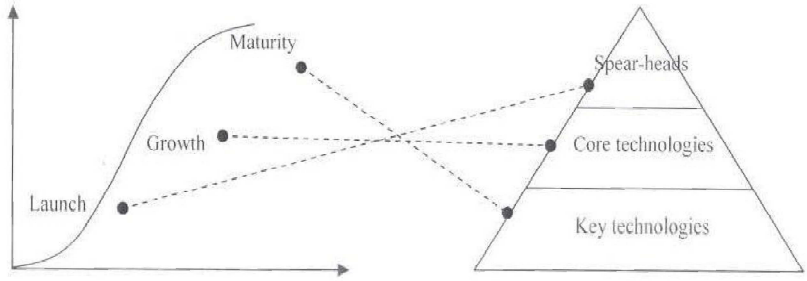

Figure 2. The linkage between technology life cycle and technology pyramid (Tuominen et al 2003: 5).

Spear-head technologies represent technologies that are seen as ones that hold the most potential and can offer successful business opportunities down the road regarding that they are exploited accordingly and efficiently. *Core* technologies include technologies that offer a competitive edge to competitors and enable the company to grow. At the bottom of the pyramid can be found key technologies, which represent technologies that the most critical ones for the business. The products and services are based on these technologies and therefore are the foundation of the business. These are kept inside the company to prevent the business of leaking to competitors. The pyramid can also contain an additional fourth level called additional technologies which represents the functions that are outsourced (Tuominen et al 2003).

3. SENSE AND RESPOND

In the previous chapter the role and importance of technology foresight was described. How can then companies start to implement these ideas in their own processes? And more importantly where do small and medium sized companies get the ideas for product and service development? Many of them do not possess the necessary resources to run their own research and development departments so they need to find other means to stimulate product and service development. In this chapter the theory of sense and respond will be covered in order to illustrate how companies can carry out technology foresight principles. An efficient way to do this is to have a close relationship with their customers in order to have an image what the customers are currently expecting and more importantly what might they be expecting in the future. And if carried out efficiently, a company may derive from the information gathered completely new products or services that the customers had not even though about.

3.1 Make and sell versus sense and respond

In order to be able to sense the needs of interest groups and to plan the company's current and future operations accordingly, methods have to be developed. Forecasting has been used in the past to gather relevant information but by using it, room for errors increases as it is always more or less guessing what the future will bring. Modern technology has enabled companies to use ´sense and respond´ strategies to assist in forming a picture of what phenomenon might take place in the future. Companies are able to use methods that enable them to collect and analyze real time data and this in turn improves their awareness in terms of what kind of trends and events are taking place in their operating environment. By using sense and respond methods, companies are not only able to collect data regarding expectations and experiences but also able to understand how the target group see themselves compared to competitors plus how they see the development of a certain attribute at a given time frame (Strauss and Neuhauss 1997; Bradley and Nolan 1998; Ranta and Takala 2007). Companies are moving from their traditional "make and sell" strategies toward "sense and respond" strategies that are faster and offer more real time information (Nolan and Bradley 1998). This has meant that the traditional concept of planning production cycles based on the manufacturers own needs has been replaced by the concept of anticipating the needs of customers in real time. By doing this companies are able to meet the needs and expectations of customers more efficiently and this in turn offers them the possibility to offer more added value compared to the traditional "make and sell" strategies. The key differences between "make and sell" strategies compared to "sense and respond" strategies are (Bradley and Nolan 1998: 6):

"Make and Sell"	vs.	"Sense and Respond"
Annual budget resource allocation is the "heartbeat"		Dynamic, real time resource allocation is the "heartbeat"
Glacial change		Real-time change
Design, build, sell		Sell, build, design
Plan		Act
Market share		Mind share
Build to inventory		Build to customer
Build reliable, complex products and services		Create unimaginably complex products and services

By incorporating "sense and respond" strategies, companies are better equipped to understand the needs of customers since these strategies integrate customers into the companies own product development processes by continuously collecting data from customers. Nolan and Bradley (1998: 5) identified five key points of the benefits that this yields:

- Reducing cycle-time for developing extremely complex products
- Efficiently delivering value to customers
- Yielding high levels of innovation
- Providing highly challenging work for knowledge workers
- Achieving high levels of financial results

3.2 Technological development enables new opportunities

So far we have mentioned that the technological development has enabled companies to use these "sense and respond" strategies, but what does this mean in practice? Since the early 1960's the computer world has develop from massive and expensive mainframes to a completely different world where everybody is able to stay in contact with one another regardless of time and place. The technological infrastructure has developed to a stage where companies, groups and individuals are able to constantly stay in contact with each other through computers, mobile phones and other IT-equipment. This has been enabled by the rapid development of broadband technology that has offered different ways to share data between different interest groups (Nolan and Bradley 1998: 9). With the aid of technological development companies are equip to monitor their customers on a constant basis which in turn offers them the possibility to be able to react, or even anticipate, to the changing needs at a accelerated pace compared to past times (Noland and Bradley 1998: 9). As important as the technological breakthroughs are for sensing the needs of the customers it also offers the companies themselves possibilities to reorganize their old traditional company structure. As information flows faster and it is possible to distribute it more widely throughout the organization, companies are able to restructure themselves more efficiently. Different departments are able to interact with another and stay up to speed what everyone else is doing and at what stage they are in a specific process at any given time. This in turn offers the companies shorter and more efficient processes like production, product development and delivery. These improved processes enable the company to plan the distribution of their resources more efficiently which ultimately results in being able to offer added value to the customer.

3.3. How to sense the customer?

The main challenge in implementing "sense and respond" strategies is how to be able to sense the needs of the customers. One popular method has been to gather customer satisfaction data, enabling companies to have better understanding how the customers see the companies are performing at a certain point time. Also it helps companies to identify matters that are not meeting the customers' expectations and re-plan processes accordingly if possible. The data gathered this way is always old data and circumstances might have changed since the customer satisfactions survey was carried out but still this way the companies are able have at least some kind of understanding about the market (Nolan and Bradley 1998). Real time data gathering is extremely difficult like Nolan and Bradley, 1998,

points out. They mention in their book couple of different ways how this can be carried out and all of those have one thing in common: All the companies mentioned in their examples have incorporated customers in their product development by allowing them to use an almost ready version of the final products and at the same time gather feedback from the users how they see the product and especially how would they, the potential buyers and end users, improve the products. Of course this is limited to certain types of industries but it can be considered as a starting point when planning "sense and respond" strategies and aiming to gather real time data from customers and other interest groups.

3.3.1. Virtual value chain

Nolan and Bradley (1998: 17) introduced in their book a term "virtual value chain". This "virtual value chain" can be seen from the following picture (Figure 3):

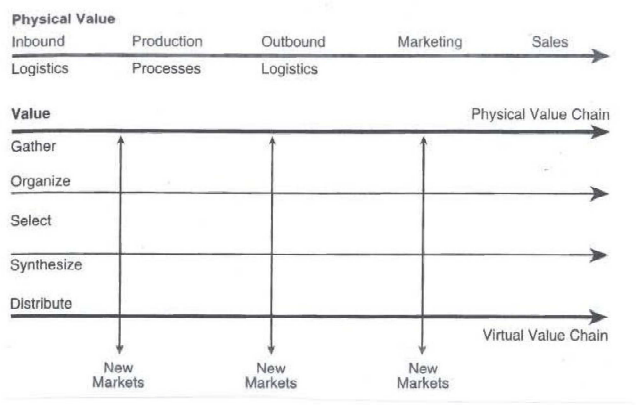

Figure 3. The virtual value chain (Nolan & Bradley 2003: 17).

The idea of the "virtual value chain" is to illustrate how much information flows inside different processes that support the physical value chain. In the picture can be seen that at each stage information is gathered, organized, selected, synthesized and distributed. Each bit of information at any point of the physical value chain might offer completely new information that can be the basis for new business opportunities. The new information can also be the starting point for research and development processes for new technological features and/or services. This is something that needs to be clear to different organizational members as they need to be aware of the different kind of information that flows through their own department. Otherwise golden chances might be lost. To be able to take full advantage of the benefits that "sense and respond" strategies offer, many times companies need to restructure their organizations. Otherwise the information gathered and the implementation of it will remain at an inefficient level and even though a company might claim that they are a "sense and respond" organization, in fact without the restructuring of operations and the organizations most of the times, they are not. The organization structure needs to support the "sense and respond" strategies (Nolan and Bradley 1998).

3.4. Transforming organizations

It is challenging for companies, both larger and smaller ones, to carry out organizational restructuring throughout the whole company. Companies have been used to operate in a certain ways for years and in some cases tens of years and suddenly to turn everything upside down and reshape things is challenging. One could show theories and research papers to company executives that this new direction is the correct direction that your company needs to take in order remain competitive and profitable also in the future. Most of the times it requires more effort to motivate a company to start the process of revamping their current operations, since it is a challenging road that they might embark on and if it is not done accordingly, it could have disastrous altercations. How can are organizations then motivated to restructure their operations if we exclude that they are forced to do so due of external factors, e.g. economical circumstances like a worldwide slump or mergers? Even though you could illustrate clear goals to a company executive what kind of improvements organizational restructuring can offer to the company, most of the times it would still be challenging to actually carry out the changes. They might recognize the need for a change which can be described as survival anxiety. And the same time as survival anxiety starts to surface, the same time learning anxiety starts to build up (Schein 2004: 329).

Learning anxiety can be described as the recognition of the need to change and discard their old ways of doing things but once the previous has been accepted, learning anxiety steps in (Schein 2004: 331). Schein (2004) described learning anxiety as a combination of different fears: Fear of temporary incompetence, fear of punishment for incompetence, the fear of loss of personal identity and the fear of loss of group membership. Fear of incompetence comes from having to step out of one's own comfort zone, i.e. while at the same time letting go of old habits and simultaneously trying to learn new ways of doing things and not yet to fully understanding and mastering these new habits. This is something that executives are really careful about since in case the new ways of doing things would not turn out to be as good they originally were intended to be, it would cripple the executive's authority. The second fear of punishment for incompetence is more or less related to the previous fear. The third of the fears described by Schein, 2004, relates to having to do something that they see is characteristic for them. Executives especially have usually long careers behind them and they have built their own identity by doing things in a certain manner. Now by learning to do something completely differently may be in conflict with one's own identity and thus creating a mental obstacle to carry out the required changes. The last fear is related to previous since by doing things in a certain way, executives have build a circle of trust from other managers and workers around them. The fear of losing the trust of that circle by altering ways of doing things might also prove to be a challenging obstacle to overcome.

It is virtually impossible to measure the level of learning anxiety but there are tools that help to determine vaguely at what level the anxiety is. So far we have determined that learning anxiety comes from the recognition that one realizes in order to perform more efficiently and therefore better than before, one would need to absorb and implement information that was previously unknown. Coghlan (1996) illustrated three stages of responses why a person could not engage in any learning process:

1. Denial where one would convince themselves that the information is not valid and therefore there is no need to further try to comprehend or implemented the information at hand.

2. Dodging, where one states that there is no need for a change before some else does it first.
3. Maneuvering, one seeks some kind of compensation for their efforts in order to implement the changes.

To overcome the previously mentioned obstacles that might stand in the way of transformative change, Schein (2004: 332-333) introduced two principles that apply:

1. "Survival anxiety or guilt must be greater than learning anxiety"
2. "Learning anxiety must be reduced rather than increasing survival anxiety"

The above principles relate to psychological aspects of the human mind that create psychological safety. Psychological safety can be achieved by supporting the members of the organization that are going through the transformational learning. This support can appear in several different ways, including training, mentoring, forming of support groups and lastly the most important thing, being able to create a positive image to the members that by doing the transformational change they will eventually enable the firm to perform better. This last point is helped by the fact that trying to avoid terms like "cultural change" or "transformational change" at the beginning of the process and stating clear targets that are need to be reached and the way they can be reached. Before the participants even realize it they are knee deep in a transformational learning process if they are pursuing the set targets using the agreed tools.

4. BUILDING THE METHOD

4.1. Service process analysis

Like previously mentioned in order for a company to maintain their competitive edge in their business environment, they need to incorporate technology foresight as an on-going process to their strategy. This in itself is not enough but a company has to be able to deliver the technological breakthroughs to the market via the correct channel.
Service Process Analysis (later on referred to as SPA) offers a normative framework where the capabilities of the services are analyzed in a matrix. The matrix is illustrated in Figure 3:

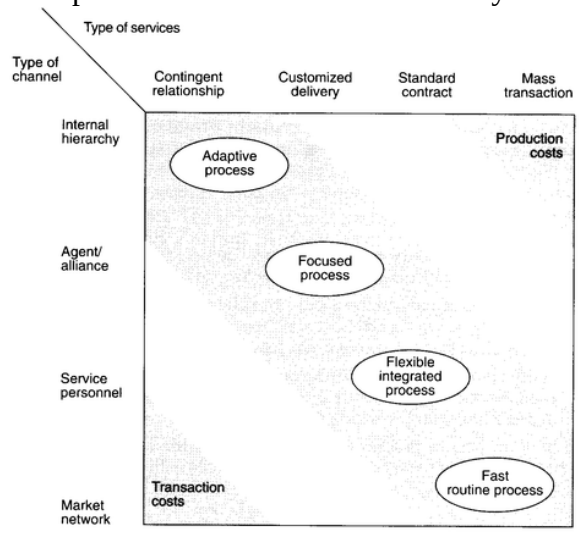

Figure 4. Service process analysis matrix (Ranta & Takala 2007: 2).

The axes consist of types of services and channels. SPA matrix has a core function of analyzing the efficiency of a certain type of service combined to a specific delivery channel (Jahnukainen and Vepsalainen 1992; Tinnilä and Vepsäläinen 1995; Ranta and Takala 2007). A delivery channel where the actual service process is carried has several parties involved. How efficiently and accordingly a certain channel operates depends on how these different parties interact with one another. Each party must have a comprehensive understanding of their own role and what is required of them to have a dynamic and efficient channel. It is important to realize that the customer buying and receiving the service is included and not considered as a separate part. Jahnukainen and Vepsäläinen (1992) and Tinnilä and Vepsäläinen (1995) determined four types of services:

- Mass transactions
- Standard contracts
- Customized delivery
- Contingent relationship

First three are clear but the last one, contingent relationship needs more clarification. It consists of complex problems and random acts that need continuous interaction from involved parties in order to tackle them accordingly and efficiently (Ranta and Takala 2009).

Jahnukainen and Vepsäläinen (1992) and Tinnilä and Vepsäläinen (1995) illustrated in the matrix four efficient services processes that are located in points where types and channel cross:

- Fast routine processes
- Flexible integrated processes
- Focused processes
- Adaptive processes

For companies the key in offering added value to its customers and as a result strengthening their own position in the market is to be able to choose correctly both the service and the channel (Ranta and Takala 2009). Sun, Ju and Su (2006) offered a three step questionnaire to help make the right choice. They said that the key is to have a clear vision and understanding where the company is situated currently in the market compared to its competitors, where they see the company is going and how are they planning to meet these objectives? Rautiainen and Takala (2003) pointed out that when measuring and evaluating customer satisfaction in service processes, the first thing to be carried out is to study the company's current service processes. Idea is to establish the connection between process operations and the attributes of services since attributes arise in operations. This enables the improvement of customer satisfaction based on customer feedback. Figure 4 illustrates the flow of information.

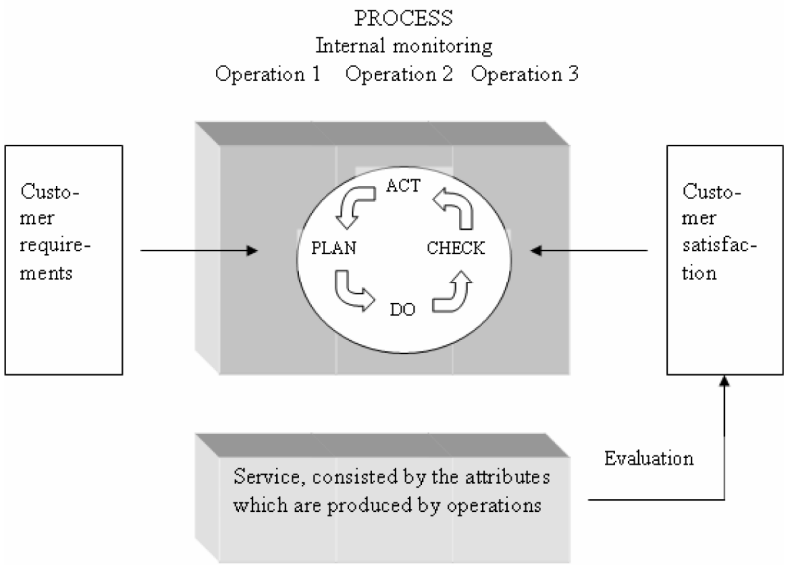

Figure 5. Continuos improvement of customer satisfaction linked to process operations (Ranta & Takala 2007: 2).

The same idea can be applied when determining critical factors influencing the operating environment of companies. First thing to be done is to determine basic characteristics of the business in which a certain company is operating.

4.2. Data collection

Rautiainen and Takala (2003) used in their study a questionnaire to gather data from customers. The questionnaire included attributes that took into account customer's expectations and experiences, how they saw themselves position against competitors in the market regarding an attribute and how they saw an attribute developing in the future in a given time frame. When planning the format of the questionnaire, one has to bear in mind that in order to collect answers using it and not just any answers, but reliable and valid ones, the structure must be planned so that is attractive to answer. This means that it has to be short, clear and easy to answer which will result in a positive and enjoyable experience. One of the core things of this method is to find out differences between attributes. This can be done by using a wide enough numerical estimation scale like Ranta and Takala (2007) used which can be seen in Figure 6.

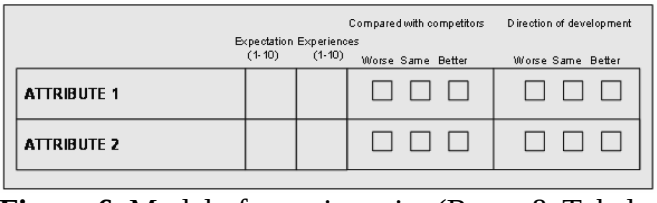

Figure 6. Model of questionnaire (Ranta & Takala 2007: 316).

4.3. Analyzing the data

The analyzing of the data is a process that requires several steps to get valid and useful conclusion. Rautiainen and Takala (2003) began their analysis by calculating standard

deviation (later on referred as SD), averages and distributions about the development of the attributes. These distributions were formed by calculating the percentage of how many answers of the total amount of answers fell into to a specific alternative (Ranta and Takala, 2007). Table 1 illustrates an example of the previous.

	Average of the expectation	SD of the expectation	Average of the experience	SD of the experience	Compared with competitors			Direction of development		
					Worse %	Same %	Better %	Worse %	Same %	Better %
ATTRIBUTE 1	8.43	1.36	8.75	0.9	3.1	59.4	37.5	6.5	77.4	16.1
ATTRIBUTE 2	8.55	1.15	8.63	1.4	16.1	58.1	25.8	10	73.3	16.7

Table 1. Preliminary analysis (Ranta & Takala, 2007: 317).

In their study Rautiainen and Takala (2003) used three different tools to analyze the data gathered from the above table. One the tools were a gap analysis where the differences of expectations and experiences could be compared. By using the gap analysis can be determined the attributes where the gap between expectations and experiences is big. This in turn points out the attributes that can be taken as the development targets. Implementation Index (later on referred to as IMPL) measures the importance and pressure to improve (Ranta and Takala, 2007). IMPL has been derived from SD by dividing the SD by the value of the corresponding competitive priority (importance) in order to improve the possibility to compare different attributes with each other and increase the sensitivity of the results. The results can be then interpret so that the smaller the number is, the larger is the possibility to the develop it. As mentioned above the questionnaire developed for this method includes questions how the answerer sees the development of specific attributes within a given time frame. Together with the estimations of the answerers of how well competitors are performing and handling themselves regarding the same attributed can be developed a so called competitor index and development index. The emphasized IMPL was calculated from the direction of development and answers which applied the competitors. Based on this emphasized IMPL tool, Rautiainen and Takala, 2003, developed a tool called the critical factor index (later on referred to as CFI). This CFI tool points out the attributes that are considered to be critical. The CFI method is more comprehensive and useable method compared to the emphasized IMPL because it takes into account also the SD of the expectations. The equations to illustrate the analyzing method further can be seen from figure 7 (Rautiainen and Takala 2003).

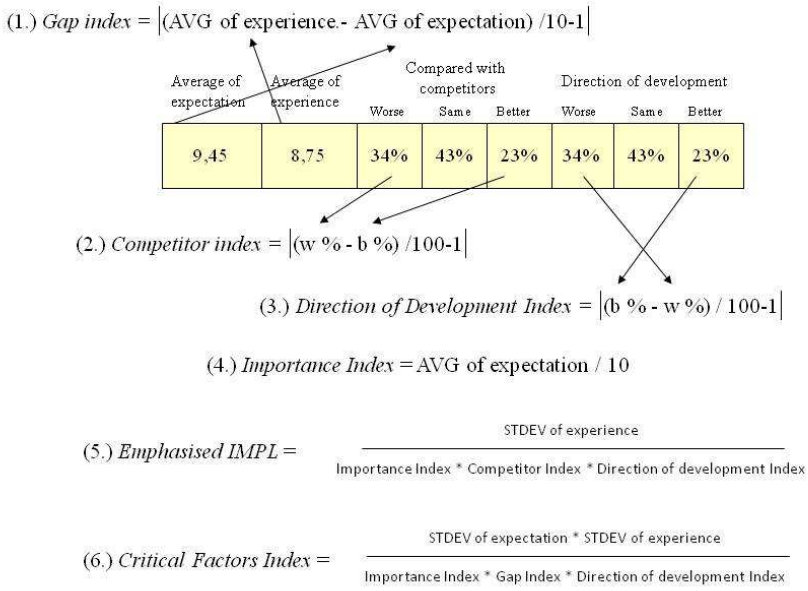

Figure 7. Equations (Rautiainen & Takala, 2003).

After the above equations have been calculated and the CFIs have been determined the next step will be the interpretations of the results. The analysis of the CFIs will be the basis of the recommended actions for Kouvola Innovation Oy. Like mentioned in the beginning of this thesis, in order to get further validation for the recommended actions, the scenario will be put through a weak market test which is a type of constructive modeling that is used in business administration. Constructive modeling will be covered in the following subchapter.

4.4. Weak market test

In this next part of the method building I will take a closer look and introduce a technique that gives even further validation to the research findings and also supports the ideas what to do next. This technique is called a “weak market test”. The “weak market test” is based on constructive research which in general means problem solving with help of constructing a model, diagram, plan, organization, machine or etc (Kasanen, Lukka and Siitonen 1991). Constructive modeling can be found from all areas of science but in this thesis we will look at it from a business administration point of view.

Kasanen et al (1991) described the constructive modeling as a combination of three different types of problem solving techniques: 1. Analytical modeling, where the solution for a problem is stressed but the applicability of it in real life problems remain vague 2. Scientific problem solving where a solution to a problem is produced based on theoretical data but it is a one off solution, i.e. it could not be applied to other problems except the one for which it was specifically developed 3. Consulting which could lead to a problem solution that could work in practice but would lack the theoretical background and the justification of it. Constructive modeling is a process that has certain characteristics. It is a process that consists

of different steps that are to be taken one step at a time in a specific order and these steps need to be transparent so that an anyone having enough theoretical and real life competence is able to see what has been done in each step and how the modeling has moved on to the following step. Lastly the most important thing is that each model must have a specific goal, i.e. a problem that could be resolved by constructing an applicable model. There are five different parts to constructive modeling in business administration. These are displayed in the following picture (Figure 8):

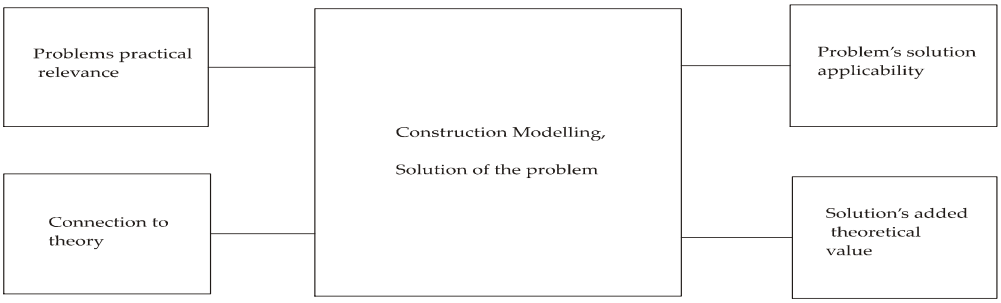

Figure 8. Components of constructive research (Kasanen et all 1991: 306).

The process starts from a real life problem that e.g. a company is facing and they need to resolve it. This problem needs to be tied up in theoretical concepts in order to get deeper understanding of the actual problem and of the issues and circumstances affecting it. By combining these two aspects, the researcher, company, etc. is able to construct a potential model that can be used to solve the problem at hand. After the problem solving model is constructed, there needs to be methods available how the model can be tested if it really has the potential of solving the relevant problem. Otherwise if this would not be done, the solution for solving the problem would only be the subjective point of view of the person(s) who constructed the model and this would lead to more questions in regard if there are many different models for the same problem which one of them is the most suitable if any since none of them have been tested in real life? Kasanen (1986) introduced in his doctoral thesis a method for this called marked based validation that is to be used business administration. The method is a two phase process that consists of a weak market test and from a strong market test. In this thesis I will only use the first part of this process, i.e. the weak market test since the latter one would require a longer period of data collection and further analysis and so due to the time frame of this thesis it will not be covered but it will only be shortly introduced. Kasanen (1986) noted that that first step, i.e. the weak market test is itself a tight test that only scarce amount of models ever pass.

The "weak market test" basically means that once a potential model for a relevant problem has been constructed, the model itself and the necessary data that was interpret in constructing the model are shown to a third party. The third party would preferably be a person that is in charge of a related business and therefore would have the competence to give valid feedback in order to do the "weak market test". In the actual test the person of choice would go through the data and see if he/she would come to the same conclusions and more importantly would he/she be willing to use the constructed model in his own business. By doing this the researcher who constructed the original model is able to gather feedback and validation for the model. After this and assuming the model had past the weak market test,

the next step would be the strong market test. In this next step basically the applicability of the model to real life problems would be observed and the data analyzed in order to see if it would have had the desired outcomes.Kasanen et all (1991) also addressed in their article the issue whether or not this constructive modeling in business administration is relevant science since scientific theories need to be theories that can be applied generally or is it just a form of consulting put into different words. They argued that constructive modeling is a type of scientific research on the basis that it reveals links between phenomenon that are common features to them despite the circumstances rather than revealing connections that are considered one off types of phenomenon that only exits in that certain environment. They based on the previous that to be able to construct an applicable model it requires deep and comprehensive understanding of the phenomenon and therefore if it works in one firm, there is no reason to believe that it could not work also in another firm. They also argued that constructive modeling, if correctly done and carried out, fulfills at least the scientific characteristics: objectivity, criticalness, autonomous and progression (Kasanen et al 1991). It also fulfills the characteristics, relevancy, simplicity and adaptability, of applicable science since the in constructive modeling there always is problem from real life situation and proof that the model can be applied to it in real life.

5. DATA COLLECTION

The research was conducted so that a questionnaire of 27 attributes was compiled that measured companies expectations, experiences, situation compared to other companies and how they saw an attribute to develop in a five year span. The attributes were chosen so that they would give general information about the company as well as their thoughts about bioenergy and construction. The attributes were divided into smaller segments and after each segment there was a possibility to explain the answers in more depth. At the end of the questionnaire there were also 4 open questions that gave the respondents the chance to bring their own ideas and thoughts to light. The idea behind these open questions as well as the explanation boxes after each segment was to get even more information from the companies and to let the respondents clarify their answers if they saw it necessary. By doing this the information gathered and used in the analysis gain more depth and relevance. All the attributes are listed in appendix 1. The data collection process itself was carried so that each and every one of the 40 companies that were chosen into the target group, were phoned. The background of this research was introduced and asked if it was possible to come over and discuss more about it. Each company was interviewed for certain amount of time (the interviews lasted between 30 minutes to 1 hour and a half) and the companies had the chance to tell in their own words their current situation and how do they see the coming months and years developing. During these interviews, it was explained in more detail what the idea behind this research was, to get the companies more interested in it and to explain that this way they were able to get their own voice heard.

The actual questionnaire was done using a web based program called Webropol which enabled the companies to answer the questionnaire in an electronic form. Reason why this approach was chosen was that in order to get as high as possible answer rate, the questionnaire and the process of answering it, were designed so that it would take as short amount of time and effort as possible. During the interviews some of the questions were explained in more detail plus a short introduction of some of the attributes were compiled that

were given to the respondents during the interviews. The reason why this was done was to limit any interpretation errors for the attributes. This way the respondent knew what was meant by a certain attribute and vice versa person analyzing the answers, knew what each respondent had meant. A list of what attributes where explained and how they were explained can be found from appendix 2.

Like mentioned in the beginning, the target group consisted of engineer offices and metal industry companies. Also there were couple of architecture firms included to the survey since it was felt that they could offer something to bioenergy and construction related projects. The criteria by which the companies were chosen were that they should have more than 5 employees and they should have had some kind of connection with the forest industry. Experts inside Kouvola Innovation Oy provided a list of potential candidates from which a shortlist was made that included 40 companies. Only the architecture companies were chosen with a different criterion, i.e. three of the leading companies in the area were chosen despite they might not had 5 employees or any connection to the forest industry.

The general response to the research was good. Out of the 40 companies interviewed, 29 companies answered the online questionnaire so the total answer rate was 72.5 %. Out the 29 answers 26 were included to this analysis since the three answers discarded, came in late and the decision was made not to include them since they would not made a relevant change to the trends and indexes. So the response rate for companies that answered in time and were included to the analysis was 65 %. The answers were analyzed so that first all the answers were analyzed together and the engineer companies and metal industry companies also separately. The architecture companies were excluded from the separate analysis since only one of the three chosen companies answered in time (One architecture company was one the three companies whose answer were discarded due to the late response) and therefore it was not relevant to analyze only one answer separately.

5.1. Preliminary analysis

5.1.1. All the answers

In the following table can be seen the results of the preliminary results for all the 26 companies:

	Average of the expectation	*SD of the expectation*	*Average of the experiences*	*SD of the experiences*	*Direction of development*		
					Worse %	*Same %*	*Better %*
Attribute 1	6.19	2.56	6.19	1.81	7.70	19.20	73.10
Attribute 2	7.46	1.73	**7.08**	1.23	26.90	57.70	15.40
Attribute 3	6.03	2.96	5.65	2.42	42.30	53.80	3.80
Attribute 4	6.44	3.06	5.62	2.66	42.30	42.30	15.40
Attribute 5	5.12	2.85	4.89	2.34	0.00	57.70	42.30
Attribute 6	**7.56**	1.45	**7.08**	1.44	4.00	60.00	36.00
Attribute 7	**9.46**	0.58	**8.27**	1.25	7.70	46.20	46.20
Attribute 8	**4.42**	2.40	**3.04**	2.09	7.70	76.90	15.40
Attribute 9	6.15	1.87	5.08	2.26	0.00	65.40	34.60
Attribute 10	5.39	2.23	4.42	2.02	3.80	76.90	19.20
Attribute 11	7.19	1.50	5.69	2.06	0.00	46.20	53.80
Attribute 12	5.54	3.02	5.08	2.74	3.80	80.80	15.40
Attribute 13	7.27	2.11	6.54	2.00	0.00	50.00	50.00
Attribute 14	6.08	3.05	4.85	2.99	7.70	26.90	65.40
Attribute 15	5.85	2.87	4.81	2.56	7.70	34.60	57.70
Attribute 16	6.42	2.97	5.69	2.77	3.80	26.90	69.20
Attribute 17	**7.65**	1.98	6.08	2.86	0.00	30.80	69.20
Attribute 18	6.08	3.02	5.19	3.10	23.10	61.50	15.40
Attribute 19	7.46	2.90	6.53	2.67	7.70	57.70	34.60
Attribute 20	**4.19**	3.00	**3.96**	2.76	42.30	46.20	11.50
Attribute 21	4.96	3.38	4.58	2.89	23.10	57.70	19.20
Attribute 22	**3.96**	2.60	**3.46**	2.56	30.80	53.80	16.40
Attribute 23	6.65	2.90	6.15	2.74	3.80	57.70	38.50
Attribute 24	6.50	3.05	5.35	3.10	3.80	61.50	34.60
Attribute 25	7.00	2.03	6.32	2.20	0.00	68.00	32.00
Attribute 26	6.46	2.18	5.40	2.27	0.00	53.80	46.20
Attribute 27	6.19	2.51	4.96	2.11	4.00	60.00	36.00

Table 2. Preliminary results for all the answers.

Preliminary analysis indicates the companies hold in high regard attributes 6, 7 and 17 which are being part of a value chain, skillful workforce and interest towards developing bioenergy related businesses. Two of these previous attributes also have high values in how the companies see that the attribute is being carried out in their companies. These attributes are numbers 6 and 7 which are being part of a value chain and the size of customer contracts. The lowest importance for companies hold attributes 8, 20 and 22 which are the support from the city of Kouvola, building houses and architecture. These also have the lowest values in how attributes are being fulfilled in the companies. It is also worth pointing out that the standard deviations for the answers are high for almost every single attribute in both how important the companies see each attribute for them and how well those attributes are being carried out

in the companies. One exception is skillful workforce which holds lowest standard deviation in both categories.

All the attributes also show a same characteristic feature: All of them score higher in importance than they do in how well those attributes are done in companies (The only exception to this being attribute 1 which is the number of customers which scored the same both in importance and performance). This suggest that all the attributes should be developed but keeping in mind that there are a total of 27 different attributes and companies have their main focus areas and limited resources as do Kouvola Innovation Oy, the critical areas that are to be taken under revision urgently will be determined later on in this thesis using the CFI tool. Interesting point from the preliminary analysis that stands out is that all the respondents see that the bioenergy attribute and related attributes will grow their importance in the next five years but at the same time innovation development and productization of new products will not increase their importance strongly which can be seen from attributes 26 and 27. Also when you look at attribute number 10 which is research and development resources can be seen that almost four out of five respondents see them remaining at the current level which are alarming. All the companies see thought, that continues education is important for them (attribute 11) even though it is not currently done as well as companies would like it to be done. Not too many conclusions are to be drawn based this since the engineer offices and metal industry companies are of different nature but this will be looked more closely when the answers are divided between the two target groups.

In the next parts the answers will be divided into two separate units, one unit consisting of answer from the engineer offices and the other one from the metal industry companies. By doing this it is possible to compare answers between the units plus compare the answers of the units to all the answers and determine if there are any discrepancies in the answers and if so what might the reasons be behind those discrepancies.

5.1.2. Engineer offices

The preliminary answers of the engineer offices can be seen from table 5:

	Average of the expectation	*SD of the expectation*	*Average of the experiences*	*SD of the experiences*	*Direction of development*		
					Worse %	*Same %*	*Better %*
Attribute 1	6.07	2.52	5.73	1.71	13.33	20.00	66.67
Attribute 2	7	1.77	6.67	1.35	13.33	73.34	13.33
Attribute 3	5.8	2.70	5.20	1.93	33.33	60.00	6.67
Attribute 4	6.07	3.26	6.00	2.54	46.67	40.00	13.33
Attribute 5	6.07	2.84	5.07	2.15	0.00	40.00	60.00
Attribute 6	7.33	1.63	**6.80**	1.47	0.00	60.00	40.00
Attribute 7	**9.20**	0.56	**8.33**	0.82	6.67	40.00	53.33
Attribute 8	**4.73**	2.31	**3.00**	1.96	6.67	80.00	13.33
Attribute 9	6.13	1.92	4.87	2.42	0.00	66.67	33.33
Attribute 10	5.27	2.43	4.40	2.13	0.00	80.00	20.00
Attribute 11	7.53	1.19	6.27	2.05	0.00	46.67	53.33
Attribute 12	4.87	2.72	4.47	2.53	6.67	80.00	13.33
Attribute 13	7.20	2.27	6.53	2.29	0.00	46.67	53.33
Attribute 14	7.07	2.34	5.53	2.39	6.67	20.00	73.33
Attribute 15	6.67	2.47	5.40	2.26	13.33	26.67	60.00
Attribute 16	**7.60**	2.23	6.53	1.88	6.67	20.00	73.33
Attribute 17	**8.00**	1.65	**7.13**	1.77	0.00	20.00	80.00
Attribute 18	6.13	2.83	5.33	2.97	20.00	60.00	20.00
Attribute 19	7.53	2.72	6.60	2.67	6.67	53.33	40.00
Attribute 20	**4.73**	3.06	**4.20**	2.68	40.00	46.67	13.33
Attribute 21	5.67	3.42	5.33	3.18	20.00	53.33	26.67
Attribute 22	**4.60**	2.41	**3.87**	2.45	33.33	46.67	20.00
Attribute 23	6.93	2.84	6.67	2.44	0.00	53.33	46.67
Attribute 24	6.67	2.89	5.60	3.00	0.00	66.67	33.33
Attribute 25	6.80	2.76	6.27	2.55	0.00	73.33	26.67
Attribute 26	7.00	1.93	5.67	2.19	0.00	40.00	60.00
Attribute 27	6.53	2.64	5.20	2.24	0.00	60.00	40.00

Table 5. Preliminary results for answers collected from the engineer offices

The response rate for the engineer offices was 83.3 %. Looking at the answers collected only from the engineer offices, one can notice that they more or less follow the same trend as did the answers from all the companies. Engineer offices see that attributes 7, 16 and 17 have high importance to them. These attributes are skillful workforce, bioenergy related device knowhow and bioenergy related project knowhow. Two out of the three attributes are also being fulfilled at a good level according to the firms. Only bioenergy related device knowhow is somewhat lagging behind more than the other two which indicates that there is much research and development needed still in that area. This is not that surprising when one considers how rapidly changing and developing area bioenergy is. Technology develops at an accelerated pace and news ideas and innovations are introduced all the time. As soon as the technologies are more known and reach a more static stage, companies are able to invest more on device development when the dominant technologies are evident. The lowest importance to the companies have attributes 22, 8 and 20 which are architecture, support of the city and building houses. All of these three attributes also are seen as the ones that are left with smaller focus than others inside the companies.

5.1.3. Metal industry companies

The preliminary analysis of the results can be seen from the following table:

	Average of the expectation	*SD of the expectation*	*Average of the experiences*	*SD of the experiences*	*Direction of development*		
					Worse %	*Same %*	*Better %*
Attribute 1	6.20	2.82	6.80	1.93	0.00	20.00	80.00
Attribute 2	**7.90**	1.45	**7.60**	0.84	50.00	30.00	20.00
Attribute 3	6.80	3.22	6.70	2.71	60.00	40.00	0.00
Attribute 4	6.80	3.22	5.40	2.80	40.00	40.00	20.00
Attribute 5	4.10	2.33	5.00	2.49	0.00	80.00	20.00
Attribute 6	6.90	2.56	6.70	2.71	10.00	60.00	30.00
Attribute 7	**9.80**	0.42	**8.10**	1.79	10.00	60.00	30.00
Attribute 8	3.70	2.50	**2.80**	2.25	10.00	70.00	20.00
Attribute 9	5.90	1.73	5.10	2.02	0.00	60.00	40.00
Attribute 10	5.40	2.07	4.30	2.00	10.00	70.00	20.00
Attribute 11	6.80	1.87	5.10	1.85	0.00	50.00	50.00
Attribute 12	6.80	3.26	6.30	2.75	0.00	80.00	20.00
Attribute 13	**7.80**	1.40	**6.90**	1.20	0.00	60.00	40.00
Attribute 14	5.10	3.41	4.20	3.61	10.00	30.00	60.00
Attribute 15	5.10	3.00	4.30	2.79	0.00	40.00	60.00
Attribute 16	5.20	3.08	4.90	3.38	0.00	30.00	70.00
Attribute 17	7.20	2.49	5.00	3.43	0.00	40.00	60.00
Attribute 18	5.60	3.31	4.50	3.14	30.00	60.00	10.00
Attribute 19	7.10	3.31	6.40	2.95	10.00	60.00	30.00
Attribute 20	**2.80**	2.04	**3.00**	2.21	40.00	50.00	10.00
Attribute 21	**3.40**	2.67	3.50	2.27	30.00	60.00	10.00
Attribute 22	**2.40**	1.51	**2.20**	1.55	30.00	60.00	10.00
Attribute 23	5.90	2.96	5.00	2.83	10.00	60.00	30.00
Attribute 24	5.90	3.31	4.50	3.06	10.00	60.00	30.00
Attribute 25	6.70	2.75	5.80	2.66	0.00	60.00	40.00
Attribute 26	5.40	2.22	4.10	2.47	0.00	80.00	20.00
Attribute 27	5.40	2.22	4.50	2.01	0.00	80.00	20.00

Table 8. Preliminary results for answers collected from the metal industry companies.

For the metal industry companies the response rate was 52.6 %. At first glance there can be seen differences compared to engineer offices which are natural bearing in mind the types of companies that were selected for this survey. For these metal industry companies attributes 2, 7 and 13 hold the highest importance and also these attributes have the highest values in how well the attributes are carried out in the firms. These attributes are the size of customer contracts, skillful workforce and environmental friendliness. One important thing is to notice that the answers of skillful workforce attribute averages almost 10 combined with a low standard deviation which indicates that this attribute is one of the key cornerstones of their business. Also the figures indicate that all except the previously mentioned attributes have relatively low scores in how well they are being executed in the firms. Lowest importance to the companies hold attributes 22, 20 and 21 which are architecture, building houses and technical construction design. Two of these, attributes 20 and 22, are also seen as ones that are not being focused on as much as the others. The companies also see that attribute 8 has little meaning to their operations and this attribute is the support of the city. One figure stands

out from the calculations and that is how well companies have been able to attract customers compared to expectations (attribute 1). It is the only attribute that has this characteristic. This also applied when taking into account the importance vs. performance from all the companies that took part in the survey as well as for answers gathered only from engineer offices.

5.2. Critical factor indexes

Next step in the analysis was to calculate using the previously mentioned formulas the CFIs of the current state of the companies in terms of the attributes. Main goal of this CFI analysis was to provide supporting decision making data for Kouvola Innovation Oy for planning their own strategies for the coming years since the CFIs indicates what areas are needed to be stressed first and what areas are particularly strong. This is one of the key issues of this thesis since Kouvola Innovation Oy is a newly founded company who's one strategic goal being trying to develop the business environment in the region of Kouvola. And to be able to do this efficiently from the start, the company naturally needs to have a vision of the current state of the companies which have had a strong presence in the area for several years and see if there are possibilities to use the expertise that already is situated in Kouvola in building new sustainable businesses. In the below table can be seen the results. CFIs were calculated for all the respondents as well as separately for engineer offices and metal industry companies. Figures in red indicate attributes that are to be seen as attributes that are in critical and figures in green illustrate attributes that are considered to be strengths.

	All the companies	*Engineer offices*	*Metal industry companies*
Attribute 1	21.63	14.71	**46.69**
Attribute 2	**2.46**	**3.30**	**1.15**
Attribute 3	8.26	6.69	7.94
Attribute 4	9.21	10.16	9.69
Attribute 5	22.07	**22.86**	19.44
Attribute 6	**3.88**	**5.17**	12.32
Attribute 7	**1.11**	**0.86**	**0.82**
Attribute 8	10.80	8.74	15.50
Attribute 9	9.49	10.10	9.14
Attribute 10	9.01	11.29	7.67
Attribute 11	8.09	6.16	8.70
Attribute 12	16.15	14.56	15.70
Attribute 13	10.82	14.50	**3.29**
Attribute 14	**31.58**	**20.56**	**44.29**
Attribute 15	**22.75**	13.92	37.99
Attribute 16	**34.52**	14.95	**64.79**
Attribute 17	20.77	16.79	24.31
Attribute 18	13.13	12.70	13.93
Attribute 19	12.99	13.24	16.07
Attribute 20	14.77	13.00	12.64
Attribute 21	18.26	**19.88**	15.01
Attribute 22	13.99	10.56	7.97
Attribute 23	17.43	18.27	16.28
Attribute 24	18.85	17.61	18.82
Attribute 25	8.78	13.40	16.69

Attribute 26	12.87	13.32	11.23
Attribute 27	11.20	13.32	9.48

Table 11. CFIs for all the companies and separately calculated for both the engineer offices and metal industry companies.
The CFIs for the all the companies are also displayed in the following graph:

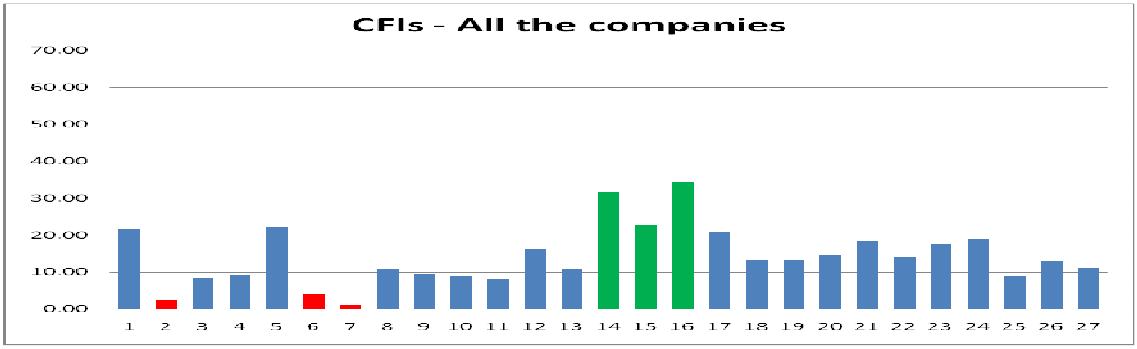

Figure 9. CFIs for all the companies.

The above graph indicates that the highest CFIs for all the companies are attributes 16, 14 and 15 which are bioenergy related device know how, bioenergy and bioenergy related project work. Attributes that are on the "red" are skillful workforce, the size of customer contracts and participation in value chains (Attributes 7, 2 and 6). At this point it is worth noticing that if an attribute is on the "red" it does not necessarily indicate that the attribute is at a critical stage and needs to be addressed as soon as possible. A low CFI value can also imply of a big gap between expectations and experiences or it can indicate how important an attribute is considered to grow during the selected time frame. In order to avoid misinterpreting the results, a holistic approach is needed to open the figures more. This enables to plan further actions for the attribute(s) in question accordingly and see beyond just the CFI of the attribute(s). This is the case for attribute 7 which is skillful workforce which all the companies see that it is important to them plus all of them see that they are performing relatively well in this. Reasons behind why it is therefore in the red are that there is a gap between importance and performance even though both of them scored high in the survey plus almost half of the respondents answered that the importance of this attribute will grow significantly in the next five years. The size of the customer contracts – attribute indicates that companies see that even though it is important for them and they are performing relatively well in this, it will not grow in importance that much in the coming years. In other words the companies even though they see the size of customer contracts being important to them, they will shift their focus more on smaller contracts and/or keep them at the current level. This is supported by the high CFI for the number of clients (attribute 1) which also suggest that companies will focus on attracting new customers which naturally will tie their resources more and restricting them on focusing on just the bigger contracts. The third attribute that is on the red, participation in value chains, indicates that the companies realize the importance of them in the coming years. Since the companies that were taken into this survey are small and medium sized companies, resources are relatively scarce. By participating in value chains companies are able to put their resources in one basket and together exploit business opportunities by each participant bringing their own area of expertise to the mix.

5.2.1. Engineer office CFIs

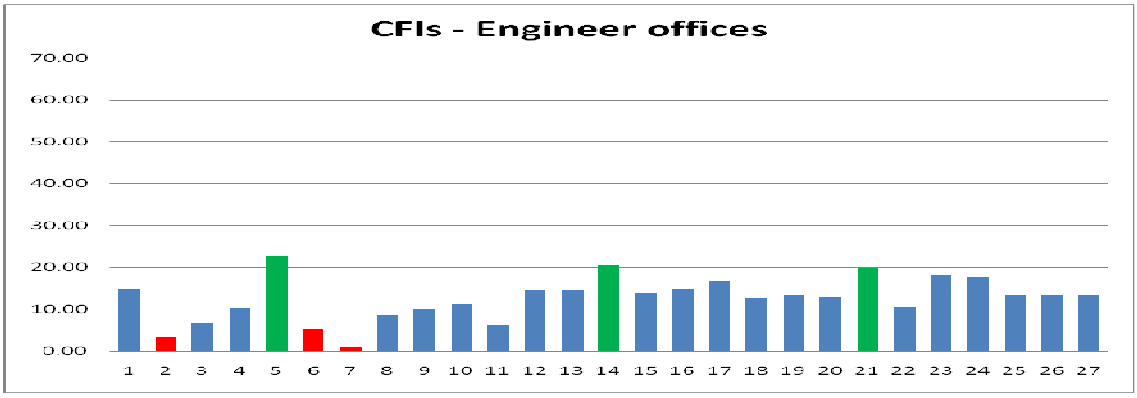

Figure 10. CFIs for the engineer offices.

When looking at the CFI's calculated from the answers collected from the engineer offices it can be seen that the indexes that are on the "red" are the same as they are for all the answers. The reasons mentioned above apply also for the engineer offices. Engineer offices have the design and planning knowhow but they need different types other companies to manufacture their designs. The deeper the co-operation is, the better understanding the counter parties have about each other and this will eventually result in better services and products. There is though some dispersion in the "green" indexes. International customers and construction related technical designing together with bioenergy are the ones that can be seen as strengths for the engineers offices. Engineer offices see that operating beyond their home market is important to them in the next five years. Over half of the respondents see that exporting knowhow will grow in the next five years. This is a positive sign since Finland in general has for several years had a reputation for offering high end technological products and services. In order to be able compete in the international markets the engineer offices need to develop products/services that are new to the markets or at least offer new ways of doing things, i.e. being the spearheads in certain types of technologies in certain fields. Also the engineers offices see that in order to develop new sustainable businesses that generate turnover and employs them in the coming years, they have to look beyond their home market and expand and penetrate even deeper into international markets.

5.2.2. Metal industry companies CFIs

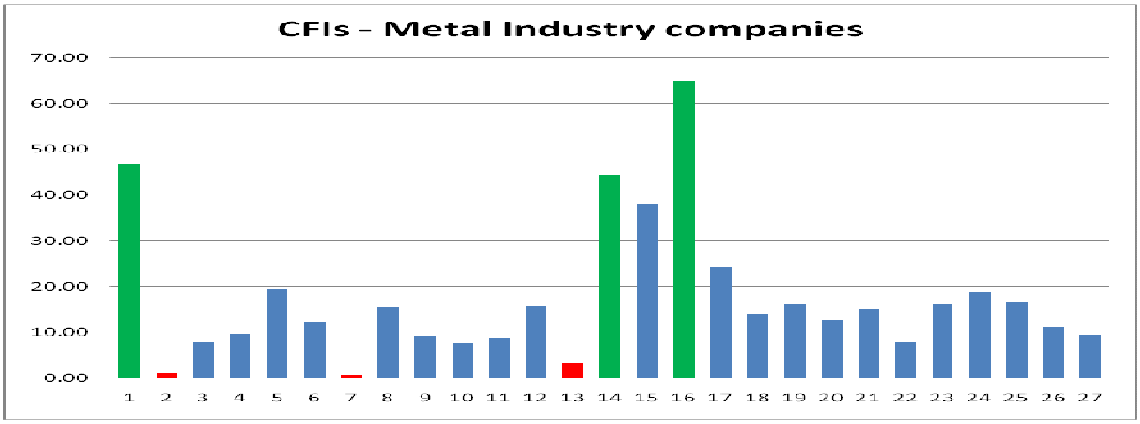

Figure 11. CFIs for the metal industry companies.

The metal industry companies on the other hand follow the same trends as does the total answers in terms of attributes being on the "green". It is worth noticing that that all the three attributes scored relatively high values in the CFI calculations. Even though these attributes have low scores in both importance and performance, companies see that these attributes (Bioenergy, bioenergy related device knowhow and bioenergy related project knowhow) will grow their importance in the next five years. Two out of three CFI's that were on the "red" were the same as they were for all the answers. The one that made the difference was the attribute number 13, which is environmental friendliness which scored a lower value than attribute 6, participation in value chains. Even thought environmental friendliness plays a significant role in companies' current processes; they still see that it will have a major role in the coming years since none of the respondents answered that its role would decrease. This in turn implies that also metal industry companies are trying to keep the environment in mind in their processes. It is also interesting to see that the CFI's that have high values, really have high values and the ones that have low values, then really have low values and the gap between them is much more wider compared to engineer offices. Reasons behind this would need a much deeper analysis on the matter, but one thing that surfaced during the preliminary interviews was that the engineer companies that took part in this are a much more homogeneous group than the metal industry companies, i.e. there were much more of different types of companies included in the metal industry target group which explains to some extent the big sensitivity of the indexes.

5.3.1. Model construction for the weak market test

The background to this thesis was to find out what is the current state of the engineer offices and metal industry companies operating in the area that have for long relied on work generating from the forest industry. Because of this long and up till recent years, profitable relationship, engineer offices and the metal industry companies have not focused as much as they should have in product and service development to strengthen their presence in the market and at the same time attracting new businesses from new industries. Together with the current state analysis, one goal was to find out how interesting the target group saw bioenergy and construction industry as potential new businesses for the area. Kouvola Innovation Oy sees especially bioenergy being one of those new businesses that could create sustainable employment to the area in the coming years. Reflecting the results against the goals of this thesis, the model constructed in this thesis and what will be put through the previously mentioned weak market test will be introduced next. Kouvola Innovation Oy must focus their efforts at this point in scouring potential new bioenergy related projects together with the companies, especially with the engineer companies. Like the results suggested the engineer companies hold potential in developing new businesses and Kouvola Innovation Oy should therefore closely work together with them to support them in any way possible. Metal industry companies on the other hand are more or less manufacturing companies and so they can provide local metal manufacturing expertise. Kouvola Innovation Oy has a crucial role together with the companies in finding out suitable partners in the area for one another that could potentially lead to forming value chains and therefore combining the expertise of the companies. Kouvola Innovation Oy must also maintain a critical point of view in terms of what projects are to be considered as potential ones, i.e. ones that can generate cash flow and

profit to the companies. Companies are interested in taking part in new projects as long as it does not tight up too much of their resources and they see that they can benefit from them. An important part in this model is that Kouvola Innovation Oy tries to establish together with the local companies networks that have on-going discussions that enable parties to share and discuss potential new businesses opportunities. Product, service and technology development should be encouraged as much as possible since according to the results, this is something that companies need to focus on more. Since Kouvola Innovation Oy is a development company and not an investment company, it should maintain a neutral position towards all the companies and be prepared to help them if possible. This model would enable to see how a development company, such as Kouvola Innovation Oy, could with their own input affect the development of the business operating environment in the region of Kouvola, i.e. bringing in a fourth element to the three forces affecting technology development introduced by Tuominen et al, 2003.

5.3.2 Weak market test

The above model was introduced to a person that has relevant expertise to comment about it. The person has insight on both the companies operating in the region of Kouvola as well as from renewable energy. The above model passed the weak market test. The person confirmed the conclusions presented above and stated that the above course of actions is a useable one for Kouvola Innovation Oy.

6 DISCUSSIONS AND FURTHER STUDY

The data collected and analyzed in this paper provide supporting data for Kouvola Innovation Oy in their decision making. The results together with the information gathered through the interviews suggest that the companies need support in developing new business opportunities. Through the interviews it came clear that the companies do not expect that much help from the city of Kouvola or for that matter also not from Kouvola Innovation Oy. It came pretty clear that all the help that Kouvola Innovation Oy can offer to the companies will be considered as a plus but nothing is expected from them. Reasons for behind these thoughts have piled up during the past years and decades and therefore are challenging to alter by just words. The companies want to see concrete ideas and projects from which they can eventually benefit i.e. make profit and create new businesses. Like the big response rate suggested companies are still open to new ideas and projects and they want to take part in them but they are careful on in which ones they do take part in because of the challenging economical situation where also Finland and the rest of the world currently is. Companies are naturally careful where their put their limited resources into use. They see that the co-operation is to be done so that each party involved are treated as equals and each of them received a fair amount of the revenues, i.e. mutual respect and openness is required. Most of the times when conducting surveys and analyzing results, one thing is always pointed out: The results are not considered to illustrate the thoughts of all the companies since the response rate was so small. In this thesis thought that was not the case. The response rate was so high, that enables to derive further study subjects that hold greater value. One thing that should be studied further is why the response rate was as high as it was? Was it because the interviewed single handedly took the time and visited all of them, the questionnaire and the background for conducting it was explained or the questionnaire itself was easy to answer

and it did not take that much of the respondents time? Or was it the combination of these? One thing that would be worth studying further would be to find out if the new potential business opportunities (bioenergy and construction) would have some other ones, would the results been different? If they would have been different, then it is clear that Kouvola Innovation Oy is on the same page as the target group. If not, then Kouvola Innovation Oy would face challenging times ahead since the results would suggest to certain extend that the companies are in a state were all that is new would interested, regardless of being suitable for them.

One clear and obvious further study would be to conduct this same survey in year 2016 after the selected time frame has passed. Same companies would be chosen as target groups and same attributes would be included in the questionnaire and see what discrepancies there are. This would offer massive amount of date for further analysis since the events that affected the discrepancies would have to be explained. This would also offer Kouvola Innovation Oy the possibility to see how the projects that they have taken part in during the time frame have affected the business environment. An interesting point of further study would also be to open the answer and see why the standard deviations were so big most of the times. Of course some of the gaps can be explained by the fact that the target groups consisted of different types of companies. The companies are focused on certain types of business and that would naturally explain the diversification of the answers when looking at a certain attribute but still it would be interesting to see if similar companies have answered differently to the same attribute and more importantly, why they see the same attribute so differently?

7. CONCLUSION

This paper from derived from the need to determine how the changes in the forest industry companies have affected the local engineer offices and metal industry companies and provide supporting decision making data for Kouvola Innovation Oy. Kouvola Innovation Oy is a development company that focuses on the development of the business operating environment in the region of Kouvola. Kouvola Innovation Oy see that areas that hold potentially new business opportunities to the area are bioenergy and wood based construction. The theory part of this paper covered the role of technology foresight in offering competitive advantage to companies that have incorporated it to their own strategies. Sense and respond strategies were also introduced and how small and medium sized companies are able to use them in the spirit of technology foresight in creating competitive advantage. In the empirical part the Critical Factor Index tool was used to analyze the results. This tool indicated the attributes that were considered as strengths and those that are needed to be addressed first. There were 27 attributes chosen that would illustrate the current situation of the companies as well as their thoughts on bioenergy and wood based construction. The data collection was conducted so that 40 companies were chosen to be the target group and each of these companies were interviewed and this research was introduced in more detail. Each company was offered the chance to answer a web based questionnaire to collect numerical data that would then analyzed using the critical factor index tool. 29 companies answered the questionnaire. The results indicated that bioenergy is seen as an interesting business opportunity by the companies. At the same time thought innovation development and innovation productization are not seen important even though they should be if the region wants to develop competitive advantage trough technology development. The

results suggest that Kouvola Innovation Oy is on the right path if they decide to concentrate on projects that aim to develop bioenergy related businesses in the region. The results were validated by using a weak market test. As a conclusion the set goals were met in this thesis and the data gathered and analyzed offers supporting decision making data for Kouvola Innovation Oy in their quest for developing the business operating environment in the region of Kouvola.

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APPENDIX 1. Attributes

Customers

- Number of customers
- Size of customer contracts
- Forest industry as a customer
- Constructual changes that has taken place in the forest industry
- International customers
- Being part of a value chain

Resources and technologies

- Skillful workforce
- Support of the city
- Networking with other companies and schools
- Research and development resources
- Continuous education
- Knowledge of sources of funding and the use of them
- Environmental friendliness
- Bioenergy
- Bioenergy related device knowhow
- Project knowhow related to bioenergy
- Interest towards developing bioenergy related businesses
- Construction
- Industrial construction
- Building houses
- Construction related technical design
- Project knowhow related to construction
- Interest towards developing construction related businesses
- Business plan

Products

- Innovation development
- Productization of innovations

Open questions

- "Do you see any possibilities to develop businesses related to bioenergy or wood based building industry in the region of Kouvola? If so, how?"
- "Do you see any possibilities to develop businesses related to renewable energy in the region of Kouvola? If so, how?"
- "Do you see any potential problems for your own business in the region of Kouvola in near future?"
- "In what kind of development projects related to bioenergy or wood based building could Kouvola Innovation Oy help your company?"

APPENDIX 2. Clarification of questions

Number of customers
Is your business based on volume or more on tailor made solutions?
Forest industry as a customer
How important role does the forest industry have in buying your company's products and/or services?
Constructual changes that has taken place in the forest industry
How has the changes that have taken place in the recent years (production capacity reductions, etc) affected your company?
Being part of a value chain
Is your company part of a value chain? Do you use subcontracting or do others use your company as a subcontractor? Do you actively try to take part in value chains?
Skillful workforce
Can skillful workforce be found from the region of Kouvola? Is it available for your own company?
Support of the city
How do you see the role of the city? Does it support your business enough in your opinion? Etc.
Research and development resources
Does your company have enough resources to develop products, services and the business in general? Are those resources deployed efficiently?
Continuous education
How important do you see continuous education for your company? Do you see it as being important? Is executed efficiently in your company? Do you actively seek possibilities to arrange training for your staff?
Knowledge of sources of funding and the use of them
How well do you see your company being aware of different types of sources of funding for projects? Are these sources used actively?
Environmental friendliness

Does environmental friendliness have any kind of role and if so how much does it affected when you are planning your business, products or services?

Bioenergy

Does your company have any experiences from e.g. biodiesel, biogas, sludge and waste digestion or CHP plant knowhow?

Business plan

Does your company have a business plan? Are you able to implement it? Are your competitors able to carry out their own business plans better or more efficiently than you are? Will you follow the current business plan also in the near future?

Innovation development

Are innovations and continuous development of innovations an essential part of your business?

Productization of innovations

How much are able to productize your innovations? Is it an essential part of your business?

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APPLYING COMPUTER AIDED EDUCATION IN INDUSTRIAL ENGINEERING

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ABSTRACT

Simulation is a powerful teaching method while it enables to illustrate the dynamics of the phenomena in question. Simulation provides a safe way of experimental learning. The amount of the use of simulation software has increased in Finnish enterprises and in the higher education during the past few years. More efficient computers and internet-connections have enabled more affordable systems and internet –based training. Regardless simulation based learning is not yet common and its potential has not bee widely understood. This paper presents a research about the possibilities of using simulation in Industrial Engineering education. At first, the phenomena of industrial engineering which can be simulated are defined. Then the evaluation system for simulation selection is delivered founded on the earlier research and the case specific requirements defined by teaching personnel. Empirical study includes also a simulation software market analysis of the products available. Two simulation software systems, which best meet the defined quality criteria were selected for a pilot. Software's features were evaluated against the needs of usability in education of strategic management.

Keywords: simulation, computer aided education, industrial engineering and management

INTRODUCTION

Computer aided/assisted teaching and learning are gaining popularity in university education world wide. eLearning has become the common term to describe the various methods that today are available for teachers and students to improve the learning outcomes. Industrial Engineering (and Management) as an engineering discipline is also about utilizing ICT (Information and Communication Technologies) in various forms for the benefit of organisations. It is therefore rather natural that an Industrial Engineering department looks for ways to utilize eLearning its own teaching.

Simulation is one teaching method of the eLearning. Through simulation one can efficiently model the whole production system with its interaction and consequences. It is a powerful teaching method while it enables to illustrate the dynamics of the phenomena in question. It also helps with the internalization of the subject like an experiential learning. However the

simulation based learning is not yet very common in universities and its potential has not been widely understood.

This paper presents a research about the possibilities of using simulation in Industrial Engineering education. The research questions are:

RQ 1: What kind of phenomena of industrial engineering can be modelled,

RQ 2: What kind of requirements can be set on simulation software in Industrial Engineering education and

RQ 3: What kind of simulation system would be the one which fulfils these requirements and is a suitable choice for teaching in the case organisation?

METHODS

This research uses constructive literature study with qualitative case study (Fig. 1). At first, the literature review was carried to recognize the phenomena of industrial engineering that are suitable for simulation in teaching. Also earlier researches were studied to define the requirements for simulation software in teaching. The requirements set for simulation software in teaching are condensed as evaluation criterion. This criterion formulates the guideline for the organisation to evaluate educational simulation software.

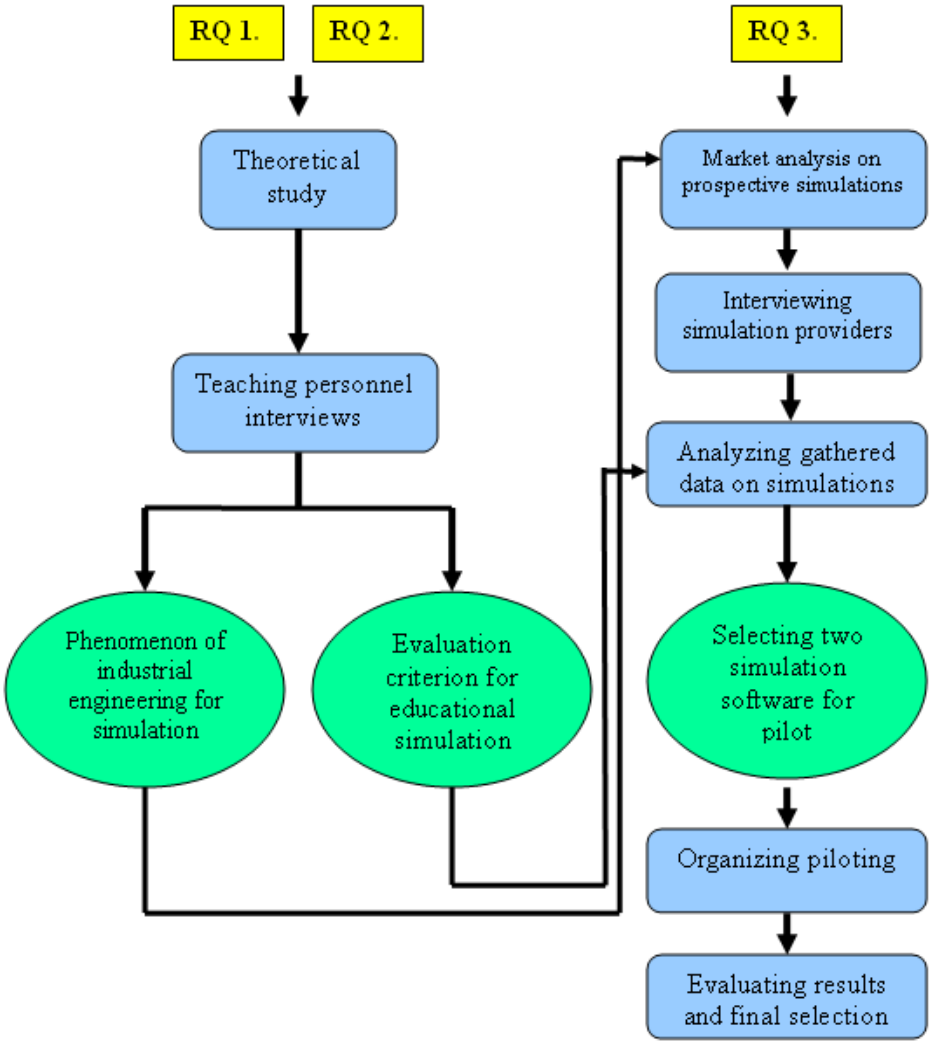

Figure 1. Research process.

The criterion is tested in the case organisation conducting an empirical case study at the department of Industrial Engineering and Management, in the University of Oulu. Teaching personnel were interviewed to define the case specific needs and requirements for simulation software. The next, education eligible simulation software was identified and finally two of them were selected for piloting and evaluation.

THEORY: SIMULATION SOFTWARE SELECTION IN INDUSTRIAL ENGINEERING EDUCATION

Industrial Engineering education

The Industrial Engineering (IE) as a discipline and profession is basically to enhance the labour, material, and capital productivity. Productivity and quality improvement are the keys objectives if IE discipline in general. Industrial Engineering can also focus on the production systems at different phases of their life cycles of like:

- design

- building
- operations
- maintenance
- services
- supplying inputs (energy, material, parts, subassemblies, etc) and even
- dismantling.

Industrial Engineering education at different levels looks for means and methods to help to achieve the management goals of an organisation. In university education, the teaching should meet the content requirements of Industrial Engineering and Management (IEM) and should therefore to some extent be based on the research in these subject areas.

There are many areas of IE where simulation is a suitable method of studying and learning the phenomena. Based on the works of Robinson (1994) and Jokinen et al. (1989) the following topic areas can be identified suitable for simulation applications:

- plant design and layout
- optimization of production systems
- production system balancing
- management method validation and improvement
- bottle neck analysis
- capacity analysis
- disturbance analysis
- materials management and inventory analysis
- change management
- modelling the entire company
- operational planning
- personnel training.

Industrial Engineering is also a discipline where the holistic view of the production system must be understood. In order to help to meet this target in this research, out of the many different alternatives the simulation of the whole company was selected.

Simulation in education

Simulation is a tool for being able to concretize the theoretical teaching and wide systems easily. From the learning point of view simulation is a process of interpretation, which makes possible to realize reality with concrete events and actions (Jalava, 2001). The idea of teaching simulation based on structured actions (Jalava, 2001).The strengths of simulations in teaching are trueness, possibility to control the phenomena under simulation, standardize teaching methods, repeatable situations, effectiveness but also enabling to learn skills that are normally used to learn in practical work (Salakari, 2007). Simulations are often used in teaching since they offer safe and cost effective teaching arrangement. However, in some cases some real life phenomena may be amended so that students can clearly see the learning points. In the virtual world simulations can be built to break the rules of real life (Meisalo et al., 2000). However, simulations cannot imitate the sudden events such as breakdowns or accidents that normally are part of real life situations (Vartiainen et al., 1989). One of the

main quality factors of educational simulation is the realism of simulation balanced with learning targets. The other quality factors of simulations are learning, experimental realism and balance, the dependency of the developer and the instructor (Töyli and Smeds, 2005).

The main elements of educational simulation are the theme of simulation, physical environment which creates many possibilities but also limitations for practical realization, the role of instructor, and the action and experiences where a feedback possibility is important part of learning. (Jalava, 2001.) The educational usage of simulation creates special requirements to simulation software which is not very widely discussed (Töyli, 2001). Meisalo et al. (2000) represents the following requirements for teaching simulations:

- EXTENSIVE. The model describes the system and key constructions and characteristics.
- FOCUSED. The model needs to highlight the key characteristics of the described system.
- TRANSPARENT. The model has to show the internal logical structure and internal relationships.
- CONCRETE. The model has to give the concrete picture about the structure of system and related interactions.
- FOUNDED ON PREVIOUS KNOWLEDGE. Model should utilize earlier learned models, and concepts and structures.
- VALID. The model has to simulate the system correctly.
- UNDERSTANDABLE. The model of presentation and concepts has to be known for the target group earlier.

The content of simulation and related material is exceptionally important in educational simulation. The simulation has to be suitable for the purpose and focus on the knowledge and skills that students need (Muehl and Novak, 2008). The content of material has to follow the educative requirements (Torrente et al., 2009).

Currently, simulations are used more often. More competent computers and software provided over Internet are enabling simulation usage in situations of different kind than earlier make possible for example distance learning. Wider simulation utilization requires new kind of thinking among teaching personnel. (Salakari, 2007)

However, when deciding to take simulation in use, full product lifecycle analysis has to be done like in every other software implementation. Even though simulation can be seen to require less of teaching personnel work load also the other aspects of work such as administration of learning environment as well as maintaining costs has to be evaluated (Torrente et al., 2009).

Selecting simulation software for education purpose

The key for successful simulation implementation and gaining the desired benefits is the simulation selection process. On this process, common simulation evaluation criteria can be utilised but need to complete with educational requirements and the requirements set by the case organisation. Robinson (2004) is representing one suitable selection process when selecting educational simulations with the following steps: define requirements for modelling, listing software providers, defining software evaluation criteria, evaluating software according to the criteria, and final simulation selection.

Simulation software evaluation should be evaluated and compared as any software. Evaluation criteria defined by SEI (Software Engineering Institute) and ISO 9000 create a reliable guideline for software evaluation. ISO 9126 standard is dividing criteria for six sub-areas: functionality, usability, reliability, effectiveness, maintainability, and transferability. In addition to these criteria, it is important to perceive the reliability of the supplier and its services and costs (Davis and Williams, 1994; Harrington and Turnay, 2000; Robinson, 2004).

Functionality is evaluated by answering the question of if software is representing the required functions so that defined needs are fulfilled. This can be reviewed by five aspects: process mapping, modelling, simulation and animation, analyse, and input and output (Harrington and Tumay, 2000).

Usability is important fact in terms of productivity. Usability should be evaluated by the views of different kind of users (Davis and Williams, 1994). Usability can be measured by using measures such as time and effort for using and learning the simulation (Harrington and Tumay, 2000).

Reliability is one of the most difficult criteria to evaluate. Harrington and Tumay (2000) guides for using following questions when evaluating reliability: is the technology used sustainable, which kind of fault repair process is used, how to prevent new faults, does software is having ISO 9000 certificate, and if there are faults linked to graphic user interface, operating system, device drivers, or animations.

Maintainability consists of four sub-areas: security, documentation, hardware and software requirements, as well as updates and improvements (Harrington and Tumay, 2000). In case of simulation, documentation needs to be extensive including the user guides and reference models (Davis and Williams, 1994). Because of software is one of the fastest upgrading products, technological issues are very important to ensure the update possibility (Harrington and Tumay, 2000).

Costs evaluating has to cover full product lifecycle in addition to procurement and licensing costs (Harrington and Tumay, 2000). Administrative costs and costs for learning have to take into account (Robinson, 2004). Assessing the basics of pricing such as is the end price including full packet or just some modules, or no service at all (e.g. Harrington and Tumay, 2000).

Reliability and services of the software provider should be as important as the costs to evaluate (Banks and Gibson, 1997). At least, the following issues should be known about the software provider: how long the company has acted on that market, how many employees are participating in bringing software to the market, how long the software has been in the market, the amount and geographical location of users, and is any literature on the software and its usage available (Banks and Gibson, 1997; Davis and Williams, 1994; Harrington and Tumay, 2000; Robinson, 2004). In addition, the services and the further development of the software are important aspects to lengthen the software lifecycle. One important service which is often needed is the introduction to the simulation and the availability of learning should be determined (Davis and Williams, 1994; Harrington and Tumay, 2000; Robinson, 2004).

Based on the literature review, the simulation evaluation criteria for IE education simulation can be conducted (Table 1).

Table 1. Evaluation criteria for comparing Industrial Engineering simulation software.

Factor	Description	Object of evaluation	Evaluation method
Functionality	Modeling phenomenon	Is the phenomenon suitable for industrial engineering education?	Yes/No
	The structure of the model	Is the model..	
		..extensive?	Yes/No
		..focused?	Yes/No
		..transparent?	Yes/No
		..concrete?	Yes/No
		..founded on preliminary knowledge?	Yes/No
		..understandable?	Yes/No
		..valid?	Yes/No
		Challenging	Yes/No
	Technical characteristics	Possibility for 3D animation?	Yes/No
		Possibility to acc-/decelerate the simulation?	Numeric
		Picture quality	
		Hierarchical decomposition	Numeric
			Numeric
	Input and Output	Analyzing the phenomenon	Numeric
Usability	Application	How is the simulation used in education?	Numeric
		How is the teaching situation organized?	Numeric
	Physical usability	Is the learning of simulation fast?	Numeric
		Easy of use?	Numeric
		Is information easily and logically available?	Numeric
Reliability	Reliability of software	Quality problems, fault analysis, quality system	Numeric
Quality	Learning	Comparing learning objectives with results	Numeric
	Balance	Does simulation give the well-balanced model of the subject area?	Yes/No
	Dependency of developer(s)	Is the application dependent on the developer?	Yes/No
	Dependency of instructor(s)	Is the application dependent on the instructor?	Yes/No
Maintainability	Documentation	Adequate number of documents	Numeric
	Technical requirements	Hardware and software requirements	Written
	Updating	Does the application provider offer updates?	Yes/No
		What and when was the last update?	Written
	Improvements	Are they still developing the application?	Yes/No
Costs	Lifecycle costs	Procurement costs	Numeric
		Costs of maintenance (including updates)	Numeric
		Costs of training	Numeric
Supplier	Reliability of the application provider	Assessing the reliability of the company	Numeric
Supplier's services	What services the supplier is providing?	Technical support	Yes/No
		Customer service	Yes/No
		Training	Yes/No

THE CASE STUDY

Simulation is seen one of the respectable learning method tools in the department of the industrial engineering and management (DIEM), at the University of Oulu. Currently teaching contains only a little or any computer aided methods which can be seen a shortcoming. However, some simulation or computer aided teaching has been included in the teaching occasionally (bi yearly computer aided methods in ergonomics, product data management demonstration, and Desim product development simulation development together in co-operation with other educational bodies) and some earlier studies of computer aided teaching has been done. However, simulation is not constantly used excluding the course in ergonomics.

With good experiences from computer-aided-teaching methods in general and some encouraging feedback from the students about the better usage of the new methods, it became necessary to evaluate possibilities to introduce new methods to Industrial Engineering education at the University of Oulu. Supply-Chain simulation has been earlier in the agenda, but because of technological developments as well as changes in the teaching personnel, these have been omitted from the curriculum. The case study consisting of three major steps; teaching personnel interviews, simulation software analysis and selection, piloting prospective simulations, and suggestion for simulation software selection (see Figure 1).

Case requirements for simulation

The aims of interviewing teaching personnel were to define what kinds of phenomena could be simulated and what the requirements that personnel is setting for simulation are. 11 interviewees participating in teaching in DIEM were interviewed. Interview included 5 themes: attitudes towards the computer aided education and simulation particularly, user experiences on simulations, the needs and requirements for simulation, information about simulation software and their providers, and vision of the future.

The necessity of simulation in the case organization can be reasoning via the most wanted benefits. Some challenges also exist but those are related mostly to user situation related issues. The overall attitude keeps simulation very beneficial for many reasons. The benefits and challenges towards simulation are listed on Table 2.

Table 2. Benefits and challenges related to the usage of simulation.

Benefits	Challenges
Possibility to model real life phenomena and to increase clarity. Motivating students. Illustrating interdependencies. Examination without broken the object. Acceleration of phenomenon.	Technical problems. Improper usage of the model in case where it actually do not work. Do not fully describe the real life situations. Resourcing user situations.

By using technical tools is a skill that technical students should have. Thus using a computer aided methods is reasoned part of technical student education. Many of the courses provided by DIEM can be utilize simulation in teaching:

- Simulations related to different business processes: Management, work, or strategy related. Simulate for example how decisions are affecting on productivity and performance. (Courses: Strategic Management, Production Management)
- Modelling material flows for (Courses: Purchasing Management, Advanced Supply Chain Management)
- Modelling project based business by simulating project actions and project management (time and resource management). (Courses: Project Management, Project Business)
- Business games are useful when modeling the influence of decisions on the business balance sheet and statement of profit and loss. (Courses: Management Information Systems, Production and Logistics Methods)
- Modelling activities when a user is using a product: user interfaces, manual material processing, human antroponometric. (Courses: Ergonomics, Usability and Safety in Product Development)

Based on the teaching personnel interviews the simulation has to fulfill three objectives: come up with the learning objectives, deepen learning, and motivate students. The major issue is that simulation corresponds to learning objectives and the simulation has to be relevant. Simulation can be an excellent tool for motivating students who are using computers naturally in their daily life. However, the simulation should also support the research objectives.

Teaching personnel has set requirements for simulation from the teaching but also from the students' perspective. These requirements are compiled on Table 3. This criterion is added for the evaluation criteria defined by theory (Table 1). Also based on interviews, the meaningfulness of single criteria has been evaluated by using numerical value from one to three where 1 is very meaningful criteria, and 3 is not that important. The justified evaluation criterion is represented in Appendix 1.

Table 3. Case requirements for simulation.

Requirement	Explanation
Usability	Easy to use, sensible, rational to use.
Accuracy	Technical readiness and working as defined.
Interactive	Is able to analyze the work of the student and giving feedback on that.
Tailoring	Possibility to modify simulation for learning situation → however, the required level of tailoring is not clearly defined.
Using simulation in appropriate way	Simulation is modeling suitable phenomena which correspond to learning objectives.
Motivation	"Hooked" influence like in video games.
Others	Availability of supporting material Non-linear workload Technical support from the application provider → poor maintainability and support may lead the desertion of an application on the selection phase.

Selecting simulation software

At first simulation software market analysis were done and possible application providers were defined. The providers of simulation software were searched by using Internet as a main source of information. Also, other universities or education organizations that are using simulations in the field of industrial engineering were contacted to collect information on the simulations that they use as well as the case organizations own personnel knowledge of possible providers were listed. Based on these three information sources, possible simulation software listed and contacted to collect further information on their product. On this phase, altogether 16 simulation providers were identified. However, 7 of them were cut down since the simulation does not contain the requested ready simulation model (4 products), the content of simulation was irrelevant for industrial engineering education (2), and one of the simulation providers did not provided the required information on their product. The rest 9 simulations has studied detailed level by utilizing the information provided by the company's Internet page, product brochures, using the demo versions, and contacted suppliers by face to face or phone. The interview done contained questions about the simulation, simulation software providers, and procurement procedure based on the defined evaluation criteria (Tables 4 and 5).

Table 4 lists the summary of the main characteristics of simulations. It lists the type of simulation, technical requirements, documents, and costs of provided application.

Table 4. Summary of the main characteristics of simulation software.

Application	Pheno-menon	Technical requirements	Documents	Costs (parts including)
OperEx Power	S, PL, PD	-	-	2 day training including all requisites.
University Tournament	S	- Excel	- User guide - Case description - Instructor's material - Results of each game round	Pricing according marketing areas. - Training of the instructor - Materials - Simulation - Results - Technical support
Delfoi Planner EDU	PM	Student needs: - Delmia Quest-net interface -Delfoi QBI Instructor: - Net interface - Configuration Client	- Prepared assignments - Example results - Guides for student/ instructor - User guide - Model description	License and yearly support payment: - Updates and developments - Materials - Delmia Quest – technical support (training and the installation costs are charged separately)
Clobal Challenge	S	- Internet connection	User guides for students and instructor are located in the system.	License costs: - Updates/maintenance - Test game for the instructor - Materials - Technical support (separate training costs)
RealGame	BP	- Installing the application into the computer	- Teaching materials - Instructions for the teaching situation - Guidance for instructor	License agreement: - Installation disc and - guides - Materials - Technical support - Implementation guidance (separately travelling costs)
ProDesim	PD	- Board - Video projector - Laptop	- Guidance for instructor - The case description - Materials for kick of and summary lecture	Starting costs: - Required devices - Instructors training Yearly license includes: - Materials - Technical support
Simbu	S	Student: - Game software - Excel Instructor: - Software	- The description of the game	3 or 5 year package: - Materials - Updates - Phone support: 4 hours per year
The Telco Manager Business simulation	S	- Internet connection	- User guide - Educational materials - Material for kick off lecture	License costs: - Technical support - Materials (separate training for instructor)
Beefeater Restaurants Microworld	S	- Installing the application into the computer	- User guide - Instructor's material	License costs (yearly/permanent): - Technical support - Materials - Updates

S = Strategy, PM = Production Management, PL = Production Planning, PD = Product Development, BP = Business Processes

Also the load of simulation utilization was identified. The load consists of tasks that personnel have to do to organize simulation and the requirements of simulation environment (see Table 5).

Table 5. DIEM teacher workload using simulations.

Application	Required tasks	Facilities
OperEx Power	- Reserve time for training	-
University Tournament	- Reserve time for training - Duties on the person in charge: - Contact person between students and BGF - Responsible for training students to learn how to use application - Guiding learning process	Internet
Delfoi Planner EDU	- User administration - Student guidance (- Organizing the kick off lecture)	Computer classroom
Global Challenge	- Informing GC about the course starting - Delivering the licenses to the students (- Organizing the kick off lecture)	Internet
RealGame	- Act as a game leader - User administration	Computer classroom
ProDesim	- Act as a game leader	Room with video projector
Simbu	- Act as a game leader - User administration	Computer classroom
The Telco Manager Business simulation	- Informing Telco about the course starting - Delivering the licenses to the students (- Organizing the kick off lecture)	Internet
Beefeater Restaurants Microworld	- Act as a game leader - User administration	Computer classroom

These 9 simulations were evaluated against the evaluation criteria (see Appendix 1). The major issues focused where the simulation model itself, the user application, and the work load for teaching personnel. Also the possibility to use simulation using internet was highly appreciated since thus avoiding the costs caused by purchasing the computers, computer class, and maintaining them. Based on all these criteria, two simulation software, Global Challenge and The Telco Manager Business, were decided to pilot by students since based on the evaluation criteria the results were similar.

The major selection criteria emphasized the simulation model itself, the nature of user application, and the required workload of teaching personnel. Since establishing the required computer classroom led to the situation where four of the simulation software was discarded. Also ProDesim was discarded since it not allows the learning regardless of the place. OperEx Power was also assessed to be very demanding to settle for other teaching schedule since it requires two full days of learning in the premises of the simulation provider in small groups. The University Tournament simulation was assessed to be too laborious for teaching personnel in the current situation.

Pilots as a part of decision process

The final selection of simulation software will be based on the true user experience gotten from students. 24 students participated in the course where these two simulations were used. The students represented the divergent group of industrial engineering and management students: students who have industrial engineering as a major (the end of the bachelor phase and advanced master's students), students who have industrial engineering as a minor, and post graduate students of industrial engineering. Students were using the simulation as a group.

Both simulations are focused on the area of business strategy so the simulation could be part of Strategic Management –course and fit for the learning objectives of the course. The piloting was started by sending material for students by e-mail and having a kick off lecture where simulations were demonstrated. The idea of both simulations is playing several rounds of the game so that students can see the effects on their decisions in practice. Students followed the defined time schedule for simulations. At the end, feedback discussion was organized to share the results how students were succeeded in simulations but also discussing the simulation utilization on teaching.

To get the feedback from the students, they had to write a conclusion report where they analyzed the user experiences and quality of each simulation game but also how the model supported learning. Students also utilized the defined evaluation criteria partially when they analyzed the activity of simulation model and overall user experiences. The results are summarized on Table 6.

Table 6. Simulation evaluation.

Factor	Description	Object of evaluation	GC	TMBS
Functionality	Modeling phenomenon	Is the phenomenon suitable for industrial engineering education?	100 %	86 %
	The structure of the model	Is the model..		
		..extensive?	100 %	23 %
		..focused?	77 %	71 %
		..transparent?	70 %	24 %
		..concrete?	81 %	33 %
		..founded on elementary knowledge?	91 %	77 %
		..understandable?	95 %	43 %
		..valid?	86 %	77 %
		.challenging ?	95 %	25 %
		Hierarchical decomposition	1.6	2.0
	Input and Output	Analyzing the phenomenon	1.5	1.9
	Interactive	Is the application able to analyze student work and give feedback on that?	71 %	45 %
Usability	Application	How is the simulation used in education?	1.5	2.1
		The amount of material?	1.4	2.0
	Physical usability	Is the learning of simulation fast?	1.8	1.6
		Easy of use?	1.9	1.4
		Is information easily and logically available?	1.6	2.0
Reliability/ Quality	Learning	Comparing learning objectives to results	1.9	2.2
	Balance	Does simulation give the well-balanced model of the subject area?	86 %	10 %
	Realism	Does simulation give a realistic picture of the phenomenon simulated?	95 %	24 %
	Dependency	Is the application dependent on the developer?	11 %	5 %
		Is the application dependent on the instructor?	0 %	5%
	Reliability of software	Quality problems, fault analysis, quality system	1.4	2.0

GC = Global Challenge, TMBS = The Telco Manager Business Simulation

Almost in all areas, Global Challenge (GC) is evaluated to be better than Telco Manager Business Simulation (TMBS). However, easy of use and the dependency of the developer is examined to be better in TMBS. The explanation for that can be found the more complex and extensive model used in GC. The easy of use is easier to build when the model for simulation is simpler. 91 % of the students thought that GC fits for industrial engineering education and got feedback that simulation created an interesting learning environment, make possible to analyze the phenomena behind the model, and gave realism to apply theory which are very important facts to attain learning objectives. GC provided more realistic view on business and the complexity of decision making. In the other hand, TMBS got quite radical critic about the fit for education purpose, the content of simulation, the usability and quality related weaknesses. Students evaluated that TMBS contains only very basic level business rules.

The model of GC is very wide and thus students analyzed the suitability of it in one single course since the background information required is vast. Thus the GC can work as very advanced phase of studies by utilizing the cumulative information attained during the whole degree. GC can be utilized over net and not necessarily requiring any contact teaching. However, by using only a simulation the learning objectives of the course of Strategic Management cannot be attaining and the elementary knowledge has to be provided for students on some other teaching method and the simulation can be used as an advanced tool.

Students also evaluated how well the evaluation criteria that they used worked on this situation when comparing software. The evaluation criteria that students utilized contained the sub-fields of the functionality, usability, quality, and reliability since the other parts were not able to analyze on the piloting phase (costs, maintainability, and simulation provider related aspects). Only two of the students were criticized the clarity of criterion when the other student was criticizing the relevance of two criteria when the student is using the criteria. Thus in general, the evaluation criterion was assessing to fit for purpose and thus to be correct.

Conclusion of the simulation software selection

Based on the whole evaluation process and the actual user feedback GC can be recommended to the industrial engineering education in DIEM when the simulation is fulfilling the requirements of teaching personnel together with good student feedback. Besides, TMBS contains remarkable lacks in the field of the completeness of the simulation model, quality, and reliability. Especially the lacks on the content of the model are the major reasons leading the decision that TMBS is not fulfilling the learning objectives defined.

If DIEM decides to procure GC based on the experience gotten through piloting, the simulation should be utilized on the phase of degree when students have enough elementary knowledge (master's thesis students). The GC would fit the given course of Strategic Management. The best results may have gotten if the lectures are held parallel with simulation so that students can apply they learning directly. Also the kick of lecture to simulation software and its usage (1-2 hours). Simulation is used by groups and it is suggested that students will get one week slot for each decision round. On the pilot, 5 rounds were played but based on this experience it is preferable to play more than these 5 rounds to see better the consequences of long term decisions. To support learning, some kind of written report should be part of course completion so that students have to also analyze the decisions made and how those affect on results or alternatively keep a discussion session after each round to analyze the results.

Procuring the simulation means some additional costs and causing some work load for the teacher utilizing simulation in teaching. However, the suggested simulation model does not require any maintenance activities, purchasing of special equipments, or user management activities. So the teaching personnel is mainly still loading by the teaching duties as earlier without some information shared with the GC provider. Also the kick off and the final analyzing meeting should be attached to using the simulation in teaching purpose.

DISCUSSION

Simulation is one of the computer aided teaching method. The strengths of this method are the capability to model the comprehensive systems and the related interconnections and consequences. It is difficult to illustrate this dynamic in teaching by other methods safely. It also makes possible to learn something by using participative tool in support which can be difficult in industrial engineering education otherwise. Simulation enables the controllability of the subject in hand, standardizing teaching tasks, creating repeatable situations. Well

working simulation can help for motivating a student to reach the learning objectives but also gives capability to use technical tools that could be a surplus at work after graduation.

This case study is showing an example of selecting a simulation. To be able to select proper simulation requires different steps to find the best solution. The evaluation criteria are very important part of the selection process to make all the requirements and emphasis visible. This case study is providing a tool for evaluate simulation software for education purpose. The students were also validated partially the criterion and based on the results the criterion is applicable. The other criteria that students were not validated are very common software evaluation criterion and widely used. However, every organization should go through the criterion and think if they need to add some own views on there. For example, the case organization is intensely requiring a simulation which can be using Internet when some other organization will may also use the simulation requiring participation in the same room. However, the case organization has always define the individual scale of importance of each criteria.

Based on the experience of piloting, using only the evaluation criteria may lead surprising conclusion. As this case shows, the user experience is very valuable when making the final decision of purchasing simulation software. Even though the researcher was first utilized the demo version of both piloting software, the real version of the TMBS did not work as thought. Without the piloting this information and the inadequacy of the simulation model would be that visible.

The selected simulation tool is covering one area of teaching when there is also requisition for other simulation tools in the field of product development, production planning and management, which proved to be too expensive or requiring so much teaching personnel work load that acquiring them is not possible.

CONCLUSIONS

Simulation as an e-Learning method can support the teaching and learning in many subject areas of the Industrial Engineering and Management. However, the full potential has not been utilized in the case university and the teaching personnel see simulation tools as a significant opportunity. It was justified to define a proper set of criteria to be used to analyze possible simulation tools for teaching purposes.

The requirements for educational simulation are defined based on the earlier literature on the requirements for software selection and requirements for applications used in education. The created evaluation criterion is then completed with the views of the case organization's teaching personnel requirements. Basically the functionality, usability, reliability, quality and maintainability have to be assessed. Case organization also settle it requirements for costs. Also assessing the simulation supplier and services that it provides are essential to be able to evaluate the sustainability of the system and the total lifecycle costs. One of the major requirements is that the simulation software and the model have to fulfill the educational learning objectives. Based on these selection criteria, the one suitable simulation software was found to fit in the education of Strategic Management.

The number of commercial educational simulation available is not very high. For sure some local players who are offering simulation on their basement are missing but irrelevant to the case organization to evaluate. However, all available major player should be noticed and based on the criteria defined a simulation for case organization can be found. Some organizational factors certainly affected to drop out some good simulation since demanding for example computer class in use which was not intended to invest and maintain.

Even though this is the case study, the evaluation criterion for educational simulation is widely usable in organizations of similar kind. However, the selected simulation is just answering the requirements of the case organization and thus every organization is made their own evaluation process when implementing simulation on their education program.

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Appendix 1. Applied evaluation criterion at DIEM.

Factor	Description	Object of evaluation	Evaluation method	Significance (1-3)
Functionality	Modeling phenomenon	Is the phenomenon suitable for industrial engineering education?	Yes/No	1
	The structure of the model	Is the model..		
		..extensive?	Yes/No	2
		..focused?	Yes/No	2
		..transparent?	Yes/No	1
		..concrete?	Yes/No	1
		..founded on preliminary knowledge?	Yes/No	1
		..understandable?	Yes/No	1
		..valid?	Yes/No	1
		Challenging	Yes/No	1
	Technical characteristics	Possibility for 3D animation?	Yes/No	3
		Possibility to acc-/decelerate the simulation?	1-3	3
			1-3	3
		Picture quality	1-3	2
		Hierarchical decomposition	Yes/No	1
		Use over Internet		
	Input and Output	Analyzing the phenomenon	1-3	2
	Interactive	Is the application able to analyze student work and give feedback on that?	Yes/No	2
Usability	Application	How is the simulation used in education?	1-3	1
			1-3	2
	Physical usability	Possibility to tailor model for teaching	1-3	3
			1-3	1
		Work load requirement is non-linear	1-3	1
		Is the learning of simulation fast?	1-3	2
		Easy of use?		
		Is information easily and logically available?		
Reliability	Reliability of software	Quality problems, fault analysis, quality system	1-3	2
Quality	Learning	Comparing learning objectives with results	1-3	1
	Balance	Does simulation give the well-balanced model of the subject area?	Yes/No	3
	Dependency of developer(s)	Is the application dependent on the developer?	Yes/No	3
	Dependency of instructor(s)	Is the application dependent on the		

		instructor?		
Maintainability	Documentation Technical requirements Updating Improvements	Adequate number of documents Hardware and software requirements Does the application provider offer updates? What and when was the last update? Are they still developing the application?	1-3 Written Yes/No Written Yes/No	1 3 3 3 3
Costs	Lifecycle costs	Procurement costs Costs of maintenance (including updates) Costs of training	€ € €	1 1 2
Supplier	Reliability of the application provider	Assessing the reliability of the company	1-3	2
Supplier's services	What services the supplier is providing?	Technical support Customer service Training	Yes/No Yes/No Yes/No	1 1 2

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THE EFFECTS OF TECHNOLOGY-ENABLED LEARNING ENVIRONMENTS ON CLASSROOM COMMUNITY

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ABSTRACT

A growing number of institutions now offer online classes as an alternative to traditional or face-to-face classes. Work and family commitments, increased course offerings, greater availability of technology, and the growth of an international online community are among the factors contributing to the growing popularity of online courses. Providing online students with learning experiences better than or at least equivalent to those available in traditional classrooms is the goal of many educators. Several factors play important roles which contribute to their level of learning as well as satisfaction. This study examines community factors which impact the classroom environment by comparing perceptions of students taking the same class from the same instructor in online and traditional classroom settings. The results reveal that these community factors were perceived differently by students in the two groups which lead to different level of satisfaction.

Keywords: Technology-Enabled Learning, Distance Learning, Online Classroom Community

INTRODUCTION

Higher-level education has seen a large shift in student shift in student preferences over the last decade in regards to course learning environments. In 2008, more than four million college students enrolled in at least one online course as compared to less than two million in 2003 (Clark, 2009). New or improved technology to facility learning, widespread availability of high-speed internet connections to access this technology, and increased course offering all contribute to this shift in student learning environment preference.

Course learning environments that facilitated distance-learning are not new and have been available to college students for decades. However, technology development has enabled a much richer and interactive communication medium that has begun to rival that offered by the traditional classroom. For example, students 20 years ago who desired a distance-learning course would often communicate to the instructor by completing all assignments individually and use postal mail to send in completed work. Technology has enabled students to have the capability to instantaneous interaction with both the instructor and other students, view videos that are posted, share files, post comments for other students to see and respond to, and work in teams.

Thus, a fundamental change has occurred in distance learning. The technological shift has caused distance learning to change from being primarily an independent study to becoming a classroom community. Historically, the primary attraction to distance learning was flexibility in schedule which attracted students who desired a more flexible schedule for the class and were self-disciplined enough to complete the work independently. Technology has attracted many more students to distance learning over the last decade because some of the classroom characteristics previously unavailable to distance learning environments yet desired by many students, such as student participation and interaction, have been integrated into the course. Thus, it is not surprising that higher-education institutions have stated that online education is very important to their long-term strategy (Allen and Seaman, 2008).

Although there have been many studies examining online courses, only one study (Shea, Li, and Pickett, 2006) was found which examined the effect of the learning environment on classroom community; however this article only examined two classroom community factors and did not use the same instructor and course for comparing the learning environment. The study we propose not only examines additional classroom community variables, but also uses the same instructor and class for the multiple sections of online and traditional courses from which data was collected. In addition, the effect of classroom community on satisfaction is examined.

This study seeks to examine how traditional and online courses compare with each in regards to classroom community and how the classroom community affects student satisfaction. In pursuit of this objective, the next section discusses prior studies that address issues related to online courses and students' perceptions on classroom communities. After an identification and examination of classroom community factors, the methodology of this study is described. The results are then presented along with a discussion of factors that are influenced by the learning environment. This study also provides practical suggestions on areas which educators may focus to improve the satisfaction levels of their online students and the success of their online programs.

LITERATURE REVIEW

The influence of peers in learning can greatly affect how much a student learns in a course as well as their perceptions of the class. Face-to-face interaction normally takes place in a traditional class, often leading to the development of peer-learning communities as students study together and work on projects together. Face-to-face interaction does not naturally occur in online courses and thus online courses often require technology tools to create a sense of community and interaction among students. There have been some studies that have examined community in online courses to discover the role of technological tools to replace the naturally forming communities in traditional courses. For example, one study found that using technology tools to create a community led to a support mechanism minimizing the negative impact online courses has been shown to have on student motivation and retention (Fisher and Baird, 2005). Another study found that some of the students perceived that online courses allowed them to interact more with instructors than in the traditional classroom (Kim, Liu, and Bonk, 2005).

Technology tools in an online course alter the classroom interactions in various ways and thus some studies have looked specifically at student interaction. For example, one study has shown that despite not having face-to-face interaction with other students, some studies were found to strive to work harder because of classmates counting on their communication (Fisher and Baird, 2005). Thus online interaction can be motivating just like traditional classroom interaction although face-to-face interaction does not occur. Another study also found beneficial results of online interaction – this study found that student to student interactions in an online course can greatly influence the course content that is delivered as students learn from each other and benefit the level of learning (Peltier, Schibrowsky, and Drago, 2007). Some case studies have shown the effectiveness of various incorporations of technology and of reliance on these tools to facilitate classroom instruction (Tennent, Windeknecht, and Kehoe, 2004; Hong, 2002; Lee, Tan, and Goh, 2004).

However, not all studies have found positive issues that have resulted from the lack of face-to-face interaction. For example, one study found that the interaction with other students created a more meaningful learning experience for an online course, but the difficulty of communicating with other students was a challenge (Kim, Liu, and Bonk, 2005). This study also found that students had less of an emotional connection with other students, not knowing how to interpret the thoughts and emotions behind the comments that they saw posted or received in emails (Kim, Liu, and Bonk, 2005). Thus, the jury still seems to be out regarding whether or not the online community leads to better or worse interactions among students.

There has been one study that has looked specifically at whether the type of class (online vs. traditional) has an impact on community, but did not even find a significant difference (Shea, Li, and Pickett, 2006). This article suggested that there may not have been a significant difference between classroom community in the online and traditional courses because technology tools were used to create a community. However, this article is based on Rovai (2002)'s Classroom Community Index, which focuses on two criteria – Connectedness and Learning. It seems that since the community of online courses and traditional courses differ on many dimensions, perhaps more community dimensions needs to be examined, as these community dimensions may be affected by the type of course that is offered. Also, it seems limited to focus only on those two dimensions when other articles suggest that there may possibly be other dimensions of community that may be impacted (Driver, 2002; Changchit and Hostetler, 2003). Thus, this study proposes that a relationship exists between course format and community.

In addition to a relationship existing between course format and community, it is likely that community will affect the level of satisfaction that a student has for a course. For example, one study found that students thought that the perceived lack of community was a negative aspect of the class (Song, Singleton, Hill, and Koh, 2004). This implies that the satisfaction level of students may be impacted because of the level of community that exists in a course.

Proposed Factors Affecting Students' Satisfaction in a Traditional and Online Class

The model used to guide this research is illustrated in Figure 1 below. Traditional and online classroom settings were investigated. Five measurement variables and one response variable

were measured: communication, harmonization, instructor support, learning, peer support, and satisfaction.

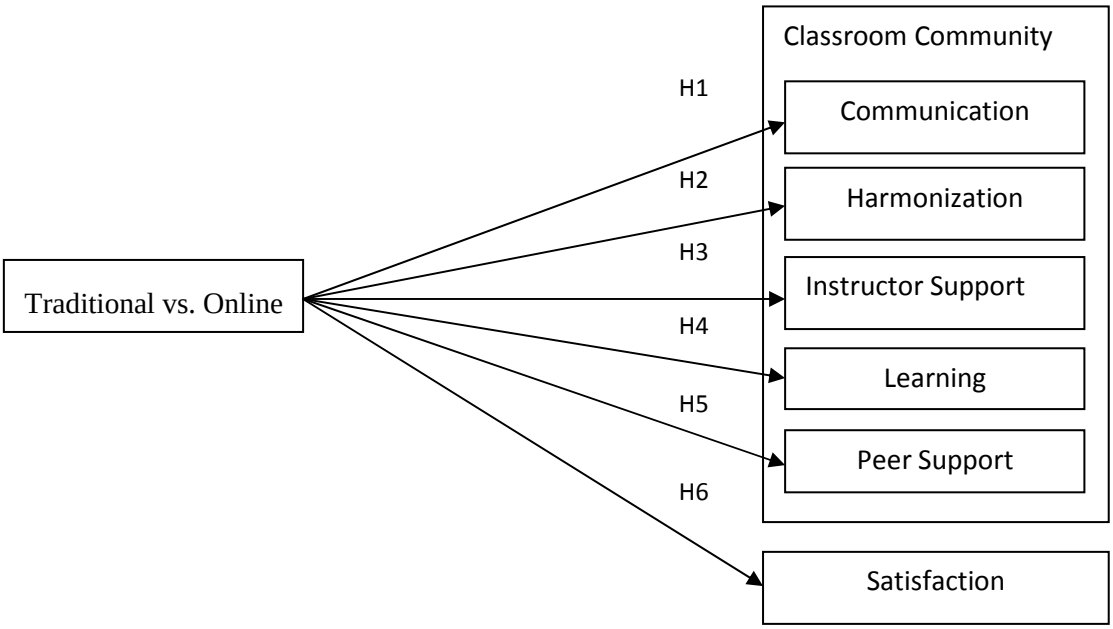

Figure 1: Research Model

Based on the research model above, six hypotheses will be tested as follows:

H1: Students' perceptions on the quality and quantity of interactions are significantly different between the traditional class and the online class.

> Communication--referred to student perceptions of the quality and quantity of interactions in the class. The following questions, with the scale of 1 (strongly disagree) to 5 (strongly agree), were used to measure levels of classroom communication perceived by subjects:
>
> - There is a lot of interaction among all participants in this class.
> - I am very active in the discussions in this class.
> - I am satisfied with the level of interaction in this class.
> - I am satisfied with the quality of exchanges that occur in this class.
> - I enjoy the exchanges I have in this class.

H2: Students' perceptions of belonging and being part of a cooperative group are significantly different between the traditional class and the online class.

> Harmonization--referred to a student's perception of belonging and being part of a cooperative group. The following questions, with the scale of 1 (strongly disagree) to

5 (strongly agree), were used to measure levels of harmonization perceived by subjects:

- I enjoy the relationships with other students in the class.
- I feel a sense of belonging in this class.
- I feel that students in this class care about each other.
- I am connected to others in this class.
- I feel a spirit of community in this class.

H3: Students' perceptions of the support and encouragement provided by the instructor are significantly different between the traditional class and the online class.

Instructor Support--referred to a student's perception of the support and encouragement provided by the instructor. The following questions, with the scale of 1 (strongly disagree) to 5 (strongly agree), were used to measure levels of instructor support perceived by subjects:

- I am encouraged by the instructor to ask questions.
- It is not hard to get help when I have a question.
- I receive timely feedback from the instructor.
- I am comfortable exposing gaps in my understanding to the instructor.
- The instructor makes this class easy to understand.

H4: Students' perceptions of the educational value of the course are significantly different between the traditional class and the online class.

Learning--referred to a student's perception of the educational value of the course. The following questions, with the scale of 1 (strongly disagree) to 5 (strongly agree), were used to measure levels of learning perceived by subjects:

- I feel that this class results in adequate learning.
- I feel that I am given ample opportunities to learn in this class.
- I feel that this class meets my educational needs.
- The materials covered in the class are valuable to me.
- The overall knowledge I gain in this class is valuable to me.

H5: Students' perceptions of the educational value of the course are significantly different between the traditional class and the online class.

Peer Support--referred to a student's perception of peer reliability and helpfulness. The following questions, with the scale of 1 (strongly disagree) to 5 (strongly agree), were used to measure levels of peer support perceived by subjects:

- I feel that other students help me to understand the class materials.
- I feel that other students in the class contribute to my learning.
- I feel confident that other students support me in course work.
- I feel that I can rely on other students to assist me in this class.
- Other students and I work together to understand materials in this class.

H6: The level of class satisfaction is affected by the level of community in the class.

Satisfaction--referred to a student's level of satisfaction with the class. The question, with the scale of 1 (strongly disagree) to 5 (strongly agree), below was used to measure student satisfaction levels:

- I enjoy taking this class.
- I will recommend this class to my friends.
- I am satisfied with this class.
- I am glad that this course is part of the curriculum.
- I have a positive perspective regarding this class.

METHODOLOGY

Questionnaire Development

A questionnaire was used to investigate the hypotheses. To derive the questions, instruments created in three studies were adapted and combined to bring forth multiple dimensions of community (Changchit and Hostetler, 2003; Driver, 2002; Rovai, 2002). Additional minor changes in wording were made to tailor the questionnaire versions to their respective settings. Two professors were asked to pretest the questionnaire in order to ensure its clarity. Their feedback was incorporated into the final version.

The questionnaires informed students that the data obtained from them will be combined with data from other people, thus responses would be kept anonymous. In addition, their decision to participate in this study is completely voluntary.

Subjects and Data Collection

Data were collected were students taking the same Management Information System class from the same instructor over the period of four semesters. Both online and traditional students responded to the same questions, but the questionnaire format differed.

To obtain the responses from students in the traditional classroom, the questionnaire was hand distributed in order to encourage them to respond. The participants were given the survey and allowed class time to complete the survey. Sixty-two (58 were valid responses) students voluntarily responded to the questionnaire.

For the online students, the questionnaire was created as a web form. Then, it was distributed as a hyperlink in an email sent to students. All participants were requested to take the online survey as part of their online course. One hundred and thirty-two (126 were valid responses) responded to the questionnaire.

Questionnaire Items

A total of 40 items were included in the survey. The first 30 questions measured students' perceptions of the course and the remaining 10 questions collected demographic data. The students were asked to rate survey items on a Likert-scale from 1 to 5 with 1 being "strongly disagree" and 5 being "strongly agree" and then to self-classify the survey items regarding specific demographic characteristics. Approximately 42.5% of the respondents preferred traditional classes while 57.5% preferred online courses. Table 1 below summarizes demographics of the respondents.

Table 1: Respondents' Demographics

Gender		**Male**		**Female**		
	Traditional	31(53.4%)		27(46.6%)		
	Online	46 (36.5%)		80 (63.5%)		
Own a Computer at Home		**Yes**		**No**		
	Traditional	57(98.3%)		1(1.7%)		
	Online	125(99.2%)		1(0.8%)		
Have a Computer at Work		**Yes**		**No**		
	Traditional	50(86.2%)		8(13.8%)		
	Online	66(52.4%)		60(47.6%)		
Take an Online Course Before		**Yes**		**No**		
	Traditional	35(60.3%)		23(39.7%)		
	Online	94(74.6%)		32(25.4%)		
Employment Status		**Full Time**		**Part Time**	**Unemployed**	
	Traditional	31(53.4%)		20(34.5%)	7(12.1%)	
	Online	45(35.7%)		3(2.4%)	78(61.9%)	
Internet Access at Home		**None**		**Dial-up**	**High speed (i.e., DSL, Cable)**	
	Traditional	2(3.4%)		1(1.7%)	55(94.8%)	
	Online	7(5.6%)		5(4.0%)	114(90.5%)	
Computer Knowledge		**Very Poor**	**Poor**	**Fair**	**Good**	**Very Good**
	Traditional	1(1.7%)	3(5.2%)	8(13.8%)	24(41.4%)	22(37.9%)
	Online	3(2.4%)	2(1.6%)	24(19.0%)	58(46.0%)	39(31%)
Ethnicity		**Anglo**	**Asian**	**Black**	**Hispanic**	**Native American**
	Traditional	30(51.7%)	4(6.9%)	2(3.4%)	22(37.9%)	0(0.0%)
	Online	69(54.8%)	12(9.5%)	2(1.6%)	42(33.3%)	1(0.8%)
Age		**Under 18**	**18-25**	**>25-35**	**>35-50**	**Over 50**
	Traditional	1(1.7%)	43(75.4%)	9(15.5%)	4(6.9%)	1(1.7%)
	Online	3(2.4%)	84(66.7%)	32(25.4%)	6(4.8%)	1(0.8%)
University's Distance from Home		**<10 min.**	**10-30 min.**	**>30-60 min.**	**1-2 hours**	**>2 hours**
	Traditional	14(24.1%)	32(55.2%)	11(19.0%)	1(1.7%)	0(0.0%)
	Online	2(23.8%)	54(42.9%)	32(25.4%)	2(1.6%)	8(6.3%)

ANALYSIS AND DISCUSSION

Data Analysis

In order to determine what factors affect students' satisfaction in classes, t-tests were conducted to compare the responses from students taking traditional class and those taking online class. The results in testing Hypotheses H1-H6 are summarized in Table 2 below.

Table 2: Results of Hypothesis Testing

Factors	Hypotheses	Average (1-5 Likert Scale)		p-value
		Traditional Class	Online Class	
Communication	H1: Students' perceptions on the quality and quantity of interactions are significantly different between the traditional class and the online class.	3.321	3.608	0.01389
Harmonization	H2: Students' perceptions of belonging and being part of a cooperative group are significantly different between the traditional class and the online class.	3.338	3.069	0.03514
Instructor Support	H3: Students' perceptions of the support and encouragement provided by the instructor are significantly different between the traditional class and the online class.	4.178	3.710	0.00028
Learning	H4: Students' perceptions of the educational value of the course are significantly different between the traditional class and the online class.	3.452	4.033	0.00012
Peer Support	H5: Students' perceptions of the educational value of the course are significantly different between the traditional class and the online class.	2.955	3.179	0.13232
Satisfaction	H6: Students' satisfactions with classes are significantly different between the traditional class and the online class.	3.334	3.856	0.00258

The results of H1 indicate that the type of class impacts the quality and quantity of communication that occurs. In fact, communication in the online course was at a higher level than in a traditional course. Perhaps this is because in the online course, students participated more frequently in the discussion board and read the comments of others regularly, expanding on a variety of discussion threads. For the traditional course, it is likely that student participation was only related to the information the instructor was presenting and did not contain the wide variety of discussions that are often found on discussion boards. Furthermore, online courses had a variety of communication mediums, such as discussion postings, instant messaging, and video conferencing.

H2 also is supported and indicates that harmonization is statistically different between online and traditional courses. However, this is different from the results of H1 in that harmonization is higher in the traditional course, not the online course. This is likely due to

students in an online course feeling emotionally disconnected from others in the class. Although quality communication occurs, as evidenced by H1, others are not physically present, which may make online students feel less connected to each than their traditional course peers.

The results also indicate support for H3 in that the level of support received by an instructor is significantly different between traditional and online courses. In a traditional course, there is a built-in structure in which students raise their hands and can immediately receive support from the instructor. However, for an online course, it may take longer to receive a response. Also, an online course requires more self-discipline and individual study and therefore a student may feel that the level of instructor support is at a lower level.
The results of H4 indicate also indicate that there is a significant difference between the learning that occurs for online courses and traditional courses. The online course respondents indicated that there was a higher level of learning that occurred and that the knowledge gained was more valuable. This is probably a result of the online discussion board in which students discuss the course material which often helps students to see why the course content is valuable and relevant to their lives.

The results did not indicate any statistically significant difference for H5. It is interesting to note that the level of peer support had the lowest values for both the online course as well as the traditional course. This may be due to the structure of both the online and traditional class that was surveyed throughout the four semesters. Neither the online nor the traditional sections of the course required any team projects. Thus students may have studied for exams together and discussed the material, but the lack of team projects did not make students feel like they needed to rely on other students in the class to complete work.

H6 is also supported in this study. The result shows significant difference on the level of satisfaction between students in online and traditional sections. It's interesting to note that contradicting with many prior studies, students in online sections show higher satisfaction than those taking traditional sections. Part of the reasons may derive from the availability of better technology-enabled learning tools.

DISCUSSION AND CONCLUSION

This study expands on previous research by identifying five classroom community factors – Communication, Harmonization, Instructor Support, Learning, and Peer Support. Furthermore, the impact of class structure on these five factors is examined. In addition, the impact of classroom community on satisfaction has been examined. The only relationship which did not yield statistically significant results was that the class structure did not yield any difference in the level of peer support. The results section comments on all of these relationships, providing explanations for these results.

It is interesting to note from the results that for two of the classroom community factors (Communication and Learning), the online courses had a statistically significant difference that was higher than the traditional courses. The tendency for many students and faculty is to think that the level of community is lower in online courses due to the lack of face-to-face

interaction. However, these results indicate that the level of community in online courses can be higher than traditional courses. Technology-enabled learning tools can indeed be used to create communities among students.

Results also indicate that classroom community has a significant relationship with satisfaction. From the perspective of an instructor, it is important to integrate the five community factors into both online and traditional courses as they have a significant positive relationship with student satisfaction. For an online course, the use of tools by instructors providers can help to facilitate each of these areas and requiring assignments that encourage a higher degree of these five areas will likely lead to a higher degree of student satisfaction. Thus, coursework should be analyzed in light of these five areas and be examined regarding whether or not they help to facilitate these areas. Also, from the perspective of university administration, it is important to have a high degree of student satisfaction so that a student will both take additional courses and talk to potential students regarding their satisfaction at the university. Training instructors to offer better online courses can be important in facilitating this. Furthermore, since online courses often can minimize university overhead costs because a classroom is not used, it is important to have satisfied students in an online course so that they will have a greater intention to take another online course.
There are various areas in which to expand this stream of research. First, this research can be expanded to also examine students' characteristics and their effect on perceptions of classroom components. Second, student preference towards each of these areas may impact satisfaction and should be examined. For example, some students may prefer a high level of classroom community while others desire to be anonymous and not have a community in their courses. Third, online courses can be tailored in several ways, with varying degrees of video, web-material and participation and thus the impact of various technology-enabled learning tools should be examined. No one format for a course is best for every student or educator, nor for every course and thus the impact of technology tools on courses could be examined.

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EVOLUTIONARY ALGORITHMS FOR UNIVERSITY COURSE TIMETABLE

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ABSTRACT

This paper presents a new heuristic based on evolutionary algorithms and applied to the university course scheduling problem, where a feasible and comfotrable timetables are required. Here, the idea is to use an evolution program which is stochastic optimization strategy similar to genetic algorithms. The main difference is that evolutionary programming insists on the behavioral linkage between parents and their offspring rather than seeking to emulate specific genetic operators as observed in nature. The paper starts by defining the problem and determining the constraints under which the solution should be found. Then, the problem model is described with a set of courses, rooms, instructors, and student groups. Finally, the proposed methodology is applied on a real data set from Rajamangala University, Surin Campus. Results show that our methodology permits more robust exploration for the search space of the designated problem which gives more optimized time schedules than those performed manually export to excel files. The obtained results also show that the proposed solutions.

Keyword: university course scheduling; timetabling, evolutionary algorithms.

INTRODUCTION

University course timetable scheduling problem concerns with the management of timetable which is a complicated problem that all educational institutes are facing at least once a year. Since the timetabling problem has been related to the information about timetable, courses, personal student data, teacher data and classroom fixed data [1], it was considered NP-complete type of problem. This problem type may be assumed that the main process of Algorithms could not solve the problem. With the best and most suitable solution, such a problem could be generally solved by manual course timetable scheduling. However, the manual timetabling method is happened to be less effective and inaccurate when the teacher, student and/or course data are more complexity. Therefore, we try to solve this problem. In this paper, we shall focus on the timetable scheduling with controlling of hard constraints and soft constraints which are applied in university course timetable scheduling. The sample of hard constraints is not allowing the teacher to have two or more classes at the same time. For soft constraint is that a teacher or a group of student should not change classrooms which are in distant.

LITERATURE REVIEW

There are numbers of research that applied Algorithms as methods to solve the problem of course timetable scheduling [1]. In both studies of Modified Genetic Algorithm (MGA) and Cooperative Genetic Algorithm (CGA) have the objective to improve capacity of Algorithms

by MGA and CGA methods respectively in order to reduce working process of each generation of Chromosome [7]. There is a research concerns with NExshed, which the additional tool for Microsoft Excel software [8]. The research in combination of applied Algorithm for solving the course timetable scheduling problem between Integer programming Algorithm and Modified simulated annealing Algorithm [8]. The study presents the solving of timetable scheduling problem by equation which is an analysis tool called Allay Analyzer [10]. There is a research on using Intelligent Agent to solve the problem [4]. The research that applied Integer Linear Programming (ILP) in course timetabling, this method has been improved from Genetic Algorithm (GA) development and Boolean Satisfiability Technique (SAT). There are many other researches related to Algorithm applying in course timetable scheduling with various constraints and different procedures depending on the university regulations.

STATEMENT OF THE PROBLEMS

At present, Rajamangala University, Surin Campus schedules the university course timetable manually and then exports into Excel file, which has caused a lot of complicated in timetable scheduling. This has become a general problem they have to struggle at least once a year. This research study has tested data and method of using the evolutionary algorithms in course timetable scheduling. In this case, the course subject details will be discussed in the first day of the semester. In each semester, the students will be divided into 15 groups. There are courses offered for 5 days a week which starts from Monday to Friday. Every Monday, Tuesday, Wednesday, Thursday, and Friday, There are 9 lessons per day, and each lesson

Takes 60 minutes.
To solve the scheduling problem, the variables are identified and divided into 6 groups consist of student, teacher, course, room, lesson and constraints of Rajamangala University, Surin Campus. The pattern is Problem = {S, T, C, R, L, W} as in
S = {s1, s2,…, si} refers to the set of student data
T = {t1, t2,… , tj} refers to the set of teacher data
C = {c1, c2,…, cn} refers to the set of course data, in each course data will be a vector to describe the following details of: group of students with required courses, teacher, lesson – theoretical section and practical section.
R = {r1, r2, …, rm} refers to set of classroom data, in each room data will be a vector to describe the highest carrying capacity of the classroom.
L = {l1,l2,…, lk} refers to the set of lesson data per week
W ={w1,w2, …wq} refers to the set of hard constraints which are seriously strict (more weight) and soft constraints which are less strict (lighter weight). In the Experiment A, the set of solution is a bigger set consisted of each problem solution which will be evaluated how suitability it is by the indicators.

RESEARCH METHODOLOGY

The solution to the problem is represented in the formula G = {g1, g2,…, gw} where G means group of yeast which combines characteristics of the Individual or Chromosome as stated in Figure 1. Each yeast is a vector consisted of course number, room number of the practical section, lesson of the theoretical section, lesson of the experimental lab

Figure 1: Individual structure

g1	g2		gw
Course	Course	…	Course
Room number	Room number	…	Room number
Theoretical Lesson	Theoretical Lesson	…	Theoretical Lesson
Practical Lesson	Practical Lesson	…	Practical Lesson

As mentioned in the introduction, the problem of university course timetable scheduling is a kind of NP-hard problem which means that it is more complicated problem. Therefore, each course must consist of classroom data, suitable lesson for both student and teacher. In order to decrease time consuming in scheduling and reduce complexity level of such problem, Algorithm helps in randomly suitable places for the courses. Then, it will also help calculating solutions to fit with both hard and soft constraints of any university which are coherent with the teacher and the student requirements. The Individual has been created in order to define a scope of the yeast, so that the selection of course and lesson would be made. Thus, each course will be presented in form of G1 yeast, which has the highest numbers of the selection of course and lesson. The yeast group with lesson numbers, respectively, such as G2 has lesser numbers than G1 and the least numbers is Gw. Data details in this research are; the selected 18 classrooms, 4 experimental labs, 102 lessons of theoretical sections and 112 lessons of practical sections. However, the usage of experimental labs are only in the testing group with number “1” means the lesson with teaching and learning situation, and with number “0” means the lesson without teaching and learning, for example, in the Figure 7-9, there are activity lessons without teaching and learning exercises.

Figure 2 Time slot

	Time slot									
Day	Monday	1	1	1	1	1	1	1	1	1
	Tuesday	1	1	1	1	1	1	1	1	1
	Wednesday	1	1	1	1	1	1	0	0	0
	Thursday	1	1	1	1	1	1	1	1	1
	Friday	1	1	1	1	1	1	1	1	1

Research control (regulations)

Testing methodology will be operated under the regulations controlled by hard constraints that must be strictly followed and soft constraints that should be followed. Here, the details of the constraints.

Hard Constraints

1. Do not assign more than one course to a teacher at a lesson time
2. The teacher is assigned only one lesson to be responsible for at a time
3. No classroom assigned to be used more than one course at a time
4. In each lesson time, the students are not permitted to enroll more than one course
5. Numbers of student in each course must be lesser or equal to the carrying capacity of the classroom
6. On Wednesday, during lesson period (7,8 and 9) there are no teaching and learning exercises as they are assigned for Activity lesson time.

Soft Constraints

1. Each subject course should be scheduled according to the teacher's design e.g. the teacher determines that the 0-8 should be arranged in one day.
2. The teachers should not have long free-period during their teaching time.
3. The students should not have long free-period during their learning time.
4. The teacher timetabling should be arranged a free whole day for other tasks besides teaching.
5. The students should not have the continuation lessons, the teaching timetable and they should change rooms as least as possible.
6. Teacher's teaching tasks in each day should not be over 8 lessons period a day (this numbers should be adjusted depend on the university).

Applying Evolution Algorithms

The research presents the applied Evolution Algorithms in solving the university course timetable scheduling problem base on the nature of Algorithm emerged the idea of developing technique in Evolutionary Computation which is finding the answer by using population. The population will be evolution from generation to generation in order to get close to the best answer. Genetic Algorithm steps are part of this methodology, the genetic step will represent the answer or result of the problem in form of Chromosome, when each Chromosome will be represented by binary digit characters. Naturally, every living creature compiles of one set of Chromosome as well as this computation. One Individual will be compiled of one set of binary digit characters and many other population combine into a group of population. The process of Algorithm program developing starts from parents selection out of population group in order to get results. Algorithm will leave out Individual that is not fit and select the best Individual for more effective in the next experimental testing. The conditions of this research or Evolutionary programming (EP) will be used in order to choose at random for the fitness with data. EP (Evolutionary programming) [6] has the operating step as follows:

1. Initialize the population
2. Expose the population to the environment
3. Calculate fitness for each number
4. Randomly mutate each parent population number
5. Evaluate parents and offspring
6. Select members of new population
7. Go to step 2 until some condition is met

Step 1: Compile data from data sets, which are student timetable data, teaching timetable, room timetable, experimental lab timetable, by Evolution Algorithms (EA) will process the results from the existing free time of the students, teachers', classrooms' and labs', respectively, with identified structure. The student can have free time throughout 5 days except the fixed activity lessons: 7, 8 and 9 where as the teacher, classroom, lab should be free only some certain period.
Step 2: Combine each Individual which violated the constraints
Step 3: Calculate the Fitness Evolution in Individual by using the equation: $f(x)=1/(cost(x)+1)$ while cost(x) means sum of Individual data
Step 4: Randomly the data to solve the Individual problem. Every Individual, there will be arranging of data in an order of yeast. Inside yeast, the data will be arranged from the highest

to the lowest by using value from the calculation of fitness. The least fit yeast will be the beginning point within Individual. Changing process will be started from the least yeast through Reordered Mutation (RM) process which the research has created new process called Two Reordered Mutation, which is a process to change the position of Individual from one to two positions and them make a comparison.
Step 5: Select tournament with Elitist Strategy by randomly choose individual in order to take 1 Individual out and replace with the best Individual.
Step 6: Go back to Step 2 to calculate fitness for each Individual until the process has done with all Individuals.

RESULTS FINDINGS

This research has used population of 30 Individual and Generation 100 in the testing. The application language is PHP and Mysql Database system. The testing tool is an Intel Centrino Core 2 duo 2.00 Gh computer with Memory of 2 GB, and the test has been done in Window xp operational system. From Figure 1 and 2 the result findings of 30 Individual and Generation 100 and repeat the testing for 5 times, the average means are shown in Figure 1. Figure 2 shows the comparison of RM and Two RM. The average time spent for testing is 8 minutes. Figure 1: show the relations between number of Generation and Average fitness per on Generation by using Reordered Mutation (RM)

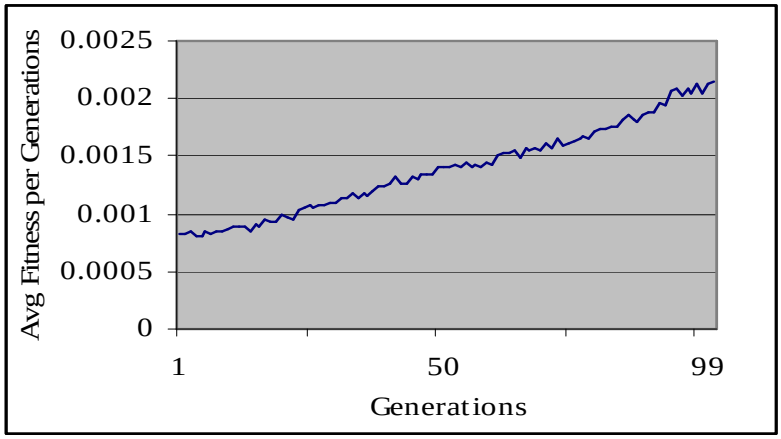

Figure 1: Average Fitness Evolution

Figure 2 presents the comparison between Reordered Mutation and Two Reordered Mutation with Average Fitness per one Generation unit. The findings of 5 times repeating tests are Two RM gives better average value in this research.

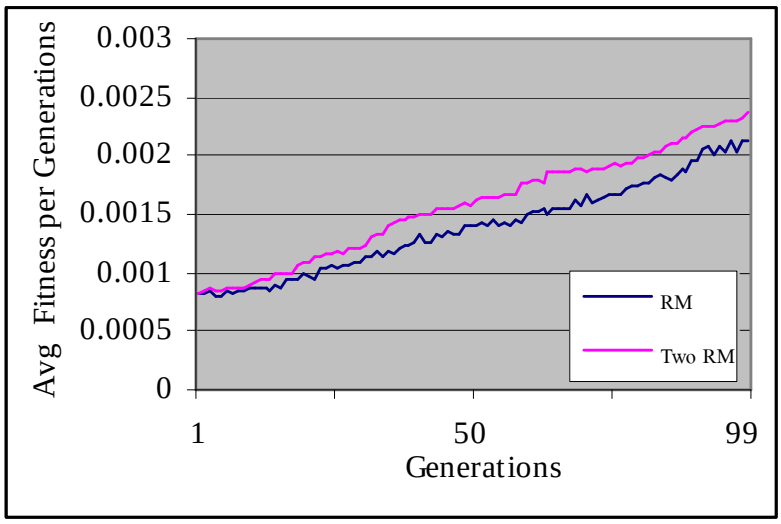

Figure 2: Comparison of RM and Two RM

RESEARCH SUMMARY

This research used EP Algorithm as the method to solve the university timetable scheduling problem. As the results, this methodology can solve the problem adequately as in the following summary:

1. Evolutionary Algorithms and Reordered Mutation are the effective methods in solving the designated problem. Particularly in this research, where Two Reordered Mutation has been applied as the results show better average and effectiveness.
2. This research outline may have been used as a tool for creating methods to solve the problem formally in the future.
3. Results and a set of real data are able to extend to be applied in other universities.

Future research possibility:

1. Comparison Algorithms in order to reduce value or severity of hard constraints and soft constraints in the very short time and with high effective. Once the data has become bigger, time consuming will become longer as it depends on the data size.
2. Attempt to test new methodology or techniques in solving the problem of course timetabling problem such as PSO Algorithms, etc.

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COMPUTER USAGE POLICY AND EMPLOYEES' ATTITUDE TOWARDS CYBERLOAFING

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ABSTRACT

Cyberloafing, or using Internet for non-work related purposes during working hours, could cause detrimental effects to organizations. Hence, various control mechanisms have been recommended for companies interested to control cyberloafing among its employees. Due to the lack of relevant studies in the Malaysian context, this study therefore explores the impact of computer and internet usage policies on employees' attitude towards cyberloafing in Malaysia. A total of 347 questionnaires were distributed among employees who worked in six local states. The effects of organizational variables, personal trait and demographic variables on respondents' attitudes toward four cyberloafing activities were tested using hierarchical regression analysis. It is found that respondents do not perceive that cyberloafing is wrong indefinitely. Perceived justice is found to be significantly associated with two of the cyberloafing activities, specifically, using office computers for personal work and surfing the Internet for leisure. It is also found that awareness of computer and Internet usage policies were significant, only in predicting respondents' attitude towards surfing for leisure. Thus it can be concluded that the influence of computer and internet policies towards cyberloafing is still minimal among Malaysian employees. Perhaps it is because there is no proper guidelines and implementation relevant to the subject.

Keywords: cyberloafing, policies, perceived justice, employees.

INTRODUCTION

The Internet has substantially changed the ways companies conduct business and may potentially boost productivity by enhancing communications and research capabilities. Nonetheless, the use of Internet at work also has a dark side whereby the technology could be easily misused, that is whenever employees access the Internet for other non-work purposes. Internet misuse is also termed as cyberloafing. Defined as the use of company-provided Internet facility by employees for non-work related purposes during working hours [29], cyberloafing activities include writing and sending personal emails, conduct personal Internet banking, participating in online forums and shopping online. Effects of cyberloafing include loss of productivity and reduced system performance. Cyberloafing could also increase legal liabilities if the online activities include harassment, copyright infringement and pornography.

Given the potentially detrimental effects of cyberloafing, it is imperative that managers pay closer attention to this issue. Throughout the years, companies have implemented various

measures in order to curb cyberloafing, including Internet use policies, management training, clinical rehabilitation [46], and monitoring [35] [2]. De Lara et al. [9] found that cyberloafing decreases when organizational control is perceived as high although fear of formal punishment increases cyberloafing. The authors conclude that a climate of fearing formal punishment due to cyberloafing causes cyberloafers to intensify their cyberloafing, perhaps as a response against a threatening organization. Another popular method of controlling for cyberloafing is via electronic monitoring, that is the use of monitoring software. However, electronic monitoring could produce adverse employees' reactions. Alder et al. [1] maintains that such monitoring could be perceived by employees as unfair and abusive, infringe their rights and creates mistrust. Monitoring could adversely affect employees' privacy perception and job satisfaction, which could consequently reduce productivity [32].

Hence, it is believed that the less intrusive methods of controlling cyberloafing could produce better results. In addition, Henle et al. [19] maintain that employees who perceive a control mechanism as fair would be more likely to adhere to its requirements. One of the ways is by implementing computer and Internet use policy. Such policy, which details employees' rights and responsibilities regarding computer and the related technologies, is believed to encourage ethical behaviors by employees. Nonetheless, computer Internet use policy is found to be moderately effective in deterring potential employee online abuse [46]. Further evidence relevant to the impact of computer and Internet use policy on cyberloafing is still very scarce, especially in the Asia-Pacific region. Yulihasri et al. [48] have determined that Malaysian employees tended to agree that it is acceptable to use the Internet for personal reasons. This finding, to an extent, indicates the prevalence of cyberloafing among Malaysian employees could be due to their lack of awareness that such behaviors are against companies' interests – perhaps due to the lack of communication and enforcement. Thus, this study is conducted with the aim to explore Malaysian employees' attitude towards cyberloafing and its relationship with the implementation of computer and Internet usage policies.

COMPUTER AND INTERNET USE POLICY

There has been an increasing interest among researchers in studying cyberloafing. The behavior has been described by various terms, including non-work related computing [27], [32], personal Internet use [33], and Internet abuse in the work place [14] [16] [38], among others. These studies can be categorized into three major groups, namely (i) prevention of the behavior, (ii) antecedents of the behavior and (iii) monitoring and blocking of the behavior [7]. In terms of prevention, many studies support the formulation and implementation of Internet and compute use policy in order to curb cyberloafing (for example see [15] [6] [42] among others). Computer and Internet use policy not only provides guideline on appropriate computer and Internet use, but also outlines how organization will monitor, enforce and punish non-work related activities related to the use of computer and Internet. Policies that clearly define the acceptable Internet use, indicate the punishment for performing non-related work on computer, and are actively enforced could reduce Internet abuse when combined with monitoring systems [42]. However, this can be counteracted by a reduction in job satisfaction and trust among employees [43]. The effectiveness of computer guidelines, nonetheless, is found to be moderated by the degree of belief on universal moral rules towards the use of computers in the workplace [36]. The study showed the presence of clear

computer guidelines had a positive effect on ethical intentions for those professionals with a low belief in universal moral values.

The effectiveness of computer and Internet use policies in deterring cyberloafing has been previously documented. In a study by Li et al. [27], the authors investigate factors that influence employee's Internet use policy (IUP) compliance intention from a rational choice theory. It has been determined that IUP compliance intention is subject to a cost-benefit analysis whereby perceived risks are evaluated against the perceived benefits of Internet abuses. The result suggests that formal sanction and organizational context could influence the employee's intention to comply with IUP. The study concludes that the perceived benefits of Internet abuses motivates employee to conduct Internet abuses and also to violate Internet use policy.

Lichtash [28] discovers most disordered behaviors of using electronic-mail in the workplace are the result of either unclear Internet use policy or lack of communication about the existence of electronic monitoring systems. Similarly, Foltz et al. [13] maintain that employees with a higher degree of awareness of the existence of Internet use policy are least likely to have internet abuse problems. Nonetheless, Henle et al. [19] believe that many organizations have implemented their electronic use policies not based on theoretically driven empirical research. This could explain the prevalence of cyberloafing despite the implementation of such control. In 2002, Greenfield and Davis [15] found that nearly 70% of 224 American companies surveyed had more than half of their employees online despite the implementation of Internet use policy in most of these organizations. The authors also reported that more than 60% of companies had disciplined, and more than 30% had terminated employees for inappropriate use of the Internet.

OTHER PREDICTORS OF CYBERLOAFING

Cyberloafing could have similar predictors to other employee deviant and counterproductive workplace behaviors. Previous studies have identified two main predictors of counterproductive workplace behaviors, namely organizational and personality variables. Rae and Subramaniam [37] suggest that strategies relating to employee fraud need to focus on organizational factors such as work environment, internal control activities, and training. Other studies have found that employee deviant behaviors to be influenced by organization's work climate [44] [3] [25]. Appelbaum et al. [3] argue that an organization's ethical climate is part of its organizational culture, values that determine what is considered as ethically correct. In Peterson [36], ethical climate of an organization has also been found to provide partial explanation of employee deviance.

Another predictor that has been found to be significant in determining employee deviant behavior is perceived justice, for example see Judge et al. [23], de Lara [9], de Lara and Verano-Tacoronte [10], and Aquino et al. [4], among others. Empirical evidence in de Lara [11] shows that unfair procedures place an employee in conflict with organizational rules, creating an association between procedural justice and cyberloafing. In addition, Lim [29] argues that employees tend to legitimize cyberloafing as a neutralization technique whenever their organizations are perceived as unjust.

Traits are individual characteristics that determine one's tendency to behave in certain ways. According to the Trait Theory, traits form broad, general guides that lead to consistent behaviors [24]. In Henle [18], it was found that personality traits could moderate the relationship between employees' deviant behaviors and perceived organizational justice. Consistent with the above contentions, Liao et al. [31] found that agreeableness is significantly related to organizational deviance. In Colbert et al. [8], it was found employees with high agreeableness are less likely to withhold effort even if they perceived little organizational support. This variable has also been found to be associated with other deviant behaviors such as alcohol involvement [34] and HIV risk behaviors [41]. Individuals with high agreeableness are described as warm, gentle, helpful, generous and modest. They tend to avoid trouble, sensitive to the needs of others and comply with workplace norms. Hence, it is believed that employees with higher agreeableness tend to be more compliant when it comes to following organizational norms and policies.

Drawing on these existing studies, it is therefore hypothesized that ethics environment, perceived justice and agreeableness traits could also have significant impact on employees' attitude towards cyberloafing behaviors – apart from the awareness on computer and Internet use policies. These variables are therefore included in the current study in order to represent a more comprehensive investigation on the issue.

METHODS

A research questionnaire was specifically developed as the main instrument for this study. The questionnaire elicits data on respondents' attitudes towards cyberloafing, the perceived organizational justice, perceived ethics environment, agreeableness scale, and demographic data. The research questionnaire is self-administered.

Population and sample

The population of this study is employees who worked in Malaysia during data collection period. A convenience sampling method was used whereby research questionnaires were distributed to offices in six main states in Malaysia, namely Kuala Lumpur, Selangor, Melaka, Johor, Penang, and Negeri Sembilan. Research assistants were instructed to approach each potential respondent, ask for their participation and wait for respondents to complete the questionnaire. A total of 450 questionnaires were distributed, out of which 381 were returned with complete responses.
The data obtained was then keyed-in into the SPSS 17.0. In order to get a better grasp of respondents' attitudes toward cyberloafing, only respondents who indicated that Internet access was available at their offices were selected for the study. It is presumed that respondents who can access the Internet at the office could give a fair view on cyberloafing. These respondents have the opportunity to cyberloaf and therefore would experience the actual office environment within which this opportunity is present. After this filtration process, only 347 respondents remained in the study.

Table 1: Respondents' demographics

		N	Percentage
Age:	29 years and below	216	62.4
	30 – 39 years	55	15.9
	40 – 49 years	41	11.8
	Above 50 years	34	9.8
Gender:	Male	188	54.3
	Female	158	45.7
Academic qualification:	Secondary school/certificate	70	20.2
	Diploma	89	25.7
	Degree	170	49.1
	Post-graduate	16	4.6
Job position:	Managerial level	59	17.1
	Executive	144	41.6
	Non-executive	143	41.3
Size of company:	20 employees and less	81	23.4
	20 – 50 employees	96	27.7
	51 – 100 employees	28	8.1
	101 – 500 employees	56	16.2
	501 – 1000 employees	19	5.5
	Over 1,000 employees	66	19.1
Years worked:	Below 1 year	124	35.8
	1 – 5 years	123	35.5
	5 - 10 years	34	9.8
	10 - 15 years	19	5.5
	15 – 20 years	16	4.6
	Above 20 years	30	8.7

* Difference in N is due to missing values

Respondents' demographics

Table 1 summarizes the tabulation of respondents, based on their demographic data. Majority of respondents were in their 20s (62%), have completed their first degree (49%), and have been working for 5 years and less (36%). In terms of gender, although female respondents (54.3%) were more than male (45.7%), the difference is rather small.

Cyberloafing

Cyberloafing is gauged based on four statements relating to cyberloafing i.e. online chat with friends while working (CL1), writing and sending personal e-mails (CL2), use office computer for personal work (CL3) and surf the Internet for leisure during office hours (CL4). For each statement, the referral to the workplace was made clear. Respondents were required to indicate their judgment of the behavior, ranging from 1, not wrong at all, to 6, very wrong. It is assumed that an employee would be more likely to commit an act that he/she believed as not wrong and would less likely to commit a behavior that is considered as wrong (see [30]). Table 2 presents the mean, standard deviation and frequency analysis of the responses. It is apparent from the frequency analysis that respondents do not view cyberloafing as wrong

indefinitely. Majority of respondents only viewed the acts as "could be wrong" while a small number of respondents (less than 10%) viewed the acts as "not wrong at all" and about 12% of respondents are of the opinion that such acts are "not wrong".

Table 2: Attitude towards cyberloafing activities

		Mean	Std. Dev.	Frequencies (%) 1	2	3	4	5	6
1	Online chat with friends while working (CL1).	4.04	1.32	4.9	6.9	20.7	**27.7**	26.2	13.5
2	Writing and sending personal e-mail at work (CL2).	3.71	1.28	5.5	12.4	22.2	**32.9**	19.6	7.5
3	Use office computer for personal work (CL3).	3.77	1.19	2.3	12.7	24.9	**32.4**	20.8	6.9
4	Surf the internet for leisure during office hours (CL4).	3.91	1.23	2.6	11.0	21.0	**34.3**	20.5	10.7

* 1 = Not wrong at all; 2=Not wrong; 3=Could not be wrong; 4=Could be wrong; 5=Wrong; 6=Very wrong

Codes of computer and Internet use

This variable is represented by one statement, i.e., "I am aware that this organization has written codes of computer and Internet use". Respondents were required to state the extent of their agreement, ranging from 1, strongly disagree to 6, strongly agree. Table 3 below summarizes the frequency analysis of the responses. It could be observed that respondents were not very aware of the codes of computer and Internet use implemented by the company (mean = 3.93). The lack of such awareness could indicate either the lack of implementation, enforcement or communication of such policies and guidelines.

Table 3: Codes of computer and Internet use

	Mean	Std. Dev.	Frequencies (%) 1	2	3	4	5	6
I am aware that this organisation has written codes of computer and Internet use	3.93	1.29	3.5	13.3	16.8	**29.0**	27.8	9.6

* 1=Strongly disagree, 2=Disagree, 3=Mildly disagree, 4=Mildly agree, 5=Agree, 6=Strongly agree

Ethics environment

Six items were used to measure the perceived ethics environment. These items include "Acting ethically in this organization is rewarding", "Senior executives at this organization are ethical", and "This organization places high value on ethical behavior". Respondents were required to state the extent of their agreement to each statement on a 6-point Likert scale, ranging from 1, strongly disagree to 6, strongly agree. An examination of factor analysis indicated that all six items loaded on a unique factor (Kaiser-Meyer-Olkin Measure of

Sampling Adequacy = 0.776, sig. = 0.000). Alpha was satisfactory at 0.708. The mean value for this variable is 4.21, with a standard deviation of 0.71.

Perceived Justice

Perceived justice was assessed based on respondents' perception of fair treatment received within the organization. Seven items were developed for this study, including "The organization evaluates my performance fairly", "My salary is fair for the amount of work that I do", and "This organization treats me with respect". Each item was rated based on a 6-point Likert scale, ranging from 1, strongly disagree to 6, strongly agree. A factor analysis was performed on these items and it was found that all seven items loaded on a single factor (Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.867, sig. = 0.000). Alpha was satisfactory at 0.824. The mean value for this variable is 4.28, with a standard deviation of 0.79.

Agreeableness

This personality trait was measured based on 10 items. Sample items for agreeableness include "I sympathize with other people's feelings", "I understand other people's problem", and "I have good relationship with everyone". Responses range from 1, strongly disagree, to 6, strongly agree. Unidimensionality of each variable was confirmed by a factor analysis and the alpha coefficients were satisfactory at 0.750 and 0.772 respectively. The mean value for this variable is 4.30, with a standard deviation of 0.57.

RESULTS

Eleven variables were examined in this study, namely gender (SX), age, organization size (Size), work position (WP), Codes of computer and Internet use (CD), agreeableness (AG), ethics environment (EE), perceived justice (PJ), and four cyberloafing activities, namely online chat with friends while working (CL1), writing and sending personal e-mails (CL2), use office computer for personal work (CL3) and surf the Internet for leisure during office hours (CL4). Table 4 summarizes the correlations of each variable. It could be observed that age, ethics environment, and perceived justice are significantly related to all four cyberloafing activities. On the other hand, codes of computer and Internet use is significantly related, albeit moderately, to CL3 and CL4.

Table 3: Correlations

Variables		1	2	3	4	5	6	7	8	9	10	11
1	SX	-										
2	Age	-0.12*	-									
3	WP	-0.07	-0.17**	-								
4	Size	0.01	0.06	-0.14**	-							
5	CD	0.05	0.05	-0.04	0.06	-						
6	AG	-0.03	0.12*	-0.07	0.06	0.03	-					
7	EE	0.07	0.06	-0.07	-0.03	0.36**	0.12*	-				
8	PJ	0.01	0.11*	0.01	0.26**	0.20**	0.19**	0.63**	-			
9	CL1	0.06	0.26*	-0.01	-0.11*	0.12*	0.16*	0.20**	0.19**	-		
10	CL2	0.03	0.17**	0.04	-0.19**	0.08	0.10	0.14**	0.15**	0.74**	-	
11	CL3	0.06	0.23**	-0.03	-0.08	0.14*	0.04	0.18**	0.26**	0.46**	0.53**	-
12	CL4	0.08	0.28**	-0.05	-0.11*	0.25**	0.11*	0.14**	0.21**	0.53**	0.56**	0.62**

Level of significance: *$p < 0.05$; **$p < 0.01$

Gender: 1= male, 2=female

Age: 1 = 20 years and below; 2 = 21 – 30; 3 = 31 – 40; 4 = 41 – 50; 5 = above 50

Work position: 1 = Managerial; 2 = Executive; 3 = Non-executive

In order to understand the influence of computer and Internet use policy and other variables on employees' attitude towards cyberloafing activities, a series of hierarchical regression analyses were performed, using each behavior as the dependent variable. A dummy variable representing gender (male vs. female) was inserted in step 1, together with respondent's age, work position and company size (as measured by number of employees). In step 2, the variable agreeableness was inserted. In step 3, three variables were included, namely, Perceived Justice, Ethics Environment and Codes of computer and Internet use. Results of these regressions are presented in Table 4. The regression's R^2 and ΔR^2 indicate that the predictors had moderate effects on the criterion (see Aquino et al. [4] for further discussions).

This study further supports existing findings relevant to Internet use. Age and organization size were found to be consistently significant across the four cyberloafing behaviors. Computer and Internet use has been frequently associated with age whereby individuals who have grown up within the Internet era are often assumed to be technologically savvy. Moreover, a handful of studies have been devoted in analyzing young people's Internet use (for example see [22] [17] [39] and provides further evidence on the influence of age towards Internet and computer use. It is also speculated that in larger organizations, employees may

have more opportunities to cyberloaf due to the facilities provided (faster Internet access, individual e-mail accounts, personal computers and individual workstation) and the large number of employees which may make it more difficult for companies to monitor employees' online activities. Moreover, in larger companies, the amount of online activities and size of data transfers could well hide these 'side' activities. Gender is not a significant predictor to the four examined behaviors although previous studies have documented the significant impact of gender on various unethical and deviant behaviors (see [20] [21] [5] [45] among others).

CL1 (Online chatting) and CL2 (writing and sending personal e-mails) are not associated either with perceived justice, ethics environment, or codes of computer and Internet use, after controlling for demographic variables and agreeableness trait. Respondents could have viewed these two behaviors as the norms and are harmless to the organization. On the other hand, perceived justice is found to be significant in association with CL3 (using office computer for personal work) and CL4 (Surfing the Internet for leisure), after controlling for demographic variables and agreeableness trait. This result supports other studies relevant to employee deviance. Nonetheless, it is also determined that codes of computer and Internet use is only significant in predicting respondents' attitude towards CL4 (surfing for leisure).

Table 4: Results of regression analysis

	B	*p* value	R^2	ΔR^2	*p* value of ΔR^2
CL1: Online chat			0.129	0.037	0.003
(1) Gender	0.084	0.102			
Age	0.252	0.000			
Job position	0.035	0.508			
Organization size	-0.153	0.004			
(2) Agreeableness	0.127	0.015			
(3) Perceived justice	0.042	0.532			
Ethics Environment	0.116	0.094			
Codes of computer and Internet use	0.090	0.106			
CL2: Personal e-mails			0.086	0.025	0.026
(1) Gender	0.043	0.412			
Age	0.181	0.001			
Job position	0.063	0.240			
Organization size	-0.213	0.000			
(2) Agreeableness	0.074	0.166			
(3) Perceived justice	0.051	0.460			
Ethics Environment	0.069	0.331			
Codes of computer and Internet use	0.091	0.112			
CL3: Personal work			0.113	0.063	0.000
(1) Gender	0.082	0.115			
Age	0.218	0.000			
Job position	-0.008	0.875			
Organization size	-0.122	0.023			
(2) Agreeableness	-0.020	0.698			
(3) Perceived justice	0.215	0.002			
Ethics Environment	-0.006	0.929			
Codes of computer and Internet use	0.110	0.052			
CL4: surf for leisure			0.180	0.089	0.000
(1) Gender	0.101	0.042			
Age	0.263	0.000			
Job position	-0.012	0.814			
Organization size	-0.182	0.000			
(2) Agreeableness	0.066	0.190			
(3) Perceived justice	0.162	0.013			
Ethics Environment	-0.076	0.258			
Codes of computer and Internet use	0.272	0.000			

DISCUSSIONS

Cyberloafing could cause various grievances to the organization, including loss of productivity, technological drain and liability risks. Due to the severity of the impact brought forward by cyberloafing, this study is conducted in order to examine the impact of computer and Internet use policy on employees' attitude towards cyberloafing. The findings illustrate the influence of several variables on Malaysian employees' attitude towards cyberloafing behaviors. Four cyberloafing activities are investigated in this study, i.e. online chat with friends while working (CL1), writing and sending personal e-mails (CL2), use office computer for personal work (CL3) and surf the Internet for leisure during office hours (CL4). It could be observed that Malaysian employees have an indifferent attitude towards cyberloafing and seemed uncertain as to the impropriety of such behaviors at work. This result is consistent with the employees' awareness of computer and Internet use policy implemented by their organizations. There is a possibility that the accessibility of the Internet at work and the lack of enforcement have amplified such attitude. It is therefore imperative for companies to provide the necessary guidelines and trainings relevant to the issue. Companies should also clearly communicate their expectations toward employees' online behaviors.

Results have shown the significant influence of age and organization size on attitude towards cyberloafing. The younger employees and those working in larger companies tended to view cyberloafing as more acceptable. Hence, the need for proper monitoring of Internet activities is definitely more crucial of larger companies. Relevant trainings and communications should also be targeted to the younger employees. It is also found that online chatting, and writing and sending personal e-mails during work are not related to perceived justice, ethics environment or even computer and Internet use policy. This implies that the two behaviors could have become the acceptable norms. Eradicating behaviors that have been viewed as the norm could prove to be challenging to all organizations whereby prohibiting such behaviors could cause dissatisfaction and aggravation among employees. Hence, companies that intend to prohibit these behaviors should consider the behavioral and psychological impact of such actions. Instead of banning these activities altogether, perhaps companies could place a limit on such activities to a certain time or platforms. Nevertheless, the actual losses due to these activities need further investigation before firm recommendations could be made.

On the contrary, using office computers for personal work and surfing for leisure could be perceived as a way of restoring justice within the organization when employees felt that they have been unjustly treated. These two activities are significantly associated with perceived justice. Apart from implementing adequate monitoring devices and policies, it is also helpful for companies to maintain organizational justice. Whenever employees perceive their organizations as unjust, they tend to retaliate and become more engaged in deviant behavior. Edgar and Geare [12] have determined that Human Resource Management practices, including working condition, training and development, recruitment and selection, contribute significantly to employees' perception of organizational justice. Although companies should monitor employees' online activities, such monitoring could have detrimental effects when organizational justice is concerned [1] [32]. Monitoring consistency, knowledge of performance from monitoring, control over the time and place of monitoring and justifications for monitoring all predicted as least one of the fairness outcomes [40].

Awareness of computer and Internet usage policies seemed only to influence respondents' attitude towards leisure surfing. Li et al. [27], in their study, found that employee's compliance intention is influenced by several factors including the perceived benefits, formal sanctions, security risks, while perceived sanction's severity is moderated by personal norms. Hence, there are several possibilities that could explain the lack of influence of computer and Internet use policies on employees' attitude toward cyberloafing activities. There is a possibility that the policies implemented by the companies are inadequate and do not clearly specifies the activities that are considered intolerable. Other possible explanations include lack of enforcement and monitoring. Perhaps, companies in Malaysia do not view online chatting and using office e-mail for personal purposes as damaging. This definitely necessitates further investigation where Malaysian companies and employees are concerned. Nonetheless, it is important for companies to communicate their stance on online activities, implement proper monitoring and enforce sanctions. Equally important, companies should educate the employees on the dangers related to online activities and the possible harm that improper Internet use could bring to the company and to the employees themselves.

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FRAMEWORK OF AN AGENT-BASED PROJECT COLLABORATION MANAGEMENT SYSTEM

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ABSTRACT

In this paper, we propose a framework of an agent-based project management system for project coordination, wherein distributed projects can be collaborative dynamically to solve problems by autonomous agents associated with concerned project participants during the project execution stage. In the framework, there are many self-interested agents, each on behalf of one self-interested project participant in a distributed project that can coordinate and cooperate with others under its owner's benefits and preferences to solve project conflicts. Besides, under the framework, a compensatory negotiation process for solving project conflicts is developed, aims to find contracts of conflict adjustments mutually acceptable to self-interested agent's acquaintance respectively while encountering project conflicts over the project execution stage. They demonstrate online coordination and resolution of project conflicts while encountering unexpected events during a distributed project execution stage.

Keyword: Project Management, Project Management Systems, Multiagent Systems

INTRODUCTION

In a highly competitive and changeable environment, a large, distributed project can easily encounter various unforeseen circumstances caused by the influence of various uncertainties at the project execution phase. O'Brien indicates that discrepancies between the needed resources for activities and the resources available to subcontractors are a major cause of project changes (O'Brien, Fischer, & Jucker, 1995). Resource discrepancies will occur when the timing of activities is not well matched with the available resources. If subcontractors do not handle the problem well in time, they may cause delays to the schedule of the project, affecting the schedules and resource allocations of succeeding activities, and even causing the project as a whole to falter or fail.

Another cause of upsets in a distributed project can occur when the traditionally centralized control mechanism of the general contractor ceases to be effective and efficient. In most multi-contract projects, regardless of contract types, 80-90% of tasks commonly are performed by subcontractors, but only 40% of subcontractors are regularly informed by the general contractor when their services will be needed in the project (Hinze & Tracey, 1994).

Although the general contractor conventionally takes the major responsibility of coordinating all project participants, due to subcontractor characteristics of independence, specialization and distribution, many of them do not have contractual relationships with general contractor; accordingly, most subcontractors still have to monitor schedule progress and project difficulties on their own as much as possible (Kim, 2001; Tserng and Lin, 2003). Also, various interface problems can occur at a project execution phase because of the general contractor's lack of specialized expertise, shortage of manpower, and slow responses (Al-Hammad, 2000; Hinze & Tracey, 1994).

Therefore, if participants in a distributed project were offered the assistance of a distributed, intelligent and real-time system approach that could automatically coordinate their activities and resources, while also encouraging intra-project cooperation based on individual benefits and preferences without the intervention of the general contractor at the project execution phase, then some potential difficulties such as resource discrepancies, interface problems, inarticulate communications and delays could be predicted and resolved earlier by the subcontractors involved. Such assistance could be important for the success of a project. Several studies have addressed that multiagent systems (MAS), a branch of distributed artificial intelligence, can be satisfactorily applied to such problems (Archimede & Coudert, 2001; Chun and Wong, 2003; Tserng and Lin, 2003; Yan, Kuphal, & Bode, 2000).

THE MULTIAGENT SYSTEMS

In general, most algorithms for project (re)scheduling problems are very costly to design, time-consuming to design, or too idealistic for practical application in the real world, especially in the case of distributed, large-scale, highly dynamic, and on-line required projects. With the emergence and rapid development of multiagent systems and Internet technology, these problems become solvable and consequently have been the focus of active research in recent years. Tserng and Lin (2003) developed an Electronic Acquisition Model for Project Scheduling called e-AMPS. The model was based on the ontology defined by the eXtensible markup language Schema for Scheduling (XSS), the Data Acquisition Language for Scheduling (DALS), the Hierarchy Searching Algorithm (HAS), and an automatic mechanism called Message Transfer Chain (MTC). In this model, each project participant is equipped with a Message Agent serving as a unique information window to automatically acquire external information and provide other participants with scheduling information. Chun and Wong (2003) introduced a generalized agent-based framework that uses negotiation to achieve a dynamic and optimal scheduling of events. The framework consisted of a user preference model, an evaluation function, and a negotiation protocol called Nstar. Yen (2002) addressed a communication infrastructure to handle connection and communication among distributed Internet scheduling systems for distributed applications. He presented an agent model of distributed scheduling systems where agents can communicate and coordinate activities with each other via an agent communication language. He also defined the syntax and semantics for the agent communication language and a negotiation mechanism. Kim (2001) introduced a framework in which a distributed project can be rescheduled dynamically by all of the concerned project participants. He also presented a formalized negotiation methodology for distributed project scheduling optimization which allows agents to transfer utility to others. The methodology uses compensation of disadvantageous agreements through a multi-linked negotiation process.

Yan et al. (2000) used multiagent systems to support project management in a distributed environment. They presented methods to schedule activities and resolve resource conflicts by message exchanging and negotiation among agents.

As well, multiagent systems are widely applied in popular fields such as electronic commerce (Klaue, Kurbel, & Loutchko, 2001; Lee, Yun, & Jo, 2003; Maes, Guttman, & Moukas, 1999), manufacturing (Sauer, 2003; Wang & H., 2001; Zha, 2002), etc.

The objective of this paper is to suggest a framework of an agent-based project collaboration management system that can handle the problem-solving of a distributed project in real situations. A compensatory negotiation process is also analyzed to reveal decision-making and collaborative functionality among agents. The characteristics exhibited by the framework are as follows.

1. The approach involves the fewest subcontractors to accomplish the problem solving of dynamic scheduling, which can reduce uncertainties to the lowest limit for the problem, accelerate problem solving, provide a fit with practical operating circumstances, and even extend to a complex problem solving.
2. The negotiation process is adequate for distributed participants in a distributed project to deal with imprecise and subjective information, to conduct practical operations and to exhibit normal business behavior as the participants react to the problem solving of dynamic scheduling in real world.
3. The framework maintains a high degree of openness and flexibilities, ensure FIPA standard compliance for future implementation and extension, and improve the performance of the distributed project operation.

THE AGENT-BASED PROJECT MANAGEMENT SYSTEM

Architecture of the system

The architecture of the agent-based project management system for a distributed project we proposed is depicted in Fig. 1. It is an information platform coordinated in real time. The system not only can provide a flexible environment, but also can help all project participants monitor and manage their activities through the assistance of agents. The architecture of the system consists of related logical and physical capability components as shown in the following:

1. Naming agent
2. Directory agent
3. Message transport service
4. Project participant services

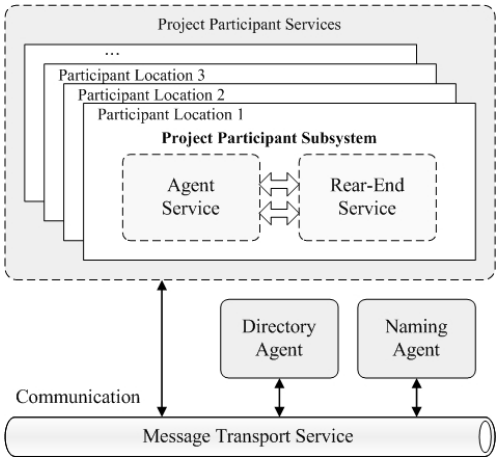

Fig. 1. Architecture of the agent-based project management system

Project participant subsystem

The project participant subsystem is the operating kernel of activity work for each participant in the system. It is deployed and executed on the host situated at the different locations of each participant. The activity work of a participant can be well performed and supervised through the agents and their support of it. These agents also can collaborate with each other or with agents associated with other participants to resolve difficulties posed for each other in the project. The architecture of project participant subsystem is shown in Fig. 2. It comprises two kinds of operating components as follows.

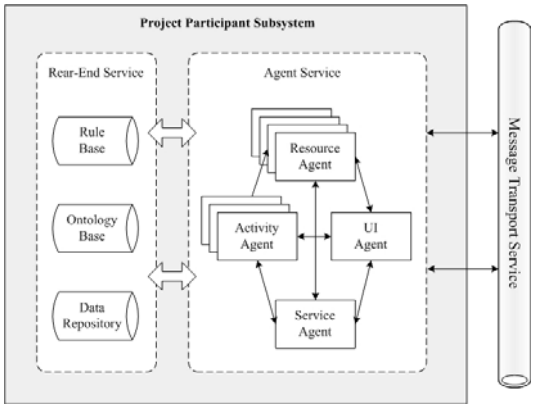

Fig. 2. Architecture of the project participant subsystem

1. Agent Service

The service is provided by several kinds of agents endowed with specialized capabilities to serve on the activity works of the project participant. If any problem occurs during the project execution phase, the agents can communicate and collaborate with others to deal with and resolve the problem. Based on the services that agents offer for the activity works of the participant, four kinds of agents in the subsystem are distinguished as follows.

I. Activity agent
II. Resource agent
III. User interface agent

IV. Service agent

2. Rear-End Service

The rear-end service is used to support all of the agents performing their tasks in the subsystem. These services such as decision making, domain knowledge, data access control, etc., can be offered by the following components deployed in each project participant subsystem.

I. Rule base
II. Ontology base
III. Data repository

In the project participant subsystem, each agent is endowed with a specialized capability and goal to perform its activity work for the project participant. The agents can also cooperate with others to resolve difficulties through the agent communication language. The agent-based project management system, constructed with three project participants, is depicted in Fig. 3 to exhibit the integrated operation of the system.

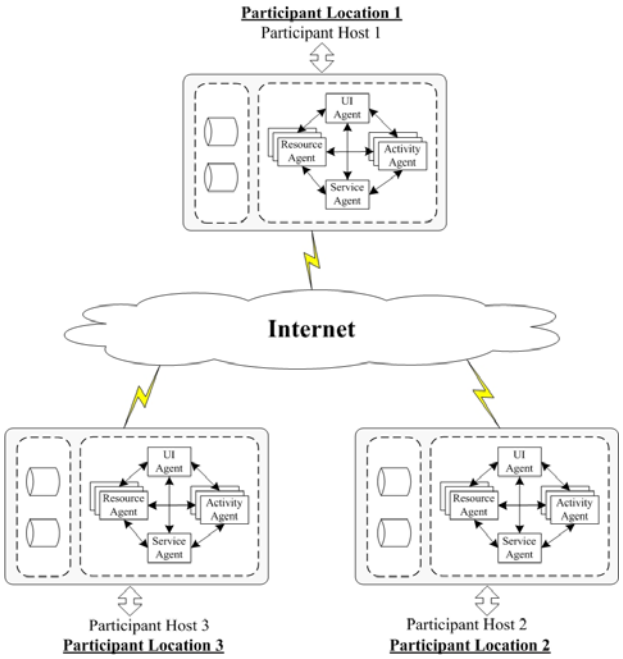

Fig. 3. Integrated operation in the agent-based project management system

THE COMPENSATORY NEGOTIAITON PROCESS

According to the different characteristics with which activity agents behave to the problem-solving of the dynamic scheduling of our framework, we define two activity agent roles as follows. One is the role of the activity agent, who encountering the problem of the delay event during its activity execution phase, is eager to take action to solve the problem. This agent is called the initiating activity agent, abbreviated as the IAA. The other role is that of the IAA's succeeding activity agent whose activity is executed after the IAA's. Its schedule will be affected as a result of any delay decision made by IAA. This agent is called the participating activity agent, abbreviated as the PAA. In later paragraphs, we will for simplicity refer to these two agent roles as IAA and PAA respectively in discussions of

dynamic scheduling in our framework. For example, in Fig. 4, if delay events occur in activity A2 during its activity execution phase, the schedules of activities A4, A5, and A6, which are to be executed following A2, will be affected as a result of any decision on the delay action made by activity agent A2. Therefore, the activity agent A2 is called an IAA, and each of the activity agents A4, A5, and A6 is called a PAA respectively. Also, if another decision on the delay action made by agent A2 will also further affect the schedule of activities A7, then all of the activity agent A4, A5, A6, and A7 are PAAs in this situation. Another case is when the project further executes activity A4, if delay events also occur in A4 at its activity execution phase, and if the schedule of the activity A7 is affected by any A4 delay action decisions, then the agent A4 is called an IAA and the only one agent A7 is called a PAA.

SN	Activity ID	Subcontractor ID	Earliest Start	Earliest Finish	Duration	Slack Time
1	A1	SC-1	2004/3/1	2004/3/5	5	0
2	A2	SC-1-1	2004/3/6	2004/3/17	12	0
3	A3	SC-1-2	2004/3/6	2004/3/13	8	4
4	A4	SC-2	2004/3/18	2004/3/25	8	2
5	A5	SC-2-1	2004/3/18	2004/3/27	10	0
6	A6	SC-1	2004/3/18	2004/3/24	7	3
7	A7	SC-2	2004/3/28	2004/3/31	4	0

Fig. 4. Gantt chart of a project example

In the framework, for practical situation, an activity agent is a self-interested agent behaving as if it were a self-interested project participant. It is or is not willing help to others, depending on how satisfied it is with the benefits and preferences it can get, but it does not dedicate itself to the cooperation. Therefore, if any loss is suffered by the PAA from a decision the IAA is going to take to delay action, the PAA must be paid the satisfactory compensation it expects for agreeing to the rescheduling; otherwise, the delay decision of IAA will not be permitted by the PAA. Acceptable compensation deals among these agents are made through a compensatory negotiation process.

Therefore, if there is any PAA whose schedule will be affected by a delay action resulting from a decision made by an IAA, then the IAA will notice it and open negotiation with all PAAs to ensure compensatory agreements for the delay action. The framework of the compensatory negotiation process for dynamic scheduling is depicted in Fig. 5. It consists of several main components as follows.

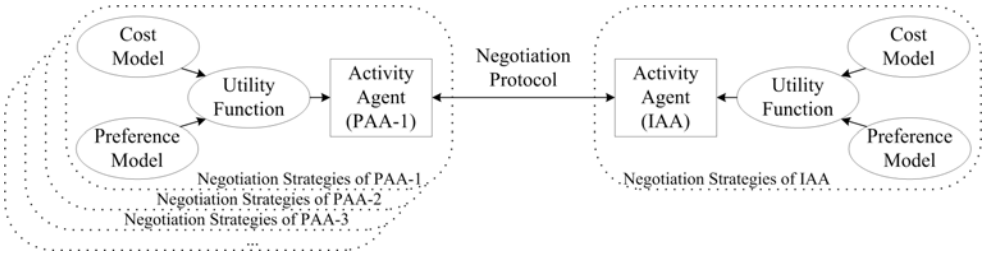

Fig. 5. Framework of the compensatory negotiation process

1. Cost model

Each activity agent has its cost model. It is comprised of running costs associated with its activity and is used to calculate the costs of alternatives among actions, proposals, and expenditures for the purposes of reaching negotiation decisions.

2. Preference model

The preference model encapsulates preferences, priorities, constraints and rules related to the activity. Each activity agent employs an individual preference model. It consists of preference levels and preference degrees, allowing the agent to react to its participant's best behavior in negotiation.

3. Utility function

The utility function is made up of the cost model and the preference model. Each activity agent has its utility function to evaluate proposals and counter proposals which influence the compensation and negotiation agreement.

4. Activity agents

IAAs and PAAs are two major agents in the negotiation process. The IAA is the initiator who needs to negotiate with the PAA for problem solving. The IAA also plays the key role in the coordination of the whole negotiation process. More than one PAA can be involved in the negotiation process, representing participants whose activities are affected by the delay action of the IAA.

5. Negotiation strategies

The negotiation strategies of an agent specify which negotiation action will be taken in various negotiation situations. In the negotiation process, each agent is equipped with individual negotiation strategies. The negotiation strategies of the IAA consist of a concession strategy, a total-negotiation-times strategy, an expected proposal model, a proposal distribution model, and a negotiation decision model; the negotiation strategies of the PAA consist of a concession strategy, an expected counter proposal model, and a negotiation decision model.

6. Negotiation protocol

The negotiation protocol contains a set of interactive actions defined in the bidding and awarding mechanism. It allows agents to interact and communicate with each other during the negotiation process.

An elaborated flow chart of detailed interactions and events between IAA and PAA in the compensatory negotiation process is depicted in Fig. 6.

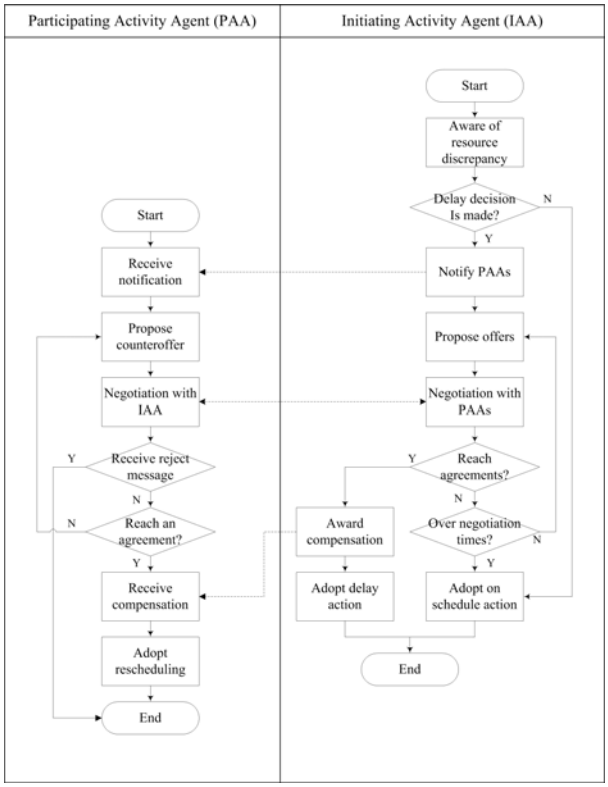

Fig. 6. Interactions and events of the compensatory negotiation process

CONCLUSION AND FUTURE WORKS

In this paper, we addressed the framework of an agent-based project collaboration management system and a compensatory negotiation process which can be applied to solve project difficulties in real situations. Uncertainties can be monitored immediately through the operation of the system, and dynamic scheduling can be performed as fast as possible by the way of the compensatory negotiation process. In a dynamic scheduling problem solving, self-interested activity agents are the major players endowed with specialized capabilities and goals that work for their project participants. If any delay event occurs in an activity, the activity agent can automatically cooperate with others in real time to solve the problem in a manner consistent with the subcontractor's subjective preferences, costs, benefits, strategies, etc.

Many features characterize our framework. To begin with, in real situations there may be too many uncertainties involved in schedule change decisions made by distributed project participants during their activities' execution phase. The compensatory negotiation process is adequate for distributed participants to deal with imprecise and subjective information, to conduct practical operations and to exhibit normal business behavior as the participants react to the problem solving of dynamic scheduling in real world. Besides, a full-scale optimum rescheduling involving too many subcontractors can hardly be performed in real world at the project execution phase, that most of optimization methods exhibits to the problem solving of dynamic scheduling. Our approach involves the fewest subcontractors to accomplish the problem solving; only those subcontractors, who encountering delay

problem during its activity's execution phase and whose activity will be affected as a result of the delay decision made by the problematic subcontractor. These considerations can reduce uncertainties to the lowest limit for the problem, accelerate the problem solving, provide a fit with practical operating circumstances, and even extend to a complex problem solving. Moreover, the framework can maintain a high degree of openness and flexibilities, ensure FIPA standard compliance for future implementation and extension, and improve the performance of the distributed project operation.

Regarding the high complexity of the domain application, this paper only focuses on addressing the framework of the agent-based project collaboration management system with the compensatory negotiation process for dynamic scheduling. Certain directions must be taken to develop more constructive models for the future, as follows.

1. To complete the system based on the framework, deep technologies have to be exhibited for the operations of various kinds of agents and the implementation of the distributed system, in order to validate that the modules can coherently work together in practice. The detailed infrastructure has to be discussed and built up, and by that we include ontology methods, communication infrastructure, external and internal information flow, operating instructions and rules, etc.
2. In the compensatory negotiation process, various kinds of utility functions, tactics and strategies possessed by agents will experience different consequences of negotiations, resulting in different outcomes of dynamic scheduling. The elaborate formulations of the models, such as cost model, preference model, utility functions, concession strategies, expected proposal/counterproposal models, negotiation decision models, etc., need to be discussed, and the results should be compared to verify the performance.

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A NEW GENERIC FRAMEWORK FOR WEB-ENABLED E-LEARNING APPLICATIONS

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ABSTRACT

Quite often, students complain about the complexity of engineering concepts and express difficulty in learning. For effective knowledge transfer, universities use different methods such as conventional classroom teaching, laboratory training, special tutoring and problem-based-learning or self learning etc. There are several existing E-learning applications, some of them are web-enabled and some are not. Generally such environments are developed for a specific concept or a course, which means, there is a need of deploying different applications for different courses. For each environment, there will be at least a minimum orientation time that needs to be spent by the students as well as by teacher in administration process. In other words, there is no generic framework or similarities in well known web-enabled e-learning environments.

This paper identifies several issues such as knowledge retention, user engagement; and problems associated with lack of standardized administrative approach for e-learning applications. Then a generic framework which potentially addresses all the identified issues and problems is suggested. This framework defines policy for knowledge creation, dissemination, assessment in terms of 'public', 'standard', 'private' and organizes the overall knowledge in systematic, individual components. Further, this framework encompasses a novel methodology for user management, assessment and overall administration. This framework, with its mandated features can be easily applied in developing any e-learning application.

According to this framework the entire learning activities in any area of teaching can be divided into certain standard parts and levels of teaching, learning and assessment. The learning and assessment is done from the beginning to the end in pre-defined stages. Learners will have the options to keep their activities private to themselves and get their questions or doubts cleared by keeping the information in public. This approach will be suitable for lengthy, complex engineering concepts.

The full paper has the details the proposed generic framework and its application to two areas of complex engineering concepts.

Keywords: Generic Learning Framework, E-learning, Innovation, Web enabled Environment

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FACTORS FOR WEAPON SELECTION: THE CASE OF ARMY ASSAULT RIFLES

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ABSTRACT

This research aims to improve the existing weapon selection decision in the Royal Thai Army by providing Analytic Hierarchy Process as the alternative model. The scope of the research is for combat troops, especially infantry and cavalry soldiers. The problem hierarchy is divided into two main sub hierarchies, namely benefit and cost hierarchies. Three alternative assault rifles are considered: M16A4, HK33, and TAR21. Taking part in the research are 38 officers from five expert groups. The judgmental results show that all five groups concur that the topmost benefit criterion is efficiency, followed by flexibility and reliability, The most important cost criteria are found to be investment cost, service cost, supplies cost, and training cost, in that order. However, the five expert groups differ in their judgments of the cost criteria. Executive officers group and logistics officers group believe that service criterion is the most important in the cost hierarchy. Combat officers group, maintenance officers group, and operation and planning officers attach the highest importance to investment cost criterion. The least important criterion for executive officers group and combat officers group is training cost criterion. For logistics officers group, maintenance officers group, and operation and planning officer group, supplies criterion is the least important criterion in the cost hierarchy. The combined judgment of the expert officers favors M16A4, over HK33 and TAR21, although the details differ among the groups. Lessons learned from the research are that AHP should be used when the judgments are given face-to-face in order to save time and cost for the interview. The structure of the decision model may be adopted for general use of the Royal Thai Army, but the recommendations given in the present study are specific to the group of intended troops. To expand the scope of the research to other uses, such as special force or parachute troops, other sets of judgments are needed and the conclusions may differ from the present study.

Keywords: Analytic Hierarchy Process (AHP), Multiple-Criteria Decision Making, Weapon Selection, Assault Rifles, Royal Thai Army, combat troops.

INTRODUCTION

Royal Thai Army (RTA) is the main land force in Thailand. The army has its responsibility to provide land defense and internal security. In order to accomplish missions, weapons are main tools for soldiers in the operations. Royal Thai Army started the current Army Weapon and System Development Program in 2002. The whole plan costs over a trillion baht (the current rate of exchange is 34 baht to US$1). There are several projects that provided for new

weapons and tools for the army including rifles, tanks, anti-aircraft missiles, and artilleries.

One major part of the plan is Rifle Replacement Project. The overall budget of this plan is approximately 5 billion baht. The key to Rifle Replacement Project is to replace the existing rifles in RTA with new rifles currently available in the market. In the first phase, RTA ordered 8,000 M16A4 rifles. After that, another lot of 15,000 TAVOR21 was ordered in the second phase. The detail of weapon selection decision has not been made clear. For one thing, the purchasing committee had only a short time to work on selection process. The third and fourth phases of the project would eventually need to be made. However, RTA is unsure whether to continue with both types of rifles. Clearly, RTA needs a good standard tool to guide them in their selection.

Table 1 Royal Thai Army Assault Rifles Replacement Project 2002-2014

	Phase 1	Phase 2	Phase 3	Phase 4
Period	2002-2004	2005-2007	2008-2011	2012-2014
Model	M16A4	TAVOR	To Be Decided	To be Decided
Units Purchased	8,000	15,000	30,350	32,400
Budget (Baht)	400,000,000	960,000,000	2,000,000,000	2,135,000,000

In this research, the existing procedures for weapon selection are examined. The factors involved in weapon selection are identified based on the demand of the rifle users. The goal is to provide the rifles that are effective in performance for the satisfaction of users.

METHODOLOGY

Rifles Requirements

In 2006, Royal Thai Army Policy conference was set to assign policy for selection new weapons for the Weapon Replacement Project. The Chief of Army also provided the concept for assault rifle selection. The Chief of Army's policy is considered as the highest policy that Thai army staff and officers must follow. The policy is described as follows:

1. Rifle must be personal weapon for soldier. It must be light weight, compact carrier, and durability. The rifle should also be compatible with 5.56x45 mm (NATO).
2. The rifle must be able to assault or obstruct enemies' operation by its own sight length.
3. The rifle must be able to fire in both automatic and semi-automatic function. It also has to swap between two modes quickly.
4. The rifle must be able to enhance other accessories and durable for use.
5. Bayonet, carrier sling, and magazine must be standard included items
6. The rifle must be able to be used in all terrain and conditions.
7. The rifle must be easy for maintenance in user level.

In fact, the policy was effective after the end of the conference. As a result, the Chief of Army policy was used as the main requirement for rifle selection.

Wongworrachart (2008) pointed out that existing rifles in Royal Thai Army are not suitable for Thai Army. There are two major problems regarding size and weight. Thai soldiers are relatively small in size. Many assault rifles in the world market are designed for large-size

users. Wongworrachart (2008) went on to survey the level of satisfaction in the existing rifles that have been serviced in Royal Thai Army. He also advised that a rifle good for Thai Army must satisfy the following requirements:

- Ability to fire in wet condition
- Ability to fire when rifle contacted dirt mud
- Ability to fire in desert
- Type of butt stock
- Good sight and scope
- Easy to adjust gunsight
- Easy for maintenance
- Hand guard should be easy to grasp
- Light impact to shooter when rifle is firing
- Size of rifle should be shorter

All the above requirements are derived from Chulachomklao Royal Military Academy cadets. The cadet training process is equivalent to infantry training in terms of tactics and operations. Therefore, the requirements from CRMA cadets can be used a part of infantry unit's requirement.

Turkish naval also studied how to make decisions with multi-criteria problems. At present, vessels have been designed increasingly modularly. Amphibious vessels also follow this trend (Albayrakoglu, 2006). A major amphibious ship consists of the following resources to perform its assigned tasks: flight deck, ski jump, well deck, vehicle or cargo deck, hangar deck, hospital, command and control facilities, and, supply and support facilities. Each of them can be thought as a module. The relative importance of each of these modules can be used to determine the architectural configuration and the type of the ship The relative importance of each module depends on the assets required for a set of tasks carried out under a set of scenarios ranging from disaster relief during peace time to participation in full-scale amphibious warfare. A multi-criteria decision-making (MCDM) model using AHP is proposed to help determine the configuration of a major amphibious vessel under a set of scenarios, associated tasks and asset requirements.

Supply for Assault Rifles

Supply concept is described as supply circle in the Royal Thai Army and contains six main processes namely requirement, procurement, distribution, maintenance, expiration, and covered by control (Directorate of Logistics, 2000). Any items which are serviced in the army must consider the supply circulation as a matter of priority.

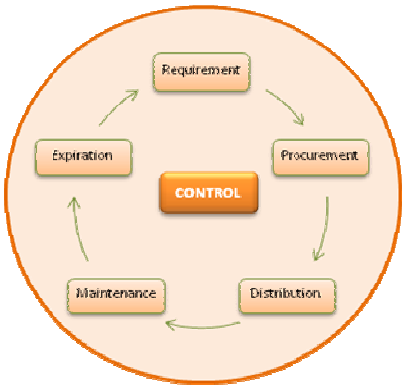

Figure 1 Supply circle of processes in Royal Thai Army

Combat Service Support (CSS) in FM 4-00 (Department of the Army, 2003) is the essential capabilities, functions, activities, and tasks necessary to sustain all elements of operating forces in theater at all levels of war. There are eight characteristics critical to the Army. These characteristics are guides to analytical thinking and prudent planning.

1) Responsiveness

Responsiveness is providing the right support in the right place at the right time. It includes the ability to foresee operational requirements. Responsiveness involves identifying, accumulating, and maintaining the minimum assets, capabilities, and information necessary to meet support requirements.

2) Simplicity

Simplicity means avoiding unnecessary complexity in conducting such as planning, preparing, executing and assessing

3) Flexibility

Flexibility is the ability to adapt CSS structures and procedures to changing situations, missions, and concepts of operations. CSS plans, operations, and organizations must be flexible enough to achieve both responsiveness and economy.

4) Attainability

Attainability is generating the minimum essential supplies and services necessary to begin operations.

5) Sustainability

Sustainability is the ability to maintain continuous support during all phases of campaigns and major operations. One of the characteristics of land combat is durability.

6) Survivability

Survivability is the ability to protect support functions from destruction or degradation. CSS survivability is a function of force protection, which consists of those actions to prevent or mitigate hostile actions against personnel, resources, facilities, and critical information. Integrating

7) Economy

Economy means providing the most efficient support to accomplish the mission. Resources are always limited. The commander achieves economy by prioritizing and allocating resources. Economy reflects the reality of resource shortfalls, while recognizing the inevitable friction and uncertainty of military operations.

8) Integration

Integration consists of synchronizing CSS operations with all aspects of Army, joint, interagency, and multinational operations. First, it involves total integration of Army CSS with the operations process. Support of the commander's plan is the goal of all CSS efforts.

Defense procurement is inherently complex (Manohara, 2000). In Singapore weapon procurement, the MINDEF encourage competition to secure the best package the market can offer. Contractors should try to understand customers' needs and expectations. They seek technology and capability to assure future support. They also expect the contractor to commit to long-term support on spares and service, including prices, through blanket ordering agreements. For major programs, tender proposals are subject to rigorous evaluation using the AHP. Technical, schedule, financial, and commercial aspects of each proposal are assessed in a two-envelope system to ensure that the most cost-effective system is selected.

Keeney and Raiffa (1976) have suggested how to construct effective criteria with five necessary approaches

- Completeness: If the hierarchy is complete, all the attributes which are of concern to the decision maker will have been included.
- Operationality: All the lowest-level attributes in the three are specific enough for the decision maker to evaluate and compare them for the different options.
- Decomposability: The performance of an option on one attribute can be judged independently of its performance on other attributes.
- Absence of redundancy: If two attributes duplicate each other because they actually represent the same thing then one of these attributes is clearly redundant.
- Minimize size: If hierarchy is too large any meaningful analysis may be impossible.

Criteria Construction

A decision process based on an analytic model can present a better chance to decision makers for better weapon decisions (Chang, 2005). Chang's research is intended to be used by the South Korean Navy when there is a need to select one weapon type among several candidate types. Chang (2005) compared three different weighting methods, namely Utility theory, Delphi technique, and AHP and recommended that AHP should be used since it has fewer cognitive burdens than the other two methods.

Tragdis (2008) suggests that the AHP is suitable for a wide variety of applications in economics, finance, politics, games and sports, conflict resolution, cost/benefit analyses, resource allocation, source selection, and resolution of everyday problems. Tragdis (2008) studied the potential use of the AHP for combat aircraft source selection by the Hellenic Air Force, analyzing legislative, acquisition and technical issues relating to this procurement. It concludes that AHP is a suitable decision making tool for defense acquisitions and recommends that the Hellenic Air Force evaluates its potential usefulness via a series of pilot acquisition programs.

AHP is used in the present research to study the important criteria for weapon selection in Royal Thai Army. The weapon selection process in RTA is complex and decisions difficult to be made. Thus, the problem is divided into two separate hierarchies namely benefit hierarchy and cost hierarchy.

Benefit hierarchy involves the plus-side criteria or the advantages: the more the better. Main criteria in benefit hierarchy are efficiency, flexibility, and reliability. Efficiency has firing criterion and carrying and movement criterion as its sub-criteria. Combat Terrain and Units Deployment are sub-criteria of flexibility criterion.

Cost hierarchy is the hierarchy that covers price, value, and budget to purchase weapons. Cost is not only considered to the purchasing cost but additional items and modules, maintenance and service cost, training cost are also considered. Weapon cost is considered in both short and long terms of theirs service. The hierarchy has as its main criteria investment cost, supplies, service, and training. Supplies criterion has sub criteria as enhanced modules and ammunition. Service criterion has as its sub-criteria warranty and maintenance. User training and mechanic training are considered as training's sub-criteria.

Participants for interview

Establishing the weight of importance for the criteria is the process after the problem hierarchy was constructed. Benefit and cost items were organized into the questionnaire format for interview. The questionnaire translated from the problem hierarchy was used to interview expert officers in Royal Thai Army. To score the questionnaire, the pairwise comparison technique was used. For each of the items in the questionnaire, the interviewees were asked to compare the relative importance between two criteria and weight assigned for the compared criteria. Data were collected from the expert officers by interviewing with the questionnaire. For the interview, the expert officers were selected from those who have experience and professional in many fields such as weapons practice, planning in combat missions and operations, technicality and engineering in weapons, weapon supply and transportation. The total number of questionnaire respondents is 38.

Table 2 Criteria Definition

LEVEL	Criteria	Definition
Level 1	Goal	Assault rifles selection
Level 2	Benefit	Benefit is focused on how good rifles will provide to RTA troops when use rifles in any operations.
	Cost	Cost is focused on how many RTA must pay for rifles in many reasons. Lower cost will get higher priorities.
Level 3	Benefit Sub-criteria	
	Efficiency	Rifles performance when the rifles are used in combat operations. This subject covered on how good the rifle can be fired and carried with their owner. The main considering subjects are efficiency for firing and carrying and movement.
	Flexibility	Considering how rifle can be used in variable environments and terrains. This criterion also considers how compatible of rifles when they are deployed with different kinds of army units.
	Reliability	The criterion is focused on how rifle is able to be trusted or to provide a correct result by soldiers when they used rifle in their operation.
Level 3	Cost Sub-criteria	
	Investment Cost	Initial cost of rifles. This is the main cost of rifles. Investment cost must be included rifles cost, shipping cost, security and insurance for transportation
	Supplied	Cost for additional/optional modules that will be enhanced to rifles. Ammunition that is fired from rifles is also considered as supplies cost.
	Service	Considering in warranty period, scope of product covered, and maintenance cost of rifles.
	Training	Overall cost for training. User and mechanics course are considering for training cost.
Level 4	Efficiency Sub-criteria	
	Firing	Rifles performance when the rifles are used in combat operations. Efficiency covered on how good the rifle can be fired and carried with their owner. The main considering subjects are efficiency for firing and carrying and movement.
	Carrying and Movement	Performance of rifles on carrying and movement by soldier. The rifle could be easy to carry, lightweight, quickly to move and fire, and agility.
Level 4	Flexibility Sub-criteria	
	Combat terrain	Considering how rifle can be uses in variable environments and terrains. Rifle could be used in hard condition such as dust environment, moist condition and, desert terrain with low struggle on firing.
	Units Deployment	The topic is focused on how flexibility of rifles when they are deployed in various types of army units such as cavalry units, special forces, and infantry units.
Level 4	Supplies Sub-criteria	
	Enhanced Modules	Optional Modules that are enhanced for more performance are considered as cost. The additional modules for the rifle such as optical sight, bayonet, and 40mm grenade launcher.
	Ammunition	Ammunition that is used for firing during combat training and operation missions. The cost also include any types of ammunition which are fired from enhance modules of the rifles.
Level 4	Service Sub-criteria	
	Warranty	Cost for products and supply service warranty. Long period of warranty can reduce for overall RTA maintenance cost.
	Maintenance	Preventive maintenance and repairing cost for the rifles. Spare parts cost is considered into this subject. Some rifle manufacturers provide good information and manual that can help for good maintenance.
Level 4	Training Sub-criteria	
	Users	User training cost for beginning user. Basic maintenance or preventive maintenance training is also included in the subject. The training focus in how to use rifles for firing, and how to lubricate and protect rifles for long life.
	Mechanics	Mechanics training cost for maintenance officers and instructors. RTA needs technology transferring for new rifles with high technology

DATA ANALYSIS

Hierarchy Analysis

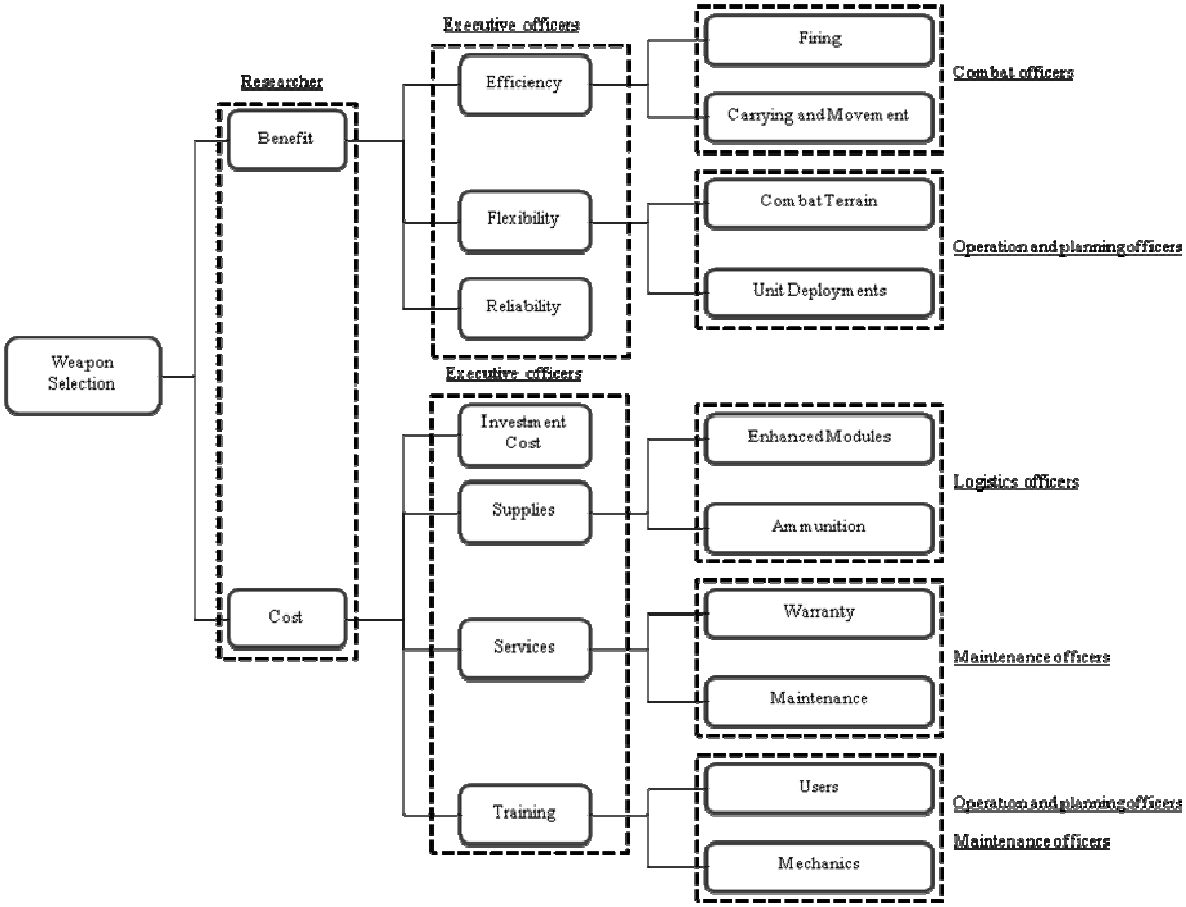

Figure 2 Weapon selection hierarchies with separate analytical groups

All of the interviewees are in Royal Thai Army. Because there are many professional officers who have experience in multiple fields related to the problem, the expert officers are divided into five groups namely executive officers groups, combat officers, logistics officers, maintenance officers, and operation planning officers. The number of persons in each group is not equal. Interview period depended on the available time of the expert officers. Some officers were too busy to be interviewed. However, they are from many departments related to the weapon selection process. In the executive group, there are 6 officers to collaborate, 10 for combat officers, 8 for logistics officers group, 7 for maintenance officers group, and 7 for operation and planning officers.

Criterion Results

To explain the result in a simple way, the research assumes the total score for weapon selection is 1000 points. The result scores in benefit hierarchy are sorted in sequence as following; efficiency (305), flexibility (159) and reliability (36). The scores in cost hierarchy are sorts as investment cost (160.5), service (179), supplies (95), and training (65.5).

Table 3 Benefit criteria priorities with scores

Benefit Criteria	Priorities	Scores	
Efficiency	0.610	305	Points
Flexibility	0.318	159	Points
Reliability	0.072	36	Points
Total		500	Points

Table 4 Cost criteria priorities with scores

Cost Criteria	Priorities	Scores	
Investment Cost	0.321	160.5	Points
Service	0.358	179	Points
Supplies	0.190	95	Points
Training	0.131	65.5	Points
Total	1	500	

Five expert officers groups compared the priorities for benefit hierarchy. All groups think in similar way to weight priorities. They considered that efficiency is the most important criterion in the hierarchy. Flexibility is the second important criterion. Finally, the lowest important criterion is reliability.

Cost hierarchy has different considerations from five expert officers groups. Executive officers group and logistics officers group think that service criterion is the most important of the hierarchy. Combat officers group, maintenance officers group, and operation and planning officers thank that investment cost criterion is the most important of the hierarchy. The least important criterion for executive officers group and combat officers group are training criterion. For logistics officers group, maintenance officers group, and operation and planning officer group opinions, supplies criterion is the lowest important criterion in the hierarchy.

Alternatives Results

Three alternatives are considered, namely M16A4, HK33, and T.A.R.21. The reason to assign these three alternatives is because the alternatives are the current serviced weapons in Royal Thai Army. They have many advantages and disadvantages regarding their properties. These alternatives will be easy for the expert officers to make decision on the model criteria. The scores in benefit hierarchy are sorted in sequence as follows: M16A4 (285.5), T.A.R. 21 (164), and HK33 (50.5). The scores in cost hierarchy are sorted as HK33 (304), M16A4 (143) and T.A.R. 21 (53). As a result, the total score for M16A4 is 428.5. HK33 is 354.5. Finally, TAR21 is 217.

Table 5 Alternatives total scores

Alternatives	Scores	
M16A4	428.5	points
HK33	354.5	points
TAR21	217	points
TOTAL	1000	

The alternatives priorities are not the same for all groups. Executive officers group, combat officers group, and operation and planning officers group considered that M16A4 has the best efficiency, flexibility and reliable rifle for the military. The second rifle is T.A.R.21. The last is HK33. While logistic officers group and maintenance officers group think that TAR21 provide the best benefit for the military, M16A4 is the second choice, and the lowest ranked rifle in terms of benefit is HK33.

For considering the alternatives in cost hierarchy, all groups are considered in similar way to weight priorities. They think that HK33 help the military to spend the cheapest cost in the hierarchy. M16A4 is the second choice to save the military budget. Finally, the most expensive rifle is T.A.R21.

Sensitivity Analysis

The two main hierarchies are separated to analyze the sensitivity analysis. As in Figure 3, M16A4 has the highest priorities from the candidate alternatives. When Efficiency, Flexibility, and Reliability were changed, the benefit ranking did not change for all priorities.

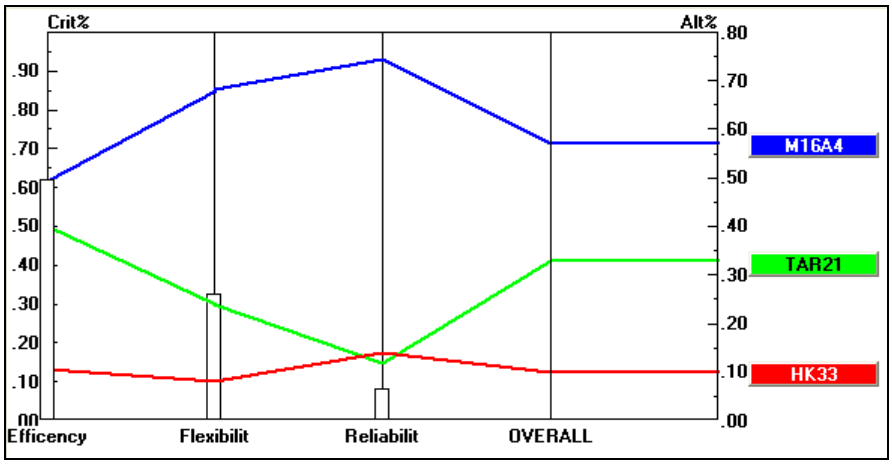

Figure 3 Sensitivity Analysis in Benefit Hierarchy

Considering in the cost hierarchy, the sensitivity analysis is shown in Figure 4. HK33 has the highest priorities from the candidate alternatives. When Investment cost, Supplies, Service and Training were changed, the cost ranking did not change for all priorities.

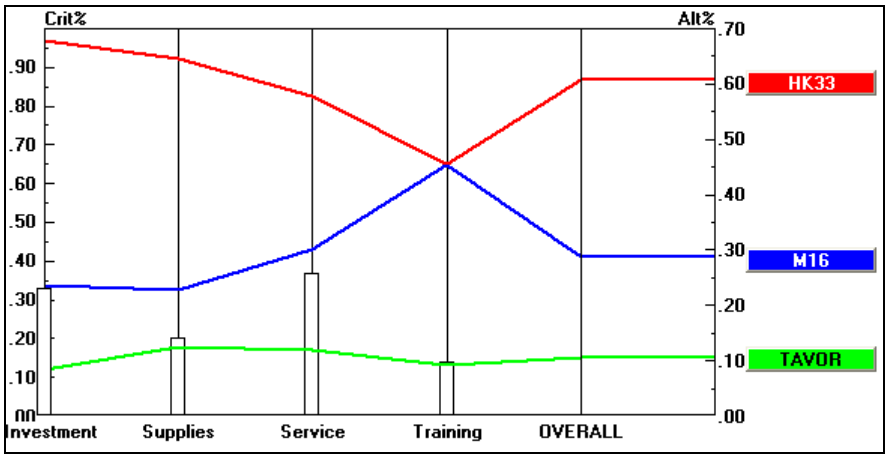

Figure 4 Sensitivity Analysis in Cost Hierarchy

DISCUSSION AND CONCLUSION

The results of the research show that aspects of the expert officers are different in some criteria. Most of the expert officers agreed that efficiency is the most important criterion in benefit hierarchy.

In cost hierarchy, service got the highest priorities. Investment cost got the second priority in the criteria. However, the weight of the first priority differs from the weight of the second priority only little number. In the criteria priorities of each group shown that only some groups selected investment cost as the most important criterion. Some groups considered that service is the most important criterion. In this case, they have a different judgment. The groups that selected service as the most important criterion may think that rifles have to use for a long time in the Army. Service will be high cost for the future. Then, they have to select a rifle with lower service cost. The groups who decided investment cost is the most important may think that if we can save cost to purchase rifle, we can have money to buy anything else.

Comparison with past decisions

In the study, it shown that the past RTA rifles selection scores does not cover for all requirement criteria in the present. Then, RTA should consider that they would change the system or criteria of selection weapons in their future. The criterion priorities of the research can be used as a model for executive officers to make a decision on weapon selection project. The model can adjust to correspond with executive officers' attitudes.

The results of the research which are the aspects from the expert officer are not similar to RTA rifles selection scores. It will occur for some obstruction to rifles competition. Some criteria which are not clear will block candidate rifles for some reason. The problem can make some candidates leaving the rifles competition. In final result, RTA will not get the required rifles for their service.

The result from the research can be compared with the weapon selection process which the committees assigned criteria for candidates to be rated scores. In 2006, the committee used this model for selecting a new rifle to serve RTA. At that time, T.A.R.21 has the highest score among other candidate rifles.

In Table 6, two different models for weapon selection are compared. Some criteria in RTA selection process are different from the research results. RTA selection criteria normally did not separate the problem into two hierarchies as in the research. They combine the entire criterion into one total score which is 200 points. Then, a match is attempted between two different criteria. Some criteria of RTA do not have scores so that it is difficult to find contradiction between candidates.

Both the research results and RTA selection criteria emphasize the same that efficiency or tactical performance is the most important criterion for decision. However, RTA selection criteria do not consider that reliability or popularity is an important criterion.

Most of the expert officers think that investment cost or budget is very significant criterion for cost criteria while there is no score in RTA selection criteria. RTA focused on supply and maintenance criterion for selection weapons. However, cost criteria have total score lower than benefit criteria in RTA selection criterion.

Table 6 Comparing tables of criterion between the research result and RTA selection criteria

Research criteria and scores

Benefit Criteria	Priorities	Scores
Efficiency	0.571	285.5
Flexibility	0.101	50.5
Reliability	0.328	164
Total	1	500

Cost Criteria	Priorities	Scores
Investment Cost	0.321	160.5
Service	0.358	179
Supplies	0.190	95
Training	0.131	65.5
Total	1	500

RTA selection criteria and scores

Benefit Criteria	Score	New score
Tactical Performance	100	666.6667
Technical Specification	50	333.3333
Popularity	0	0
Total	150	1,000

Cost Criteria	Score	New Score
Budget	0	0
Supply and Maintenance	50	1,000
Total	50	1,000

The purposes of the study were to analyze and construct a model for weapon selection in Royal Thai Army. AHP is used as the main instrument for finding the criteria weights. In this study, the researcher found that building a model with multi-criteria problem by using AHP is satisfyingly and reliably. The inconsistency of pairwise judgments can be checked by finding inconsistency ratio (I.R.). The maximum allowable I.R. is .10.

However, there are disadvantages in using AHP technique for the decision making. Generally, it takes a long time period for an interviewee to answer the questionnaires and to

compare criteria for each pair. In this research, it took about 45-60 minutes for one interview. As a result, there are few officers who want to participate in the interviews. Moreover, it takes a long period for the interviewer to explain the questionnaire and take a long time for interviewees to understand the goal of the research.

Using AHP to solve a problem, it should be a group of expert people which have a meeting in the same time. The meeting will have a time to describe the problem in detail and explain about AHP process. The time will be short. It also can help the expert people understand better.

The advantage of AHP is that judgments are made more carefully. Pairwise comparisons can make decisions more systematic. AHP judgment can score and check for any error in judgment by using I.R. value.

Recommendations

The main purpose of the research is to provide a model that can help executive officers easy to decision making on weapon selection problem. Another purpose is to improve the current weapon selection model. Research directions for future studies are recommended as follows:

First, this research is a model to select rifles for combat troops especially infantry and cavalry soldiers. Then, other combat troops such as special force, parachute troops may have different requirement. However, for the future study, they can use this model and add more criteria which are suitable for the requirement.

Second, Rifle technology and design will be changed in the future. This model may not be suitable for the future weapons. Then, the next research needs to study more about new rifles. As a result, the new model will be corresponding to the aspect of executive officers.

Third, Analytic Hierarchy Process should be used when judgments are made together face-to-face. It will save both time and cost for interviews. Confusion will be reduced. AHP interview takes a long time to explain in detail and make the judgments. The researcher has to make them understand what the researcher wants.

Fourth, hierarchy in the problem should not have many criteria. It can make judgment to be confused. More complexity in the hierarchy, more error the researcher will get from interviews. The I.R. will be increase if the questionnaires have many criteria in the same root.

Fifth, some problems have many criteria in the same level. Judgments for many criteria over then two criteria can get error in I.R. rate easily. The better way is to construct the problem hierarchy in Expert Choice program on notebook. In the interview meeting, using the notebook and filling the score in front of the judgments will help the judgment to avoid any errors.

Sixth, the structures of the judgments are different. Each person has his own decision and opinion. This problem can occur with different summary results. Then, it is better to collect data with more expert officers to be close to the reality.

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A STUDY OF THE EFFECTS OF GREEN SUPPLY CHAIN PRACTICES ON ENVIRONMENTAL MANAGEMENT PERFORMANCE- A MODERATOR OF TOTAL QUALITY ENVIRONMENTAL MANAGEMENT

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ABSTRACT

In response to the increasing worldwide awareness of the importance of business sustainability, there have been more and more environmental regulations enforced in the last decade (e.g., WEEE, RoHs). Those regulations have a tremendous impact on global supply chain systems and have begun to force companies to implement Green Supply Chain Management (GSCM). Firms must collaborate with their supply chain partners to improve their operations on green purchasing, manufacturing, packaging and reverse logistics.

This study examines the moderating effects of Total Quality Environmental Management (TQEM) on GSCM and EP. The research premise is that total organizational effort from top management and employees support and facilitate the implementation of GSCM, which ultimately enhance EP. The statistical analysis includes two stages. In the first stage, a factor analysis with varimax rotation is performed to capture the dimensions of GSCM and EP. The second statistical technique used Hierarchical regressions analysis, which tests the moderated effects of TQEM on GSCM and EP.

Empirical results show that manufacturers, through the interactions of GSCM and TQEM, receive significant effects on EP. Specifically, firms which implement GSCM practices and simultaneously adopt TQEM can produce at a higher level of EP. For a successful GSCM program, firms must adopt TQEM as an imperative strategy to ensure top management support, establish a close partnership with suppliers, and enhance employees training. Consequently, this finding would provide academics and practitioners who are interested in this subject for further investigation in the other industries or reference in the near future.

Key words: green supply chain management (GSCM), environmental performance (EP), total quality environmental management (TQEM)

INTRODUCTION

In the 21st century, environmental issues have emerged as a primary concern for enterprises sustainability. Technology has been rapidly changed in industries, product life cycles have shortened, and large increases in waste have forced them to strengthen and improve environmental policies. Developing countries, especially, have paid more attentions on environmental issues (Zhu et al., 2005). In February 2003, the European Union approved legislation such as the "Waste Electrical and Electronic Equipment (WEEE)" and the "Restriction of Hazardous Substances (RoHs)" in order to reduce toxicity in manufacturing as well as disposal waste and hazardous substances. Because of WEEE and RoHs, upstream and downstream supply chain manufacturers facing regulations and competitive pressures have become strategic allies to increase environmental management systems for green management practices (European Union, 2005). In particular, after the United States and Germany have already constructed and instituted waste management policies and recycling systems which have brought significant attention to multinational corporations and original equipment manufacturing (OEM) enterprises become more concerned with how to balance economic and Environmental Performance (EP) issues (Shultz and Holbrook, 1999). And the theme of EP has become one of the primary competitive advantages in multinational corporations (Theyel, 2001).

Recently, the consequences of industrial pollution have become more critical. Environmental problems occur at all stages of a product life cycle. Recent studies show that green products and services have spread to Asia such as Japan, China, and Korea (Boysere and Beard, 2006). In order to survive and strengthen their corporate image, manufacturers must produce green products to meet their customer's requirements, which include green purchasing, green manufacturing, green packaging and reverse logistics within Green Supplier Chain Management (GSCM) system. In turn, such efforts will help the firms enhance corporate innovation and create competitive advantages for the long-term sustainability (Murphy et al., 1995; Sarkis, 1998; Wu and Dunn, 1995).

Most of the Taiwanese manufacturers in electronic and electric industries belong to Original Equipment Manufacturing (OEM) and Original Design Manufacturing (ODM), and over eighty percent of computer products around the world are produced from Taiwan. Taiwan enterprises have recently tried to adopt green practices as a way to bolster a competitive advantage in the electronic and electric industry to meet their customer's requirements.

Roberts and Gehrke (1996) indicated that firms employ Total Quality Environmental Management (TQEM) as an effective method to improve the quality of the environment. TQEM programs are only successful when they receive supports from senior supervisors, participation by employees, and establish long-term partnerships with their suppliers and continually customer relationship management. Successful TQEM programs also require company-wide awareness and implementation of green design and manufacturing processes that promote environmental conservation (Ahire et al., 1996).

Therefore, international enterprises have increased their environmental awareness due to regulations and competitions. International governments are not the only institutions advocating environmental preservation and conservation; multinational and domestic

enterprises need to strive for competitive advantages within their industry, they have recognized the importance of GSCM practices and have begun using long-term partnerships with their suppliers to increase EP (Hanfield and Bechtel, 2002; Johnson and Sohi, 2003). Previous literature emphasizes the relationship between SCM and operational performance, or the concept of GSCM, green products distinctly (Zhu et al., 2008; Ofori, 2000); however, there is a shortage of integrative framework of exploring TQEM as a moderator which impacts the relationship between GSCM and EP. According to Curkovic and Sroufe (2007), TQEM can effectively moderate the effects of industrial strategies. The purpose of this study is to explore enterprises implement TQEM practices that can effectively enhance the relationship between GSCM and environmental performance. Briefly, TQEM as a moderator to investigate the impact of GSCM practices on firms' EP which interprets any potential value might incur in operating performance and long-term strategy for competitive advantages.

LITERATURE REVIEW

Green Supplier Chain Management (GSCM)

Green Supply Chain Management (GSCM) has been recommended as an effective approach to enhance environmental sustainability, because it integrates the distribution channel from upstream suppliers to customers (Cooper and Ellram, 1993; Van Weele, 2002), through green raw materials purchasing and manufacturing as well as to recycle, reuse, and remanufacture products and packaging, GSCM searches for reducing environmental damage (Godfrey, 1998; Messelbeck and Whaley, 1999).

GSCM is also a strategic management system that takes "green" notions into the supply chain management (Winn and Roome, 1993). In the process of environmental management, GSCM needs to take considerations include the processes of product design, raw material purchasing, product manufacturing, creating recycling programs, and containing and disposing of hazardous materials (Walton et al., 1998；Sarkis, 2003).

In summary, this study identifies the four variables of GSCM including green purchasing, green manufacturing, green packaging, and reverse logistics (Godfrey, 1998; Messelbeck and Whaley, 1999; Walton et al., 1998; Sarkis, 2003).

1. Green purchasing

Sarkis (1998) emphasizes the delivery and purchase of green materials, which will be influenced by suppliers and vendors. Chen (2005) suggests green purchasing should be separated into two stages: (1) the qualification screening of suppliers, products, and logistics systems; (2) vendor selection, eco-labeling of parts, and environmental influences of logistics systems.

2. Green manufacturing

Green manufacturing is the practice of conserving energy and materials, forbidding the use of hazardous materials, and minimizing waste production (Bowen et al., 2001); it also a mode to minimize the environmental damage on product manufacturing processing (Tan et al., 2002). Green manufacturing is an advanced manufacturing approach and sustainable science which

apply to the manufacturing industry. In addition, green manufacturing includes broad issues which embrace extended product life cycle, environmental consciousness, and sustainable management (Liu et al, 2005).

3. Green packaging

Bowen et al. (2001) explain GSCM practices to include cooperation with suppliers to eliminate packaging and to put recycling initiatives into effect. Wu and Dunn (1995) propose better packages can reduce material used and scraps. Package re-using may decrease environmental burdens from reducing pollution. Handfield et al. (2002) define green packaging as material re-packaging, re-using, re-cycling, and reducing package.

4. Reverse logistics

Fleischmann et al. (1997) define reverse logistics as the process of transforming used products into re-usable products. Reverse logistics operates under two criteria, which are the return flow of products and recovery and recycling activities (González-Torre et al., 2004). Thierry et al. (1995) also propose other alternatives of reverse logistics, which embrace repair, renovation, reprocessing, and cannibalization.

Total Quality Environmental Management (TQEM)

TQEM has been defined as a systematic and integrated method to reduce and eliminate all waste and hazardous streams connected with the design, manufacturing, packaging, and disposal of materials and products (Curkovic and Sroufe, 2007). Sarkis (1998) proposes that TQEM sub-components include (1) strong leadership in all environmental strategies and programs, which also must be supported by the upper management—generally, most strategic programs fail due to the lack of top management support; (2) human resource development, which refers to the employees who are empowered and trained to observe, control, and implement environmentally conscious business practices (ECBP). Lippmann (1999) recommends several key components of implementation of GSCM, which include the production of written GSCM policies, supplier meetings and training, collaborative R&D with suppliers, top management support, cross-functional integration, and effective communication within firms and with suppliers. Schroeder et al. (1992) considers employees are encouraged to actively participate in training programs to increase their environmental consciousness on how effectively advance environmental quality policies and production processes. Summarizing the above discussion, TQEM is recognized as the variable in this study.

Environmental Performance (EP)

Theyel (2001) suggests that innovative technologies for hazardous materials management and use of recycled products will offer potential patterns within supply chain relations that will improve EP. In the directives of WEEE/RoHs, WEEE seeks to promote product re-use, recycling, and recovering; thus, it tends to be a critical trend within environmental protection. RoHs encourages the acquisition of materials that are beneficial to EP and the elimination of the production of hazardous materials (Sarkis, 1998). Based on the above discussion, this study adopts two variables of EP including waste minimization and hazardous materials minimization (Sarkis, 1998; Theyel, 2001).

RESEARCH HYPOTHESES

Based on above-mentioned notion and related literature, the proposed research framework is shown in Figure 1:

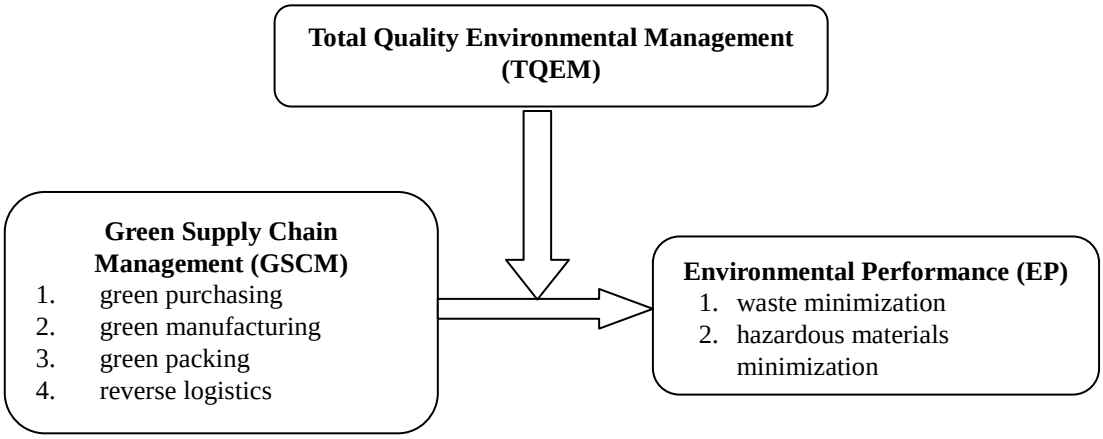

Figure I: Research Framework

The Relationship between GSCM and EP

Cattanach et al. (1995) and Beamon (1999) discuss GSCM as an extended supply chain theory which takes environmental management into consideration. Zhang et al. (1997) imply additional potential benefits of GSCM, which include the avoidance of purchasing and storing hazardous materials, waste disposal, reducing environmental risks and health threats, and working in safer and cleaner factories. Porter and van der Linde (1995) conduct an empirical study and discover that manufacturers engage in environmental management to develop technology innovations that could minimize waste production. Winn and Roome (1993) indicate that GSCM, as a strategic management model, must take product designing, manufacturing, raw material purchasing, and recycling management along with the green products into consideration. Then, it must effectively control hazardous material using and environmental management (Walton et al., 1998; Sarkis, 2003).

The demands for strict adherence to environmental standards from downstream customer have caused industries implementing GSCM to promote their EP (Theyel, 2001; Hsu and Hu, 2008). Regarding environmental performance, firms can assist inter-organization to generate environmental consciousness, create high quality environment, transform a company into a green company, and promote a positive environmental friendly giving such companies a competitive advantage, therefore, GSCM practices will become an essential criterion for positive EP (Sarkis, 1998). Based on the above discussions, we recommend the following hypothesis:

H_1： GSCM practice has a positive influence on EP.

Green purchasing aims not only to lessen unnecessary or hazardous materials, but it also assists in creating supplier be more environmental friendly (Min and Galle, 1998). Berg (1997) proposes that purchasing executives can take advantage of environmental management systems to lessen the negative influences on running operations.

Rao (2002) argues that GSCM practices should consider environmental preservation and search for environmental friendly alternatives, therefore, purchasing green raw materials will reduce the waste and hazardous products; green purchasing also creates positive effects in the area of EP and has an indirect impact on industrial competitiveness. Based on the above discussions, we construct the following hypotheses:

H_{1-1}：Green purchasing has a positive influence on industrial waste minimization.

H_{1-2}：Green purchasing has a positive influence on hazardous materials minimization.

Green manufacturing is closely linked with green productivity. Green productivity refers to the concept of how to take each link of the production process into consideration to reduce shock to the environment (Willig, 1994). Green productivity also encourage enterprises to use the fewer raw material for design, manufacturing, and distribution processes, while promoting the economic and financial advantages of product recycling. Moreover, Hui et al. (2001) suggest the adoption of green manufacturing can also decrease waste and pollution. Pollution prevention measures, like reducing resource usage and the amount of solid waste, can drastically reduce manufacturing costs. Based on the above theories, this study proposes the following hypotheses:

H_{1-3}：Green manufacturing has a positive influence on waste minimization.

H_{1-4}：Green manufacturing has a positive influence on hazardous materials minimization.

In the Green Consumer-Supermarket Guide, Elkington et al. (1993) assert that green product in well packaging processes are designed for the prevention of waste and could minimize environmental harm. Chu et al. (2009) state that the main purposes of firms to meet green products in designing, manufacturing, and recycling are to eliminate toxic materials and to reduce waste substances. Green packaging uses environmental protection as its main perspective through better packaging, together with rearranged loading patterns, reducing material usage, minimizing required waste handling, reducing hazardous materials production, and increasing space utilization in the warehouse (Zhang et al., 1995). From the above theoretical development two hypotheses emerge:

H_{1-5}：Green packaging has a positive influence on waste minimization.

H_{1-6}：Green packaging has a positive influence on hazardous materials minimization.

Stock (1998) defines firms can develop reverse logistics managerial systems for the return of recyclable or reusable products and materials to the forward supply chain. Reverse logistics calls for product reuse, waste disposal, and hazardous materials management. Through reverse logistics, managerial systems can effectively create EP business benefits (Walton et al., 1998). Hui et al. (2002) explore the recycling system of multi-type hazardous materials using multi-time-step format as opposed to the liner model of time separation. The results show that reverse logistics recycling systems can effectively reduce production costs as well as the creation of hazardous and waste materials. Based on the above discussions, we

construct the following hypotheses:

$H_{1\text{-}7}$：Reverse logistics has a positive influence on waste minimization.

$H_{1\text{-}8}$：Reverse logistics has a positive influence on hazardous materials minimization.

The Moderated Effect of TQEM between GSCM and EP

GSCM is a strategic management system that takes "green" notions into the supply chain management (Winn and Roome, 1993). Lippmann (1999) recommends several key components of implementation of GSCM practices, which include the production of written GSCM policies, supplier meetings and training, collaborative R&D with suppliers, top management support, cross-functional integration, and effective communication within firms and with suppliers. Florida (1996) states that firms drive TQEM keep close relationships with suppliers in order to avoid providing hazardous materials from suppliers. Geffen and Rothenberg (2000) suggest building long-term partnerships with suppliers allow for the adoption and development of innovative environmental technologies and joint research to improve EP. In addition, supplier management can effectively decrease solid waste and hazardous materials production, increase raw material re-use, and simultaneously promote resource re-use (Sarkis, 2003). Zhu et al. (2005) indicate that top-level manager support and cross-functional collaboration are key approaches to implement environmental management. Especially, when upper stream suppliers exert pressures on manufacturers to use and manage green raw materials as a way to improve their EP. Additionally, keeping close partnerships with suppliers will bring more opportunities to create and share new knowledge and to make advances in raising environmental consciousness (Theyel, 2001).

Miles et al. (1997) discuss the ISO 14001 certification, which establishes environmental benchmarks for purchased items, eco-design practices, and investment recovery for promoting environmental performance. It is essential for businesses to select superior and reliable suppliers that sell high quality raw materials. Furthermore, responsible suppliers are more likely to take part in the design and R & D of new products. In the near future, it will become crucial to have information concerning materials, components, data of manufacturing, and other alternatives so that firms can work together with their suppliers to protect the environment (Green Business Network, 2001).According to Zhu and Sarkis (2004) demonstrate that firms result in excellent economic and EP while they implement GSCM practices.

GSCM as a strategic management model (Winn and Roome, 1993), GSCM must take product designing, manufacturing, raw material purchasing, and recycling management along with the green notions into consideration. Then, it must effectively control hazardous materials using and environmental management (Walton et al., 1998; Sarkis, 2003). Zhu and Sarkis (2006) draw attention to GSCM's win-win effect on EP; similarly, TQEM, through superior manager support and cross-functional collaboration, close partnerships and collaborative R&D with suppliers that deliver a positive impact on internal environmental management and external performance. Based on the above discussions, the following hypotheses are proposed:

H_2 : Adopting higher degree of TQEM has a higher and positive influence between GSCM and EP.

$H_{2\text{-}1}$: Adopting higher degree of TQEM on green purchasing has a higher and positive influence on waste minimization.

$H_{2\text{-}2}$: Adopting higher degree of TQEM on green purchasing has a higher and positive influence on hazardous material minimization.

$H_{2\text{-}3}$: Adopting higher degree of TQEM on green manufacturing has a higher and positive influence on waste minimization.

$H_{2\text{-}4}$: Adopting higher degree of TQEM on green manufacturing has a higher and positive influence on hazardous material minimization.

$H_{2\text{-}5}$: Adopting higher degree of TQEM on green packaging has a higher and positive influence on waste minimization.

$H_{2\text{-}6}$: Adopting higher degree of TQEM on green packaging has a higher and positive influence on hazardous material minimization.

$H_{2\text{-}7}$: Adopting higher degree of TQEM on reverse logistics has a higher and positive influence on waste minimization.

$H_{2\text{-}8}$: Adopting higher degree of TQEM on reverse logistics has a higher and positive influence on hazardous material minimization.

RESEARCH METHODOLOGY

The questionnaires were reviewed and pre-tested by five experts including managers and university faculty in the fields of environmental management and supply chain management to ensure survey content validity and the appropriateness of the measurement scales. The sampling frame in this study included strategic businesses units of the top 5000 firms of computer industries in Taiwan, 2008. A total of 580 questionnaires were mailed along with a cover letter and postage. In order to increase the response rate, we contacted manufacturing plant managers of target plants by phone to stimulate professional interest and improve survey participation. Following Swink (1999), we divided all returned samples into two groups: early respondents, who returned their surveys prior to the follow-up phone call, and late respondents who returned their surveys after the follow-up phone call. There are no significant differences between respondents in the sample or between early and late respondents in this study (Armstrong and Overton, 1977). As the result, 119 questionnaires were returned and 116 questionnaires are valid for statistical analysis with a response rate of 20%. The relatively low response rate of 20% suggests a potential nonresponsive bias (Amstrong and Overton, 1977; Lambert and Harrington, 1990).

Statistical Methods

Based on the previous literature, this paper identifies three dimensions in terms of GSCM, TQEM, and EP (see table I). Each of the variables was measured with a five point Likert scale (1 = strongly disagree, 5 = strongly agree). Regarding the control variables, this study

uses capitals, firm sizes, as well as the number of employees as control variables.

There were two stages of statistical analysis. In the first stage, a factor analysis with varimax rotation was applied to provide insight into which dimensions of GSCM and EP were captured. The second statistical technique used was Hierarchical Regressions Analysis, which tested the moderator of TQEM on GSCM and EP.

Table I： Research Variables and Operational Definitions

Dimensions	Operational Definitions	Measured Variables	Literatures
GSCM	a strategic management system that takes "green" notions into the supply chain management	green purchasing green manufacturing green packaging reverse logistics	Godfrey (1998) Walton et al. (1998) Messelbeck and Whaley (1999) Sarkis (2003)
EP	the innovative technologies for hazardous materials management and use of recycled products	Waste Minimization Hazardous materials minimization	Sarkis (1998) Theyel (2001)
TQEM	a systematic and integrated method to reduce and eliminate all waste and hazardous streams connected with the design, manufacturing, packaging, and disposal of materials and product which need top management support, cross-functional integration, and effective communication within firms and with suppliers	TQEM	Schroeder et al. (1992) Sarkis (1998) Lippmann (1999) Curkovic and Sroufe (2007)

1. Reliability and validity analysis

The reliability analysis uses Cronbach's coefficient alpha (α>0.70) to judge the sufficient reliability (Jones and Janes, 1979). Table II shows that Cronbach's α value of three dimensions respectively are GSCM (0.984), EP (0.967), and TQEM (0.963). Therefore, GSCM, EP, and TQEM possess high internal consistency reliability. Also, according to Table IV, V, and VI, CR **>** 0.8 which is higher than a suggested value 0.6 presents high reliability (Fornell and Larcker, 1981).

Regarding content validity, all questionnaires are drawn from previous related research and aligned with the conceptual aspects of each construct. The questionnaires are pre-tested and modified by five experts in order to insure survey content validity and measurement scales appropriateness. For the convergent validity, the results show that all variables have high factor loadings from 0.576~0.891, and this would be considered relatively significant for the convergent validity based on factor loading>0.5 (Hair et al., 1982). For discriminate validity, this study adopts average variance extracted (AVE) of latent variables to measure validity. AVE **>** 0.5 shows high discriminate validity (Fornell and Larcker ,1981). Therefore, the derived GSCM, EP, and TQEM possess appropriate discriminate validity.

Table II ：Reliability of Three Dimensions

Dimension	Crobach's α
GSCM	0.984
EP	0.967
TQEM	0.963
Total	**0.984**

2. Factor analysis

This study adopted Kaiser's (1974) Kaiser-Meyer-Olkin (KMO) and Bartlett's (1951) Sphericity Test to examine whether these questionnaires would fit with factor analysis. KMO values > 0.8 showed high appropriateness; On the contrary, KMO < 0.5 presented low appropriateness which did not fit with factor analysis (see table III).

As supported by the current literature, there were four variables of GSCM, which were green purchasing, green manufacturing, green packaging, and reverse logistics. The study used varimax rotation to examine a factor matrix and uses Eigenvalue > 1 and factor loading≧0.5 as a standard to proceed with exploratory factor analysis (Table IV,V, VI). In the dimension of GSCM, it extracted three variables. As a result, green purchasing had been combined with green manufacturing and renamed green manufacturing. Therefore, $H_{1\text{-}1}$ combined with $H_{1\text{-}3}$ and renamed $H_{1\text{-}3}$, $H_{1\text{-}2}$ combined with $H_{1\text{-}4}$ and renamed $H_{1\text{-}4}$. $H_{2\text{-}1}$ combined with $H_{2\text{-}3}$ and renamed $H_{2\text{-}3}$, $H_{2\text{-}2}$ combined with $H_{2\text{-}4}$ and renamed $H_{2\text{-}4}$.

3. Hierarchical regression analysis

In order to further elaborate upon the moderating effects of TQEM on GSCM and EP, this study conducts hierarchical regression analysis to test the moderating effects (Mohr et al., 1996). In regression equation, if the interaction term (βvalue) is statistically significant it has reached a moderator effect. In addition, the magnitude ofβvalue can judge the degree of moderation (Mohr et al., 1996).

Modules 1 estimate the effect of control variables (firm size, the number of employees, and capital) on EP and control variables and GSCM on EP. Module 2 adds interactive variables between GSCM and TQEM to Module 1 to examine the moderating effect.

Table III： KMO Value of Three Dimensions

Dimension	KMO	*p*
GSCM	0.934	0.000
EP	0.942	0.000
TQEM	0.951	0.000

Table IV： Factor Analysis of GSCM (N = 116)

GSCM	Factor loading	Eigenvalue	Accumulated variance (%)	AVE	α	CR
Green Manufacturing						
Q201 setting a regulation for using green materials	.855	10.58	58.80	.553	.956	.931
Q203 making environmental management material lists	.831					
Q202 investigating raw materials using	.822					
Q204 reviewing environmental management material lists	.817					
Q209 modifying production process for environmental products	.733					
Q205 looking for alternative materials positively	.724					
Q206 adopting low pollution raw materials	.702					
Q210 importing new green producing technology which fits the original one	.693					
Q208 adopting environmental friendly design	.682					
Q211 the new products can reduce environmental destruction	.671					
Q207 implementing GSCM can saving material cost	.610					
Green Packaging						
Q214 adopting recycled materials	.855	1.715	68.32	.572	.879	.841
Q213 using easily decomposed materials	.791					
Q215 implementing reused package system	.697					
Q212 adopting simple materials	.668					
Reverse Logistics						
Q218 positively launching recycle system	.891	1.119	74.54	.731	.916	.890
Q216 setting internal material recycling system	.839					
Q217 implementing recycle system and increasing profit	.833					

Table V： Factor Analysis of EP (N = 116)

Environmental Performance	Factor loading	Eigenvalue	Accumulated variance (%)	AVE	α	CR
Hazardous materials minimization						
Q308 implementing hazardous materials restrict system	.843	10.33	42.01	.563	.960	.927
Q310 implementing green purchasing to reduce radiogenic and hazardous materials	.826					
Q311 implementing green manufacturing to reduce radiogenic and hazardous materials	.822					

Q309 implementing air pollution restriction practice	.802					
Q307 implementing pollution restriction system	.794					
Q312 implementing green packaging to reduce radiogenic and hazardous materials	.789					
Q314 implementing GSCM to reduce environmental disaster frequency	.742					
Q315 positively improving and promoting environmental situations	.636					
Q313 implementing reverse logistics to reduce radiogenic and hazardous materials	.616					
Q302 implementing waste recycle system	.576					
Waste Minimization						
Q304 implementing green manufacturing to reduce waste	.876	1.19	76.82	.667	.939	.909
Q303 implementing green purchasing to reduce waste	.843					
Q305 implementing green packaging to reduce waste	.822					
Q306 implementing reverse logistics to reduce waste	.773					
Q301 implementing GSCM to reduce waste disposal cost	.764					

Table VI： Factor Analysis of TQEM (N = 116)

TQEM	Factor loading	Eigenvalue	Accumulated variance (%)	AVE	α	CR
Q406 demanding suppliers' products should have the green label	.882	9.05	69.60	.71	.963	.967
Q405 senior supervisors participate in determination and activities of environmental conceptual stages	.878					
Q404 senior supervisors positively in response to government policy	.876					
Q411 periodically arranging employees to participate in environmental training	.869					
Q407 suppliers coordinate with environmental policies and activities	.851					
Q410 suppliers are willing to develop long-term partnership with firms	.850					
Q412 employees support future strategical goals and directions	.837					
Q402 adopting environmental management system to save cost	.837					
Q409 adopting suppliers suggestion in R&D processing	.821					

Q408 suppliers often participate in environmental quality improvement activities	.820
Q401 constructing environmental management system and passing ISO 14001 censorship	.809
Q403 senior supervisors support environmental management system	.793
Q413 consumers take environmental education and announcement into account	.708

Statistical Results

1. GSCM and waste minimization

Table VII shows R^2 =83.1% that indicates two modules effectively explain dependent variables. In module one, control variables such as firm age (β=0.024, p=0.610), number of employees (β=0.103, p=0.077), and capital (β=0.041, p=0.470), do not have significantly related to waste minimization. However, after adding control variables to GSCM variables, green manufacturing (β=0.499, p=0.000), green packaging (β=0.191, p=0.005), and reverse logistics (β=0.329, p=0.000) have significant influences on waste minimization.

Module 2 which increases TQEM as a moderator, the interaction between TQEM and green packaging (β=0.162, p=0.013), and the interaction between TQEM and reverse logistics (β=-0.142, p=0.021) have significant effects on waste minimization.

Table VII shows green manufacturing, green packaging, and reverse logistics have positive impact on waste minimization; therefore, $H_{1\text{-}3}$, $H_{1\text{-}5}$, and $H_{1\text{-}7}$ are supported. In addition, firms which take TQEM into practices show green packaging and reverse logistics have positive impact on waste minimization. Thus, $H_{2\text{-}5}$ and $H_{2\text{-}7}$ are supported. Conversely, green manufacturing doesn't have a significantly influence on waste minimization. $H_{2\text{-}3}$ is not supported.

Table VII ：Test between GSCM and Waste Minimization

Independent variables	Waste minimization			
	Module 1		Module 2	
	β	*p*	β	*p*
Control Variables				
Firm age	0.024 n.s	0.610	0.045 n.s	0.333
No. of employees	0.103 n.s	0.077	0.108 n.s	0.067
Capital	0.041 n.s	0.470	0.035 n.s	0.527
GSCM				
Green manufacturing	0.499***	0.000	0.471***	0.000
Green packaging	0.191**	0.005	0.164*	0.015
Reverse logistics	0.329***	0.000	0.370***	0.000
Interaction				
Green manufacturing × TQEM			-0.036 n.s	0.589

Green packaging × TQEM		0.162*	0.013
Reverse logistics × TQEM		-0.142*	0.021
R^2	0.814		0.831
F	69.497***		50.299***
$\triangle R^2$	---		0.017
$\triangle F$	---		3.023*

Note：*** p<0.001；** p <0.01；* p <0.05

2. GSCM and hazardous materials minimization

Table VIII shows R^2 =64.9% that indicates two modules can effectively explain dependent variables. In module one, control variables as firm age (β=0.034, p=0.607), number of employees (β=0.095, p=0.254), and capital (β=0.048, p=0.546), do not have significantly influence on hazardous *materials* minimization. However, after adding control variables to GSCM variables, green manufacturing (β=0.516, p=0.000) and reverse logistics (β=0.306, p=0.000) prove to be significantly related to waste minimization. But green packaging (β=0.077, p=0.403) doesn't have a significantly influence on hazardous materials minimization.

Module 2 which increases TQEM as a moderator, the interaction between TQEM and green manufacturing (β=0.-080, p=0.404), the interaction between TQEM and green packaging (β=0.001, p=0.992), and the interaction between TQEM and reverse logistics (β=0.055, p=0.527) have significant influence on hazardous materials minimization. Due to the moderating effect of TQEM, green manufacturing, green packaging and reverse logistics have no significant moderated effects on hazardous materials minimization.

Table VIII shows that green manufacturing and reverse logistics have positive impact on hazardous materials minimization; therefore, $H_{1\text{-}4}$ and $H_{1\text{-}8}$ are supported. However, green packaging has no significant impact on hazardous materials minimization; thus, $H_{1\text{-}6}$ is not supported. In addition, firms take TQEM into practices; green manufacturing, green packaging, and reverse logistics don't have impact on hazardous materials minimization. Therefore, $H_{2\text{-}4}$, $H_{2\text{-}6}$, and $H_{2\text{-}8}$ are not supported.

Table VIII： Test between GSCM and Hazardous Materials Minimization

Independent variables	Hazardous Materials Minimization			
	Module 1		Module 2	
	β	*p*	β	*p*
Control Variables				
Firm age	0.034 n.s	0.607	0.031 n.s	0.643
No. of employees	0.095 n.s	0.254	0.104 n.s	0.255
Capital	0.048 n.s	0.546	0.051 n.s	0.537
GSCM				
Green manufacturing	0.516***	0.000	0.511***	0.000
Green packaging	0.077 n.s	0.403	0.093 n.s	0.328
Reverse logistics	0.306***	0.000	0.284***	0.001
Interaction				

Green manufacturing × TQEM		-0.080 n.s	0.404
Green packaging × TQEM		0.001 n.s	0.992
Reverse logistics × TQEM		0.055 n.s	0.527
R^2	0.645	0.649	
F	28.512***	18.692***	
$\triangle R^2$	---	0.004	
$\triangle F$	---	0.309 n.s	

Note：*** p <0.001；** p <0.01；* p <0.05

3. Adopting higher degree of TQEM on GSCM to affect waste minimization

According to Table IX, Regression analysis of GSCM and EP , green manufacturing adopts lower degree TQEM (β=0.834***) and higher degree TQEM (β=0.908***) on waste minimization, it shows a significant difference ($\triangle$F=12.240***). Therefore, adopting higher degree of TQEM on green manufacturing shows a significant positive impact on waste minimization.

Green packaging adopts lower degree TQEM (β=0.745***) and higher degree TQEM (β=0.948***) on waste minimization, it shows a significant difference ($\triangle$F=46.855***). Hence, adopting higher degree of TQEM on green packaging shows a significant positive impact on waste minimization.

Reverse logistics adopts lower degree TQEM (β=0.708***) and higher degree TQEM (β=0.939***) on waste minimization, it shows significant difference ($\triangle$F=52.568***). Thus, adopting higher degree of TQEM on reverse logistics shows a significant positive impact on waste minimization.

4. Adopting higher degree of TQEM on GSCM to affect hazardous materials minimization

According to Table IX, Regression analysis of GSCM and EP, green manufacturing adopts lower degree TQEM (β=0.758***) and higher degree TQEM (β=0.827***) on hazardous materials minimization, it shows significant difference ($\triangle$F=7.036**). Therefore, *adopting* higher degree of TQEM on green manufacturing shows a significant positive impact on hazardous materials minimization.

Green packaging adopts lower degree TQEM (β=0.636***) and higher degree TQEM (β=0.837***) on hazardous materials minimization, it shows significant difference ($\triangle$F=30.176***). Hence, adopting higher degree of TQEM on green packaging shows a significant positive impact on hazardous materials minimization.

Reverse logistics adopts lower degree TQEM (β=0.638***) and higher degree TQEM (β=0.852***) on hazardous materials minimization, it shows significant difference ($\triangle$

F=52.568***). Thus, adopting higher degree of TQEM on reverse logistics shows a significant positive impact on hazardous materials minimization.

Table IX： Regression Analysis of GSCM and EP (N = 116)

Module	Dependent Variables	Waste Minimization				
	Main Variables	β	R^2	ΔR^2	F value	ΔF
1	Green manufacturing	0.834***	0.695	---	241.600	---
2	Green manufacturing	0.657***	0.727	0.032	253.84	12.240***
	TQEM	0.251***				
1	Green packaging	0.745***	0.554	---	131.832	---
2	Green packaging	0.507***	0.692	0.138	178.687	46.855***
	TQEM	0.441***				
1	Reverse logistics	0.708***	0.501	---	106.535	---
2	Reverse logistics	0.463***	0.668	0.166	159.103	52.568***
	TQEM	0.476***				
Module	Dependent Variables	Hazardous Materials Minimization				
	Main Variables	β	R^2	ΔR^2	F value	ΔF
1	Green manufacturing	0.758***	0.575	---	141.875	---
2	Green manufacturing	0.596***	0.594	0.027	148.911	7.036**
	TQEM	0.231***				
1	Green packaging	0.636***	0.404	---	71.155	---
2	Green packaging	0.404***	0.538	0.134	101.331	30.176***
	TQEM	0.433***				
1	Reverse logistics	0.638***	0.501	---	106.535	---
2	Reverse logistics	0.414***	0.661	0.166	159.103	52.568***
	TQEM	0.438***				

Note：***p <0.001；** p <0.01；* p <0.05

CONCLUSIONS

The moderating effects of TQEM on GSCM and EP are examined in detail throughout this study. The empirical results of the study are as follows:

1. According to previous literature, this study adopts green purchasing, green manufacturing, green packaging, and reverse logistics as variables of GSCM to examine the impact on EP. Through exploratory factor analysis, as a result, green purchasing has been combined with green manufacturing and renamed green manufacturing. After discussion with practitioners, we found that variables of green purchasing and manufacturing are too similar.
2. This study investigates the effect between control variables (firm age, numbers of employees and capital) and EP. The statistics show that different sizes of firms do not significantly affect the EP.

3. This study finds that enterprises that adopt GSCM (green manufacturing and reverse logistics) can effectively reduce waste and hazardous materials. But green packaging can significantly reduce waste but not hazardous materials. It is possible that enterprises have preliminarily eliminated harmful materials or have the inspected green label on their package materials; thus, green packaging would not affect EP.
4. Taking under consideration the interaction between GSCM and TQEM, green packaging and reverse logistics have a positive impact on waste minimization but no impact on hazardous materials. However, green manufacturing doesn't have significant effects on waste minimization and hazardous materials. After discussing with experts, it is possible that the whole firm has a mechanism and concept of green product and the purchasing department has preliminarily eliminated harmful materials, so there is not much waste in the process of manufacturing and hazardous materials during GSCM practice.

IMPLICATIONS

Previous studies examine the relationships between SCM and operational performance, or the concept of GSCM, green products distinctly (Zhu et al., 2008; Ofori, 2000), which lack an integrative framework of using TQEM as a moderator to investigate the impact of relationship between GSCM and EP. In particularly, this empirical study demonstrates that it is important to consider the adoption of TQEM in terms of senior management support, employees' involvement, and supplier coordination on GSCM practice. This study helps to develop an effective GSCM framework and propose guidelines for managerial decision. However, this study also recommends that if companies desire to reach a higher level of TQEM, they should establish senior management support as well as communication with suppliers. Through the purchase of environmentally-safe raw-material, simplified design concepts, and re-use packaging, enterprises can decrease disposal cost, reduce environmental damage, encourage participation in environmental protection programs through training courses that are in compliance with global environmental protection legislation and ultimately, promote their image.

This research finds that GSCM and TQEM are essential in achieving waste and hazardous materials minimization and in enhancing EP. The support of top managers increases the launching of environmental strategies within the entire corporation and this consciousness also determines how resources will be used. All employees must follow and cooperate with industrial environmental policies that are established by top managers. Maintaining a good supplier partnership can improve the company's image and reputation, increase the quality of the green products it produces, and provide manufacturers with opportunities to develop their innovative capabilities and productivity. By having top to bottom support, GSCM and TQEM can help enterprises enhance and improve their EP. Future research could also address environmental issues. A lot of authors (Zhu et al., 2008) have explored this issue but not in the context we did. It is possible that different measures of GSCM would shed light on this field of interest. GSCM practices will effectively function as they integrate with TQEM program and create synergistic effects on competitiveness.

LIMITATIONS OF RESEARCH

Despite the significance of findings, the limitations of the present study with regard to the research procedure and data collection and analysis need to be noted.

1. Questionnaire- related limitations
   Despite the fact that all the variables used to measure GSCM, TQEM and EP are derived from literature reviews and interviews with practitioners and then modified, not all variables and dimensions are covered due to the parsimony and conciseness of the questionnaire.
2. Respondent- related limitations
   Although the objectivity of measurement was followed during the development of the questionnaire variables such as the respondent's, value judgment, recognition bias, and defensive mechanisms may have prevented the disclosure of the whole truth.

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A SURVEY OF SUPPLIER-CUSTOMER COLLABORATION AND MANAGEMENT IN THE THAI AUTOMOTIVE INDUSTRY

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ABSTRACT

The paper details the results of a questionnaire survey of the supplier-customer collaboration and management in the Thai automotive industry. A questionnaire survey was used to collect data in four key areas; (1) principal objectives, (2) key success factors, (3) major barriers in building and managing relationship with its supplier and customers effectively and (4) key business activities that required the suppliers and customers' participation for the smooth functioning of an efficient supply chain. The sample in this study consists of 206 organizations. The average mean score for each area was calculated and some statistical analyses were then performed. The survey results show that many companies in the automotive industry ranked increasing in profit as the major objective in developing relationship with suppliers and customers while the most important success factor and barrier in managing the relationship is trust and poor understanding of the concept, respectively. Information sharing was ranked the first key important business activities required the supplier and customer to collaborate with. Furthermore, the study also reveals that the respondents gave the collaborating with customer has more importance than the collaborating with supplier according to the mean score. Even though this study focused on the specific group; automotive industry, at least this sever as a useful guide for other manufacturers when they are building and managing relationship with their supply chain partners.

Keywords: Supply chain management, Collaboration, Supplier, Customer, Automotive industry

INTRODUCTION

In today's competitive environment, well-integrated supply chain is one of the primary business strategies to improve supply chain performance. Linkage with suppliers in the upstream and with customers in the downstream enables to reduce lead-times and contribute to enhancing performance. The linkage in supply chain encompasses not only the firm's suppliers but also the suppliers' supplier and the network of indirect manufacturing and distribution professionals that provide firms with the capability to design, manufacture, and delivery products and services to customers. There is also an increasing focus on the demand chain, which includes the customers, the customers' customers, and the network of indirect marketing and service professionals that allow firm to get information about customers' needs. Zacharia *et al*, (2009) stated firms have more concerned on how to build up the relationship with their business partners and to integrate their business processes across organizations throughout the supply chain in order to smooth their operations, achieve efficiencies, flexibility and a competitive advantage. Collaboration can be described as an inter-organizational relationship type in

which the participating parties agree to invest resources, mutually achieve goals, share information, resources, rewards, risks and responsibilities as well as jointly make decisions and solve problems (Narasimhan and Arlbjorn, 2008; Soosay *et.al*, 2008). Typically, collaborative relationship is based on mutual trust, openness, shared risks and shared rewards that yield a competitive advantage, resulting in better performance than it would be without the collaboration (Nyaga *et.al*., 2010).

Typically, supply chain collaboration does not only refer to external integration but also to internal integration. Internal integration involves coordinating purchasing, production and information systems and logistics wile external integration involves coordinating with both supply-side and demand-side (Duffy and Fearne, 2004). The collaborative activities in supply-side generally involve with suppliers in new products during the design stage, in production planning and inventory management, developing a rapid response order processing system with suppliers, placing a supplier network that assures reliable delivery, and exchanging information with suppliers (Sahay, 2003; Myhr and Spekman, 2005; Li *et al*., 2007; Singh and Power, 2009). Collaboration with customer, on the other hand, deals with the ability to communicate delivery of the right products and services to customers locally and globally in the right time, right place, and right quantity with correct invoice (Duffy and Fearne, 2004; Gloria, 2008). Daughty et al. (2006) found that firm engaged in collaborative relationships achieved improved visibility, higher service levels, increased flexibility, greater end-customer satisfaction, and reduced cycle times. Simatupang and Sridharan (2005) found that supply chain members who had higher levels of collaboration practices were also to achieve better operational performance and innovation activities. Another study by Cannon and Homburg (2001) indicated that collaboration reduces purchasing costs by lowering contracting costs, frequent communication, improved coordination and acts a joint approach to operational problem saving. The literature clearly demonstrates the importance of relationships. This paper therefore attempts to shed light on what current situation of supplier and customer collaboration and management in the Thai automotive industry. We are also interested in what characterizes successful collaboration and what the level of collaborative relationship with suppliers and customers.

PROBLEM BACKGROUND

Currently, the automotive industry is the third largest industry in Thailand with an estimated total workforce of more than 300,000 employees. Thailand is named the "Detroit of Asia" being the second largest producer of 1 ton pick-up trucks and the fifth largest automotive assembler in APAC region with an annual production capacity of around 1.89 million vehicles in 2008. This can be simply said that the automotive industry in Thailand is one of critical sectors for the country's export-dominated economy. Based on master plan project by the Federation of Thai Industries (FTI), there is a clear urgency on improving supply-chain management from upstream-side to downstream-side across industrial clusters, especially automobile and automotive parts[1]. In order to achieve this improvement, it is important that awareness on how supply chain relationships 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[2]. 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 strengthen supply-chain operations.

[1] 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

[2] In reference to the report on Critical Assessment into Industrial Restructuring in Thailand, Ministry of Industry

As above discussion, to develop a competitive advantage through building relationships with supply chain partners, the degree to which a firm understand the supply chain partners' business and organization; their business objectives, the skills and capabilities they bring to the collaboration effort, how they operate, and the risks they are trying to manage is needed (Zacharia et al, 2009). This study mainly focuses on supply chain collaboration. The research questions addressed in this paper are:

- What main objectives, supporting factors and obstacles in building relationship with suppliers and customers were evident in the firms studied?
- What key business activities in collaborating with suppliers and customers were perceived the most important to enhance the firms' competitiveness?
- What difference perspectives on the supply chain collaboration among participated firms were existed?

OBJECTIVES

This study aims to present the extent of supply chain collaboration and management among Thai automotive manufacturers. This study also determined if a significant difference exists in the supply chain collaboration among firms participating in this study.

RESEARCH METHODOLOGY

Data were collected using a survey method. A questionnaire was developed based on an extensive review of the literature in the areas of supply chain management and collaboration. The questionnaire was divided into two main parts exploring supply chain relationships. For the first parts, respondents were asked to indicate the typical demographic information of the company such as employee size, ownership type, years in business and length of partnership agreement with supply chain partners. Next, in the second part, they were asked to fill out a survey questionnaire to elicit their opinion on four important areas: (1) principal objectives, (2) key success factors, (3) major barriers in building and managing relationship with its supplier and customers effectively and (4) key business activities that required the participation of suppliers and customers to smoothing the functions throughout the supply chain efficiently. The questionnaire was designed using a five point Likert scale with "5" indicating "high extent" or "most important" and "1" indicating "least extent" or "least important". The questionnaire instrument was initially pre-tested by industry representatives and academics familiar with collaborative relationships. Minor changes were made to the questionnaire and the instrument was then distributed by mail. The questionnaire was sent to 473 manufacturers based on the list of Thai Auto parts Manufacturers Association (TAPMA) and The Federation of Thai Industries (FTI) during October and November 2009. A total of 206 companies participated in the study (43.5% response rate).

RESULTS AND DISCUSSIONS

Data analyses were undertaken using the statistical package for social sciences (SPSS) and dealt mainly with the ranking of the variables based on mean values and frequency distribution. See Table 1 and Table 2 for the profile of respondents and participated companies, respectively. The responses were split into three groups (large, medium and small) based on employee size. Then, analysis of variance (ANOVA) was also undertaken to test the null hypothesis that mean values of the dependent variables are equal for all groups. This enabled researchers to clarify whether or not the opinions of the separate groups were the same on various issues dealt with in the study.

Respondents' profile

Based on 206 returned surveys, a majority of respondent are male (95.6%). More than sixty percent of respondents' ages are 31-40 year olds. The titles of the respondents are Purchasing Manager (14.1%), Factory Manager (36.4%), Quality Manager (18.9%), Engineering Manager (17.0%) and others (13.6%). Almost half of respondents have between 11- 15 years of working experiences. See Tables 1.

Table 1: Respondents' Profiles

	Frequency	Percent
Gender		
Male	197	95.6
Female	9	4.4
Total	206	100.0
Age		
<30	22	10.7
31-40	127	61.7
41-50	56	27.2
>50	1	0.5
Total	206	100.0
Position		
Purchasing Manager	29	14.1
Factory Manager	75	36.4
Quality Manager	39	18.9
Engineering Manager	35	17.0
Others	28	13.6
Total	206	100.0
Work experience		
<5	10	4.9
5-10	82	39.8
11-15	92	44.7
>15	22	10.7
Total	206	100.0

Among them, 31.4 percent of respondents have more than 500 full-time employees. Almost 80 percent of respondents have their experience more than 10 years in business. Foreign investors own 70.4 percent of the firms that return the survey. It is interesting that 48.5% percent of respondents have length of partnership agreement with suppliers less than 2 years while over 50% of respondent have length of partnership agreement with customers more than 5 years. See Tables 2.

Table 2: Companies' Profiles

	Frequency	Percent
Number of employees		
<50	29	14.1
50-200	37	18.0
>200	140	68.0
Total	206	100.0
Years in business		
<5	8	3.9
5-10	36	17.5
11-15	57	27.7
16-20	62	30.1
21-25	23	11.2
>25	20	9.7
Total	206	100.0
Length of partnership agreement with suppliers		
< 2 years	100	48.5
2-5 years	78	37.9
>5 years	28	13.6
Total	206	100.0
Length of partnership agreement with customers		
< 2 years	24	11.7
2-5 years	74	35.9
>5 years	108	52.4
Total	206	100.0
Ownership type		
Thai Wholly	61	29.6
Joint Venture	145	70.4
Total	206	100.0

Objectives in developing supply chain collaboration

The principal objectives in developing supply chain relationship with either suppliers or customers were shown in Table 3. Among the seventeen factors listed as the Table 3, the participated manufacturers ranked increased profitability as the most important objective followed by increased market; the least important factor is logistics cost reduction. For manufacturers, the direct benefits of supply chain collaboration lie in improved product quality, improved plant productivity and improved customer service – these being ranked third, fourth and fifth, respectively. However, there is no statistical difference at the 5% significance level between the first and ninth principal objectives. The findings have consistent with several literatures (Chang et al., 2007; Sahay, 2003; Myhr and Spekman, 2005; Li, 2007; Singh and Power, 2009). Two significant differences among respondents considering based on the number of employee were found on delivery development and increased quality assurance.

Table 3: Objectives in developing supply chain collaboration

Factors	Overall	Number of Employee			Sig.
		>200	50-200	<50	
Improved customer service	4.40(5)	4.36(5)	4.46(3)	4.52(4)	0.51
Improved plant productivity	4.41(4)	4.39(4)	4.38(6)	4.55(3)	0.54
Improved manufacturing processes	3.97(12)	3.92(12)	4.22(11)	3.90(12)	0.24
Improved quality of product	4.46(3)	4.43(2)	4.46(3)	4.59(2)	0.56
Improved investment planning and deployment	3.80(14)	3.83(13)	3.70(15)	3.76(16)	0.82
Delivery development	4.09(10)	4.17(9)	3.68(16)	4.24(8)	0.01*
Flexibility in services	4.15(9)	4.19(8)	4.16(11)	3.97(10)	0.52
New products development	3.77(16)	3.81(14)	3.57(17)	3.86(13)	0.46
Technology development	3.78(15)	3.78(16)	3.76(14)	3.79(15)	0.99
Increased quality assurance	3.89(13)	3.79(15)	4.32(8)	3.83(14)	0.03*
Increased profitability	4.53(1)	4.53(1)	4.46(3)	4.62(1)	0.61
Increased market share	4.47(2)	4.43(2)	4.62(1)	4.45(5)	0.29
Logistics cost reduction	3.71(17)	3.69(17)	4.03(12)	3.45(17)	0.08
Operating cost reduction	4.32(6)	4.26(6)	4.54(2)	4.31(6)	0.11
Increased demand forecasting accuracy	4.02(11)	4.06(11)	3.95(13)	3.97(10)	0.74
Reduced inventory level	4.19(8)	4.16(10)	4.24(9)	4.24(8)	0.83
Operational risks reduction	4.25(7)	4.21(7)	4.38(6)	4.28(7)	0.56

Key success factors in building up the relationship

Table 4 shows the key factors considered by manufacturers in forming supply chain collaboration. The most important factor identified by the participated manufactures is trust followed by sharing information, the agreement in the contact and more frequent meeting. On the hands, investment is ranked the least important factor. Among ten variable considered in this study, there is no statistical difference at the 5% significance level except the ninth. The findings have consistent with the study of Akintoye in 2000; Cortsten, 2005; Panayides and Lun, 2009 since their findings founded the positive effects of trust and identify trust as an antecedent to higher performance in the supply chain collaboration.

Table 4: Key success factors in building up the relationship

Factors	Overall	Number of Employee			Sig.
		>200	50-200	<50	
Trust	4.40(1)	4.44(1)	4.30(2)	4.34(1)	0.51
Information sharing	4.25(2)	4.26(2)	4.27(3)	4.17(2)	0.86
Collaborative in process control	3.82(5)	3.78(5)	3.78(5)	4.03(3)	0.52
Investment	2.67(10)	2.59(10)	3.11(10)	2.55(10)	0.11
Costs and benefits sharing	3.18(9)	3.03(9)	3.68(6)	3.28(8)	0.02*
Technology transfer	3.25(8)	3.26(8)	3.30(8)	3.14(9)	0.85
Risk sharing	3.38(7)	3.37(7)	3.19(9)	3.66(7)	0.31
More frequent meetings	4.06(4)	4.11(4)	4.03(4)	3.83(5)	0.27
Joint decision making	3.60(6)	3.61(6)	3.41(7)	3.76(6)	0.46
The agreement in the contract	4.19(3)	4.18(3)	4.38(1)	4.03(3)	0.25

Obstacles to building up the supply chain relationship

The biggest barrier to building up the supply chain relationship was lack of understanding of the concepts, followed by lack of strategic setting and lack of appropriate information technology system. ANOVA tests did not show any significant difference of opinion on each of the obstacles factors by the manufacturers' groupings at the 5% significance level. Clearly, the three most important barriers are related to the culture of the industry in dealing with mentality, strategy, IT infrastructure of its organizations. It suggests that an effective supply chain management not only calls for education but also for IT infrastructure development.

Table 5: Obstacles to building up the supply chain relationship

Factors	Overall	Number of Employee			
		>200	50-200	<50	Sig.
Lack of top management supports	2.42(7)	2.41(7)	2.59(6)	2.24(7)	0.46
Lack of understanding of the concept	3.19(1)	3.17(1)	3.11(1)	3.38(1)	0.59
Lack of supports and collaboration form partner	2.72(4)	2.71(4)	3.00(3)	2.45(6)	0.22
Lack of strategic setting	2.99(2)	2.93(2)	3.08(2)	3.17(2)	0.56
Lack of appropriate information technology system	2.85(3)	2.90(3)	2.81(4)	2.69(3)	0.72
Lack of believe and trust	2.64(5)	2.62(5)	2.65(5)	2.69(3)	0.97
Lack of communication channel	2.52(6)	2.52(6)	2.49(7)	2.55(5)	0.97
No concern on the benefits of making the relationship	2.31(8)	2.32(8)	2.35(8)	2.21(8)	0.88

Collaborative activities with suppliers and customers

Figure 1 shows the overall comparative study on the business processes collaborating with suppliers and customers. It is interesting that among twelve factors almost given the higher importance level in collaborating with customers than suppliers except problem solving. This findings have similar perceptive with the study of Prajogo in 2004 and Gloria in 2008 researching about supply chain collaboration and management in Australia and Philippine, respectively.

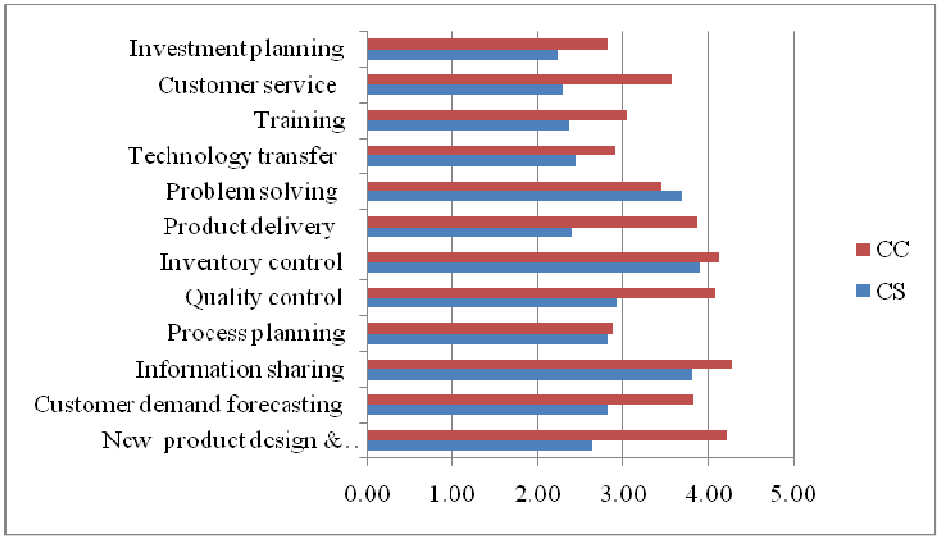

Figure 1: Comparison on collaborative activities with suppliers and customers

The findings further illustrate that most manufacturers rated the similar perspective on collaboration with suppliers and customers since three of four most important business processes required the collaboration of suppliers and customers are sharing information, inventory control and quality control. See Table 6 and 7. ANOVA tests did not show any significant difference of opinion on each of the collaborative activities with suppliers' factors by the manufacturers' groupings at the 5% significance level. On the other hands, there are two significant differences on the respondents 'perceptive in collaborative activities with customers; transfer technology and investment planning. The findings show that the small-sized firms ranked the higher importance level of these two processes than others. This consists with the literature findings see Kayis (2004) for example.

Table 6: Collaborative activities with suppliers (CS)

		Number of Employee			
Factors	Overall	>200	50-200	<50	Sig.
New product design & development	2.64(7)	2.66(7)	2.73(7)	2.45(8)	0.36
Customer demand forecasting	2.82(5)	2.76(6)	3.03(4)	2.83(6)	0.17
Information sharing	3.81(2)	3.73(2)	3.89(2)	4.10(1)	0.15
Process planning	2.81(6)	2.83(4)	2.65(8)	2.93(5)	0.31
Quality control	2.93(4)	2.83(4)	2.97(5)	3.34(4)	0.18
Inventory control	3.91(1)	3.89(1)	4.00(1)	3.90(3)	0.70
Product delivery	2.41(9)	2.42(8)	2.54(10)	2.21(11)	0.21
Problem solving	3.68(3)	3.59(3)	3.78(3)	4.00(2)	0.21
Technology transfer	2.45(8)	2.35(9)	2.78(6)	2.48(7)	0.16
Training	2.36(10)	2.27(10)	2.62(9)	2.45(8)	0.17
Customer service	2.29(11)	2.26(11)	2.32(11)	2.38(10)	0.66
Investment planning	2.23(12)	2.26(11)	2.27(12)	2.07(12)	0.59

Table 7: Collaborative activities with customers (CC)

		Number of Employee			
Factors	Overall	>200	50-200	<50	Sig.
New product design & development	4.21(2)	4.20(2)	4.30(2)	4.17(2)	0.81
Customer demand forecasting	3.83(6)	3.87(5)	3.62(6)	3.90(6)	0.47
Information sharing	4.28(1)	4.26(1)	4.22(3)	4.48(1)	0.47
Process planning	2.89(11)	2.94(10)	2.57(11)	3.10(12)	0.14
Quality control	4.08(4)	4.05(4)	4.19(4)	4.07(3)	0.76
Inventory control	4.12(3)	4.07(3)	4.35(1)	4.07(3)	0.28
Product delivery	3.88(5)	3.83(6)	3.92(5)	4.07(3)	0.52
Problem solving	3.46(8)	3.50(8)	3.30(8)	3.45(9)	0.71
Technology transfer	2.92(10)	2.80(11)	2.86(10)	3.55(7)	0.03*
Training	3.04(9)	2.98(9)	2.92(9)	3.52(8)	0.12
Customer service	3.57(7)	3.62(7)	3.51(7)	3.38(11)	0.67
Investment planning	2.81(12)	2.76(12)	2.51(12)	3.45(9)	0.02*

Finally, the limitations of this research cannot be overlooked and need to be specifically pointed out since the study was conducted only one industry sector. Future studies should be conducted in regard to how different other profiles impact on the perception on supply-chain relationships such as targeted customers, ownership type. Furthermore, a possible future study should not only to explore and present the perceptions of supply-chain relationships in difference countries and industry sectors; electronics, food and service but also to investigate the effect of collaboration on organization's performance.

CONCLUSION

Supply chain collaboration and management has been used in many industries to gain competitive advantage. The automotive industry was selected in this study. The research focuses on understanding the perceptions of supply chain collaboration from managers and executives of 206 Thai companies. The overall findings indicated that that many companies in the automotive industry ranked increasing in profit as the major objective in developing relationship with suppliers and customers while the most important success factor and barrier in managing the relationship is trust and poor understanding of the concept, respectively. Similarly, information sharing was ranked the first key important business activities required the supplier and customer to collaborate with. Furthermore, the study also reveals that the respondents gave the collaborating with customer has more importance than the collaborating with supplier according to the mean score. These findings are generally consistent with previous studies. See Groves and Valsamakis in 1998, Furlan *et al*., in 2006, Gloria and Talavara in 2008, and Nyaga *et al.* in 2009. The results appeared to support the overall policy by the FTI in the ICT- related projects and initiatives. 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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FACTORS THAT INFLUENCE THE MALAYSIAN MOBILE ENTERTAINMENT ADOPTION: AN EMPIRICAL ANALYSIS

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ABSTRACT

Purpose *- This study aims to empirically examine the factors that influence the consumer intention to use (**IU**) mobile entertainment (m-entertainment) in Malaysia. The proposed factors examined in this study are Perceived usefulness (**PU**), Perceived ease of use (**PEOU**), Social influence (**SI**), Perceived self-efficacy (**PSE**) and Perceived enjoyment (**PE**). The study sample consists of 423 respondents with a response rate of 92.8 per cent. Data were analyzed by employing confirmatory factor analysis and a structural equation modelling method. The findings discovered that SI, PU, PE, PEOU and PSE are positively associated with consumer IU of m-entertainment in Malaysia. It was also found that PE, SI and PU were perceived as dominant adoption factors in influencing the consumer intention to use (**IU**) mobile entertainment (ME) in Malaysia.*

Keywords: Mobile entertainment, adoption, consumer behaviour, Malaysia

INTRODUCTION

The recent advancement in mobile telecommunication technology has made possible the emergence of pervasive and ubiquitous computing. The ubiquitous of mobile phones existing in tandem with the consistently upgraded network connectivity and advancement in mobile devices has contributed to the development of mobile entertainment or m-entertainment (ME) (Shchiglik and Scornavacca, 2004). ME services including mobile music, mobile games and mobile video services have generated worldwide revenue of about USD 24 billion in 2008 and is estimated to surge to a USD 47.2 billion by the end of 2013.

Even though there are a lot of potentials for the Malaysian ME businesses, it is still in its infancy stage when compared to developed nations such as South Korea and Japan (Wong and Hiew, 2005). Currently there is still scarcity in the researches and studies on ME in the context of Malaysia. Most of previous studies have been carried out in developed countries such as USA (Dai and Palvia, 2009), UK, Sweden, and France (Moore and Rutter, 2004), Germany (Geiger *et al.*, 2004), Finland (Bendas and Myllyaho, 2002), New Zealand (Chou, 2006; Tan and Chou, 2008), Korea (Lee and Cho, 2006) and Hong Kong (Lo, 2005). It is therefore useful to examine if certain behaviours of Malaysian users will determine the adoption of m-entertainment. For many developing nations such as China and Thailand, ME will play an important role in their economic development as it has the potential to be an important contribution to the service industry. Hence, a study on the factors that affect the adoption of ME in Malaysian context would provide a good basis for other developing countries to further develop their ME industry.

The purpose of this study is to fill the existing gap in ME adoption by empirically establishing a model to explain the factors that influence the acceptance of ME in Malaysia. An empirical analysis is carried out to examine the hypotheses of the adoption. This paper is organised as follows:

- presenting a literature review on adoption factors of m-entertainment;
- constructing a research model based on literature review;
- attending to the research methods;
- discussing the research findings; and

The next section presents a review of the m-entertainment as well as the current adoption models.

Literature review

Overview of m-entertainment (ME)

ME is still a new concept for majority of Malaysian people. It is a common term that insinuates mobile communication devices such as mobile phones and PDAs being applied in obtaining entertainment services. Due to the emergence of ubiquitous and pervasive computing with the advancement of the mobile technologies, ME applications have a significant profit generation potential for mobile operators, content providers and also device manufacturers (Rashid *et al.*, 2006). In this study, ME is defined as any paid or freely charged leisure activities or product and services that are conducted via mobile or wireless technologies and devices. Application of ME include downloadable mobile phone games, images, ring tones, MP3, logos, cartoons, wallpapers and services such as instant messaging (IM), gambling, live sports and reports, fortune telling, movie trailers, celebrities, location-based entertainment, Internet browsing, e-journals, comedies, sensation and serialized books and newsletters.

Factors affecting the adoption of ME

Previous studies have been conducted to identify the factors or determinants of technology acceptance based on theories such as TRA (Fishbein and Ajzen, 1975), TPB (Ajzen, 1991) and TAM (Davis, 1989). In studying the factors influencing IU on ME, Wong and Hiew (2005[b]) proposed an extended TAM model by integrating pricing issues and privacy and security issues from Consumer Segmentation Model (CSM), perceived benefit and product and technological standardization issues from TAM and influences from peers, community and the media from TPB. The result showed that only perceived benefit gave the most significant impact on the adoption of ME and other factors did not contribute significantly in predicting the adoption of ME. Lo (2005) suggested a model consists of PEOU, PU, PE and IU in her research about Hong Kong's ME adoption. Based on the discussions above, modifications have been made to the original (Figure 1) and extended TAM models by introducing a new construct of PU, PEOU, together with SI, PSE and PE. PU, PEOU are taken from TAM whereas SI is derived form TPB while PSE and PE are obtained based on the prior studies on ME. Attitude and Situational Effect constructs have been discarded for simplicity purpose. IU is used instead of 'actual use' in the TAM model since ME is still at its infancy stage in Malaysia (Wong and Hiew, 2005[a]). Last but not least, consumer

confusion, ineffective marketing and lack of compelling content are purposely left out for future studies.

Take in Figure (1)

Hence, this study will use the conceptual model for ME adoption as shown in Figure 2 in order to augment the prediction of IU on ME in Malaysia while retaining its simplicity.

Hypothesis development

Perceived usefulness (PU)

Davis (1989) defined PU as the degree of which an individual believes that using a system would enhance his or her job performance. Many studies (Bigné-Alcañiz *et al.*, 2008; Guriting and Ndubisi, 2006; Lin and Wang, 2005; Luarn and Lin, 2005) have shown the influence of PU on IU. Furthermore, Jaruwachirathanakul and Fink (2005), Tan and Teo (2000) and Tornatzky and Klein (1982) stressed that relative advantage is an important factor which determine the adoption of innovations. Rogers (1995) discovered that the perceived usefulness of an innovation is positively related to its rate of adoption

Hence, in this study, PU is defined as the extent to which an individual believes that the use of ME will enhance his or her job performance and daily activities. Ho and Kwok (2003) opined that this construct does not assess solely on the extrinsic characteristics of ME but in addition to that it also shows the ways ME may assist users to achieve task-related goals such as efficiency and effectiveness. Therefore, we may infer that the rationale for users to use ME is that they believe the systems are useful to their job performance. Hence, the hypothesis is proposed as:

H1: PU has positive effect on consumer IU m-entertainment in Malaysia

Perceived ease of use (PEOU)
Davis (1989) stated that even though users may believe that an application is useful, they may find that the system is difficult to use. PEOU has been identified as the core determinant in adoption of most of the information technologies such as online banking (Guriting and Ndubisi, 2006; Jahangir and Begum, 2008; Wang *et al.*, 2003). By applying Davis (1989) definition, in this study PEOU refers to the degree of which an individual believes that using ME would be free of physical and mental effort. Therefore, ME must be easy-to-use or learn and this leads to the proposition of the following hypothesis:

H2: PEOU has positive effect on consumer IU m-entertainment in Malaysia

Social influence (SI)

Lu *et al.* (2003) asserts that SI is equivalent to subjective norm (SN) and has a meaning of an individual's belief regarding whether others think that one should engage in an activity. Fishbein and Ajzen (1975) stated that SN refers to the social pressure exerted on an individual to exhibit or not exhibit a particular behaviour. SN is an important determinant of

TRA and TPB that may explain a technological adoption. The significance of SN on intention to use mobile services was revealed from studies based on the information system perspective (Hung *et al.*, 2003; Teo and Pok, 2003). From the DOI theory pioneered by Rogers (1995), SI can be divided into two types namely mass media and interpersonal influence. Mass media influences encapsulate newspapers, magazines, television, radio, academic journals, Internet and other mediums (Toh *et al.*, 2009). On the other hand, the interpersonal influence includes social network such as peers, friends and families, superiors, colleagues and etc (Gerrard and Cunningham, 2003). In fact, SI poses a huge effect on IU in m-commerce (Khalifa and Shen, 2002). Liu *et al.* (2009) found that social factor is of most importance in the acceptance of ME among Chinese rural people. Hence, the following hypothesis is put forward:

H3: SI has positive effect on consumer IU m-entertainment in Malaysia

Perceived self-efficacy (PSE)

Liu *et al.* (2009) defines PSE as an individual's self perception of being able to use a service or product. Bandura (1997) opined that PSE is people's belief about their abilities to produce designated levels of performance that exert influence over events that influence their lives. Besides that, Compeau and Higgins (1995) and Marakas *et al.* (1998) define computer self-efficacy (CSE) as an individual's judgment of their capabilities to use computers in various situations. Liu *et al.* (2009) discovered that self-efficacy ranked number five among seven factors in their mobile entertainment acceptance (MEA) model. In this study, Bandura's definition is used as the basis of reference. Therefore, there is evidence to support the following hypothesis:

H4: PSE has positive effect on consumer IU m-entertainment in Malaysia

Perceived enjoyment (PE)

Perceived enjoyment is defined as a reward derived from the use of technology or service (Igbaria *et al.*, 1996). However, PE was defined by Davis *et al.* (1992) as the extent to which an activity of using computers is perceived to be enjoyable in its own right regardless of any performance consequences that may be anticipated. They also found that PE is a significant determinant of behaviour intention and influences the IU. It was proven that PE has a significant influence towards consumers' use of mobile services (Hoflich *et al.*, 2001). Koufaris (2002) stated that there is a direct effect of enjoyment on IU in the context of online shopping. On the other hand, Teo and Lim (1999) discovered that PE has a positive influence on Internet users in Singapore. Hence, we would like to posit the following hypothesis:

H5: PE has positive effect on consumer IU m-entertainment in Malaysia

Methodology

Sampling and data collection

A survey instrument was developed to test the above mentioned hypotheses. To ensure the validity of the scale used, it is advised to largely adapt the items for each construct from previous empirical studies (Luarn and Lin, 2005). Therefore, in this research, 23 items for five constructs of independent variables and 4 items for one construct of dependent variable in the questionnaire were adopted from prior empirical researches and were modified to suite into the context of ME. Table 1 displays the sources of where the questions were adapted from.

The target population of this study are individuals who are mobile device users based on the rationale that there are more likely to adopt ME than those who do not have mobile devices. The questionnaires were administered to the students from a private institution of higher learning in Malaysia. A total of 460 respondents took part in the survey. Out of these 460 samples, 37 samples were discarded due to partial response and/or missing data, leaving an actual total sample size of 423 and thus giving a response rate of 92.8%.

Take in Table 1

Variable measurement

Independent variables

The independent variables were chosen based on factors derived from previous studies. The questions were modified to fit the context of ME. A total of 27 questions were constructed to capture the five adoption factors under investigation. Each question was measured by five-point Likert scale. For example, “1” denoted as strongly disagree, “2” denoted disagree, “3” denoted as neutral, “4” denoted as agree and “5” denoted as strong agree. Field (2005) stated that these items are important to minimize the response bias due to the fact that respondents will have to read the items more carefully in case they are phrased the other way round.

Dependent variable: consumer IU on ME

The 4 items for IU were adapted from the original TAM by Davis (1989). For this study, some of the items for IU on ME were also consistent with those of Davis (1989), Kurnia *et al.* (2006), Luarn and Lin (2005), Liao *et al.* (2007), Jaruwachirathanakul and Fink (2005), Pikkarainen *et al.* (2004) and Tan and Teo (2000). The IU item was measured using five-point Likert scale where “1” denoted as strongly disagree, “2” denoted disagree, “3” denoted as neutral, “4” denoted as agree and “5” denoted as strong agree. A total of 31 questions for both dependent and independent variables were used to capture the IU on ME. The reliability coefficient (Cronbach’s alpha) for the scale ranges from 0.762 to 0.883.

Data analysis

Statistical Analysis

A Structural Equation Modelling (SEM) methodology was engaged to analyze the research framework as shown in Figure 1. A two-stage model-building process is used to carry out SEM which was previously suggested by many researchers and scholars (Lin and Lee, 2004; 2005; Hair *et al.*, 1998; Sit *et al.*, 2009). The initial stage refers to confirmatory factor analysis (CFA) test while the structure model testing was performed in the later stage.

Exploratory Factor Analysis (EFA)

EFA with varimax rotation has been conducted separately on the adoption factors and intention to use ME to extract the dimensions of each construct. The validation process has resulted in the deletion of 8 items in the adoption factors as they did not contribute to the Cronbach's alpha values. Specifically, the fifth (PEOU4) item of perceived ease of use; the fourth (SI4) and fifth (SI5) items of social influence; the first (PSE1) and second (PSE2) items of perceived self-efficacy and the third (PE3); fourth (PE4) and the fifth (PE5) items of perceived enjoyment have been removed as these items also have poor factor loadings of less than 0.5 on their latent variables respectively (Hoang *et al.*, 2006; Sit *et al.*, 2009). Table 2 which summarizes the results of EFA shows the Cronbach's alpha values ranging from 0.762 to 0.883 are well above the acceptable threshold of 0.70 as asserted by Nunnally and Bernstein (1994). Besides that, their corresponding factor loadings are also statistically significant ($p < 0.001$).

Take in Table 2

Measurement Model – Confirmatory Factor Analysis

In the third step, the measurement model is tested using CFA to determine the construct validity of the adoption factors. The measurement model in this research consists of 19 items which represent five factors, namely perceived usefulness (PU), perceived ease of use (PEOU), social influence (SI), perceived self-efficacy (PSE), and perceived enjoyment (PE). Fornell and Larcker (1981) affirmed that a more appropriate indicator was the composite reliability, having taken into consideration the actual factor loadings instead of presuming that every item was fairly weighted in the composite load determining (Lin and Lee, 2004; Molina *et al.*, 2007). Molina *et al.*, (2007) has suggested that the minimum proposed value is 0.70. Subsequent analysis was carried out to determine the Average Variance Extracted (AVE), in which according to Molina *et al.*, (2007, p. 691), the minimum suggested value should be 0.5. As shown in Table 2, the scales for all cases are within the acceptable limits. The composite reliability of all the latent constructs is also over 0.7, which has surpassed the suggested benchmark by Nunnally (1978) and thus, can be concluded that the measurement is good. Besides that, the convergent validity and internal reliability for constructs are also being included in Table 2.

Seven common measures, namely ratio of χ^2 statistics to the degree of freedom (df), comparative fit index (CFI), goodness-of-fit index (GFI), adjusted goodness-of-fit index

(AGFI), normed fit index (NFI), the standardized root mean squared residual (SRMR) and root mean square error of approximation (RMSEA) were subsequently applied to gauge the measurement model's goodness of fit (Segars and Grover, 1998; Kaynak, 2003; Lin and Lee, 2004; 2005). Table 4 indicated the observed normed χ^2 for this model was 1.245 (*p*-value = 0.288 > 0.05), which is less than 3 as suggested by Bagozzi and Yi (1988). All other fit indices such as the GFI = 0.998; AGFI = 0.982; CFI = 0.999; NFI = 0.993 are greater than the suggested cut-off level of 0.9 (Bagozzi and Yi, 1988) and the SRMR coefficients are less than 0.1 (Hoang *et al.*, 2006). On the other hand, the RMSEA which is 0.024 appears to be below the cut-off level of 0.08 as proposed by Brown and Cudeck (1993).

Hence, based on the combination of the above mentioned test results, it can be concluded that the measurement model provides a very good fit for the data collected.

Take in Table 3

Structural Model

The overall results of the structural model analysis are shown in Table 5. Table 4 shows that the structural model has a well fit as determined by the Chi-square index (χ^2 statistics to the degree of freedom (df) = 1.279; *p*-value = 0.278 > 0.05) and other indices (GFI = 0.998; AGFI = 0.979; CFI = 0.999; NFI = 0.995; SRMR = 0.004; RMSEA = 0.026). All the model-fit indices exceeded their respective common acceptable levels which imply that the structural model portrays an acceptable fit to the data (Bagozzi and Yi, 1988; Lin and Lee, 2005; Sit *et al.*, 2009; Brown and Cudeck, 1993; Hoang *et al.*, 2006).

Take in Table 4

Hypothesis testing

In this testing stage, the validity of the hypothesized paths was ascertained by checking the statistical significance of all the structural parameter values. The analysis results indicated that 5 factors, namely perceived usefulness (PU) (standard error = 0.036; critical ratio = 3.589; $p < 0.01$), perceived ease of use (PEOU) (standard error = 0.048; critical ratio = 2.432; $p < 0.05$), social influence (SI) (standard error = 0.038; critical ratio = 4.527; $p < 0.01$), perceived self-efficacy (PSE) (standard error = 0.052; critical ratio = 2.995; $p < 0.01$), and perceived enjoyment (PE) (standard error = 0.055; critical ratio = 5.057; $p < 0.01$) were found to be significantly and positively related with intention to use m-entertainment. Hence, all the hypotheses H1, H2, H3, H4, and H5 were supported. The hypotheses results are as shown in Table 5.

Take in Table 5

Discussion

In order to validate the proposed conceptual model for ME adoption, construct reliability test, normality test, EFA, CFA and SEM were carried out. It was found that PU, PEOU, SI, PSE, and PE have positive effects on IU of ME. These will be discussed in the following section.

Perceived Usefulness (PU)

PU has been proven to be significant in influencing adoption of ME. This is consistent with prior findings in the context of ME adoption (Wong and Hiew, 2005[b]; Liu *et al.*, 2009; Lo, 2005; Nysveen *et al.*, 2005). It shows that when users assume that ME is useful, it will influence them to adopt ME. Therefore, mobile and entertainment industry players should consider this as a key factor when designing their products and services by providing the relevant functionalities and useful features to consumers.

Perceived Ease of Use (PEOU)

PEOU was found to have significant influence towards adoption of ME. This result is in agreement with the previous findings (Liu *et al.*, 2009; Lo, 2005; Nysveen *et al.*, 2005; Wong and Hiew, 2005 [b]; Yeh and Liang, 2009). Therefore, we may conclude that if ME products and services are easy to use, the ME adoption rate will be greater. On the other hand, it was emphasized also by Davis (1989) that consumers are more willing to go through the hassles of learning the difficult to operate functions if they are deemed vital to them.

Social Influence (SI)

SI is the second most important factor. This is almost similar to the finding by Liu *et al.* (2009) who found that SI is the most important factor of ME adoption in China. It is also consistent with the findings by Wong and Hiew (2005) and Nysveen *et al.* (2005) but contradicts with the finding by Yeh and Liang (2009) who discovered that SI is insignificant in adoption of mobile games. Since the majority segment of ME users in Malaysia is relatively young (Wong and Hiew, 2005), they are easily affected by SI (Lu *et al.*, 2003). SI such as peers, friends and family, colleagues, mass media and etc play an imperative role in convincing them to use ME. Therefore industry players should give due consideration in promoting their products and services via either the printed media such as newspapers and magazines or electronic media such as TV advertisements or Social Networking Sites e.g. Facebook and Twitter as a means of market penetration and expansion strategy.

Perceived Self-efficacy (PSE)

PSE is the fourth important factor that affects the IU of ME. Nevertheless, it was found to have a significant influence towards ME adoption. This finding is in agreement with the finding of Liu *et al.* (2009) who ranked PSE as the fifth important factor out of seven factors. It may be concluded that users who have high PSE will tend to adopt ME more easily compared to those of low PSE. As a result, industry players should take into account this factor by providing the necessary programs and campaigns to educate and enlighten users regarding the usage and function of mobile devices. One option is to raise the users' self-efficacy by providing online tutorials, CD ROMs, quick-reference cards or user manuals that are easy to understand and follow. They may also offer help-desk or even on-call services to teach the necessary skills to the users.

Perceived Enjoyment (PE)

The most important factor that was found to have a vital influence on ME adoption is PE. Such a finding is consistent to the prior researches conducted by Liu *et al.* (2009), Lo (2005) and Nysveen *et al.* (2005) but contradicts to the finding of Yeh and Liang (2009) who found that PE is insignificant in the mobile games adoption. The finding indicates that users are willing to try and adopt ME if it is able to bring fun and joy to them. Since users are willing to spend money on entertainments, therefore, ME industry players should utilize this factor by coming up with products and services that are more enjoyable and fun to play with.

Conclusion

The most significant contribution of the research was the development of the conceptual model for ME adoption which consists of SI, PU, PE, PEOU and PSE. This is indeed helpful for all ME industry players as it would provide the guideline of factors for them to consider in developing and marketing their products and services.

Limitation and future studies

This research has several limitations that should be addressed in future study. The research was done in Malaysia and therefore it may not suite exactly the scenario of other geographical regions. Future studies may focus on comparison study across different countries and regions to create a global view in terms of ME adoption. Finally, due to large number of young respondents, future study may explore further the ME adoption across a wider age groups.

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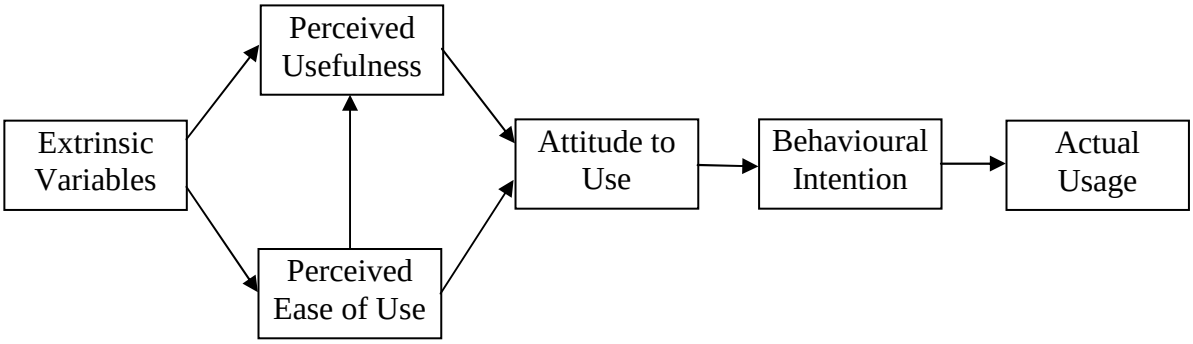

Figure 1: Original TAM model
Source: User Acceptance of Entertainment Services via Mobile Phone System in Hong Kong (Lo, 2005)

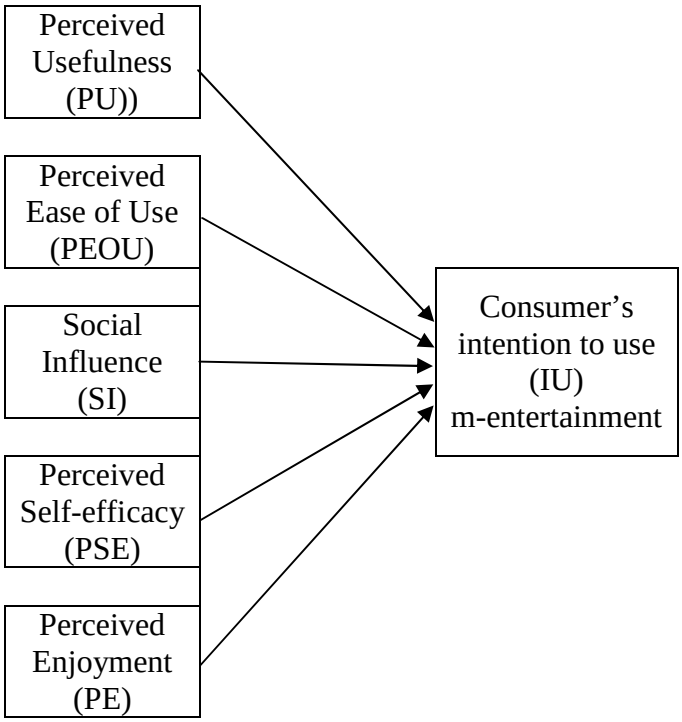

Figure 2: Conceptual model for adoption of Mobile Entertainment (ME)

Table 1: Construct and their sources

Constructs	Number of items	Sources
Perceived usefulness (PU)	5	Taylor and Todd (1995), Khalifa and Shen (2002), Wong and Hiew (2005[a]), Kurnia *et al.* (2006), Wang and Barnes (2007),
Perceived ease of use (PEOU)	4	Luarn and Lin (2005), Lin and Wang (2005), Wang and Barnes (2007), Tan and Chou (2008) and Toh *et al.* (2009)
Social influence (SI)	5	Luarn and Lin (2005), Lin and Wang (2005), Wong and Hiew (2005[a]) and Toh *et al.* (2009)
Perceived self-efficacy (PSE)	3	Liu *et al.* (2009)
Perceived Enjoyment (PE)	6	Tan and Chou (2008)
Intention to use (IU)	4	Davis (1989), Liao *et al.* (2007), Kurnia *et al.* (2006) and Toh *et al.* (2009)

Table 2 Instrument reliability and validity

Latent Constructs	Indicator	Standardized Loading	Reliability (SCR[a]; AVE[b])
Perceived usefulness (PU)	PU3	0.878	Cronbach's alpha = 0.883
	PU2	0.845	SCR = 0.886
	PU4	0.813	AVE = 0.611
	PU1	0.681	
	PU5	0.668	
Perceived ease of use (PEOU)	PEOU3	0.807	Cronbach's alpha = 0.762
	PEOU2	0.689	SCR = 0.757
	PEOU1	0.664	AVE = 0.522
Social influence (SI)	SI1	0.785	Cronbach's alpha = 0.729
	SI2	0.772	SCR = 0.738
	SI3	0.576	AVE = 0.515
Perceived self-efficacy (PSE)	PSE4	0.804	Cronbach's alpha = 0.802
	PSE5	0.759	SCR = 0.804
	PSE3	0.719	AVE = 0.579
Perceived Enjoyment (PE)	PE6	0.782	Cronbach's alpha = 0.853
	PE7	0.763	SCR = 0.859
	PE1	0.752	AVE = 0.553
	PE2	0.733	
	PE8	0.688	
Intention to use (IU)	IU3	0.793	Cronbach's alpha = 0.801
	IU4	0.695	SCR = 0.806
	IU2	0.681	AVE = 0.505
	IU1	0.668	

Notes: [a]**SCR = $(\Sigma\lambda i)^2/[(\Sigma\lambda i)^2 + \Sigma\delta i)]$, ($\lambda i$ = standardized factor loadings, i = observed variables, δi = error variance)**
[b]**AVE = $\Sigma\lambda i^2/n$ (i = 1 ..n, λ = standardized factor loadings, i = observed variables);**

Table 3 Latent construct correlation

	SEM Correlations				
	PSE	PE	PEOU	PU	SI
PSE	1.000				
PE	0.283**	1.000			
PEOU	0.446**	0.333**	1.000		
PU	0.155**	0.374**	0.182**	1.000	
SI	0.172**	0.415**	0.131**	0.389**	1.000

Notes: n = 423; **p < 0.01; PSE = Perceived self-efficacy; PE = Perceived Enjoyment; PEOU = Perceived ease of use; SI = Social influence; PU = Perceived usefulness

Table 4 Measures of the model fit

Goodness of fit measures	χ^2 test statistics/df	GFI	AGFI	CFI	NFI	RMSEA	SRMR
Recommended Value	$\leq 3.00^a$	$\leq 0.90^a$	$\leq 0.90^a$	$\leq 0.90^a$	$\leq 0.90^a$	$\leq 0.08^b$	$\leq 0.1^c$
CFA Model	**1.245**	**0.998**	**0.982**	**0.999**	**0.993**	**0.024**	**0.005**
Structural Model	**1.279**	**0.998**	**0.979**	**0.999**	**0.995**	**0.026**	**0.004**

Sources: [a]Bagozzi and Yi (1988); [b]Brown and Cudeck (1993); [c]Hoang *et al.* (2006)

Table 5 Hypothesis testing results

Hypothesis	Path	Estimate	Std. Error	Critical Ratio	*p*-value	Remarks
H1	PU → IU	0.131	0.036	3.581	0.000**	Supported
H2	PEOU → IU	0.116	0.048	2.432	0.015*	Supported
H3	SI → IU	0.174	0.038	4.527	0.000**	Supported
H4	PSE → IU	0.153	0.052	2.955	0.003**	Supported
H5	PE → IU	0.276	0.055	5.057	0.000**	Supported

Note: ** $p < 0.01$; *$p < 0.05$; PSE = Perceived self-efficacy; PE = Perceived Enjoyment; PEOU = Perceived ease of use; SI = Social influence; PU = Perceived usefulness; IU = Intention to use

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COLLABORATIVE KNOWLEDGE MANAGEMENT IN ORGANIZATION FROM SECI MODEL FRAMEWORK

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ABSTRACT

In the age of social collaboration and sharing that enables by Web 2.0 and Linked Data, many organizations adapt themselves into advantages of interactive, sharing, reusing, interoperability and collaboration on World Wide Web. Organizational learning which is sub of knowledge management also greatly gains benefit from this emerging collaboration culture too. It provides abilities to share valuable insights, to reduce redundant work, to avoid reinventing the wheel, to reduce training time for new employees, to retain intellectual capital as employee turnover in an organization, and to adapt to changing environments and markets.

However, user created content from Web 2.0 multiplying with published structure of data according to Linked Data concept will be a massive amount of data. It is inevitable facing the overwhelming of data. Traditional knowledge management is not designed to extract knowledge from social collaboration. We need a framework that fit for knowledge transfer in highly interaction environment.

SECI model which is a knowledge management based on collaborative knowledge transfer in organization seem to be the best candidate for navigating knowledge creation in this case. This study attempts to address how to apply SECI model to knowledge management system in collaborative organization.

Keywords: Knowledge management, Organizational learning, Collaborative, Web2.0, Linked Data, SECI model

INTRODUCTION

The emerging of Web 2.0 changes the way we manage knowledge in organization. We not only acquire knowledge and store but also concern about how it can be created, shared, learnt and reused. In 2004, Tim O'Reilly suggested new version of World Wide Web that had accumulative change in the way developers and end-users using the Web [14][16]. Web 2.0 slightly focuses on new technology but it mainly facilitates interactive among users, information sharing, interoperability and collaboration on World Wide Web.

The collaborative organization works together for the common goals by sharing, learning and building consensus. Particularly, collaborative team can obtain greater resource, recognition and reward in finite resources competitive [4]. Brainstorming is a good example for collaboration. It may not provide significantly measureable advantage such as number of ideas generated more than working individually but it improves moral, work enjoyment and

teamwork [13][12]. From the attempt to improve brainstorming, electronic brainstorming stands out through the positive effect of overcoming group size barrier [6]. Web 2.0 also allows participants to easily present, collect, discuss and evaluate associated ideas of the solution.

While Web 2.0 is only focusing on interface, data from collaborative interaction on web has increased successively. Traditionally, web data is published in raw dumps with formats such as HTML and XML. Raw web data is not sufficient to express its structures and semantics. Instead of traditional one, Linked Data [5] is published with well described relationships which link to other structured data on the Web. Linked Data aims to use web as single global database. Unified data interface will be a great benefit, but multiplying by user created contents encouraged by Web 2.0; we will definitely be overwhelmed with data.

To encounter data overloaded, many companies and organizations apply knowledge management to convert raw data into knowledge. Nonaka and Takeuchi [8] define knowledge management as the capability of an organization to create new knowledge, disseminate it throughout the organization, and embody it in products, services and systems. They also introduce the concept of SECI model which is a knowledge management theory based on more competitiveness of Japanese companies from their collaborative culture. The model describes collaborative learning or knowledge transfer in organization as a spiral. The spiral becomes larger in scale while moving up through organizational levels and triggers new spirals of knowledge creation [11].

Many approaches exist to implement knowledge management in an organization, but rarely mention about how to manipulate overwhelming data in the age of Web 2.0 and Linked Data. SECI model framework seems to be the best candidate for knowledge management approach while collaborative interaction is rising. This study attempts to derive a knowledge management by SECI model framework from the existent open source without building from the scratch.

RESEARCH OBJECTIVES

Knowledge management consists of a range of strategy and practice that are used in organization to identify, create, represent, distribute, and adoption of insights and experiences. Knowledge management targets typically focus on organization objectives such as improved performance, competitive advantage and innovation. Organizational learning which is in sub of Knowledge management but greater focused on the management of knowledge as a strategic asset and encourages the sharing of knowledge. Its efforts can help organization to share valuable insights, to reduce redundant work, to avoid reinventing the wheel, to reduce training time for new employees, to retain intellectual capital as employee turnover in an organization, and to adapt to changing environments and markets [9] [15]. Therefore, this study aims to develop knowledge management emphasizing in organizational learning module based on SECI model framework. The specific objectives are as followed:

- To describe how SECI model can be applied to collaborative organizational learning
- To design knowledge management system from SECI model.
- To address existent open source software that appropriate to implement SECI model knowledge management system.

- To implement SECI model knowledge management system.

METHODOLOGY

We develop software through waterfall model which process is seen as flowing downward through the phases of Requirements specification, Design, Implementation and Testing. Maintenance phase is out of scope of this study.

Requirements specification is to identify a behavior of knowledge management system when integrates with Web 2.0 and Linked Data.

System Design is to solve problem and plan for a software solution according to specifications. We design the software basis on combination of open sources.

Implementation of the system is not from the scratch. We aim to build on the top of existent open source systems which contain proper functions.

Testing of application is conducted by creating example of case study. We simulate problem-solving situation for organization and apply SECI model knowledge management to facilitate the processes.

REVIEW OF LITERATURES

SECI model

SECI model represent the spiral of knowledge conversion between tacit and explicit knowledge. To convert between two types of knowledge, user acts as a learner who an instructor transfers tacit knowledge to [8]. The knowledge that received from instructor is in explicit form. The learner embeds explicit into his/her tacit knowledge through learning process such as learning by doing, trial & error or simulation. Now, the learner with thorough understanding in the transferred knowledge acts as an instructor to forward the tacit knowledge to another

SECI model has four components

1. Socialization is a process that shared tacit knowledge among people in “social interacting space”. The key skill that makes socialization success is [empathizing].
2. Externalization is a process that converts [articulating] from tacit to explicit knowledge. This process creates knowledge in explicit form which is understandable and interpretable.
3. Combination is a process that integrates [connecting] different kinds of knowledge. The process focuses on interoperability between data such as metadata.
4. Internalization is to understand explicit knowledge and embeds [embodying] into oneself tacit knowledge. The transformed explicit knowledge becomes a part of individual’s thought process. The spiral is expanded when the individual shares the knowledge back through Socialization then the cycle will be completed

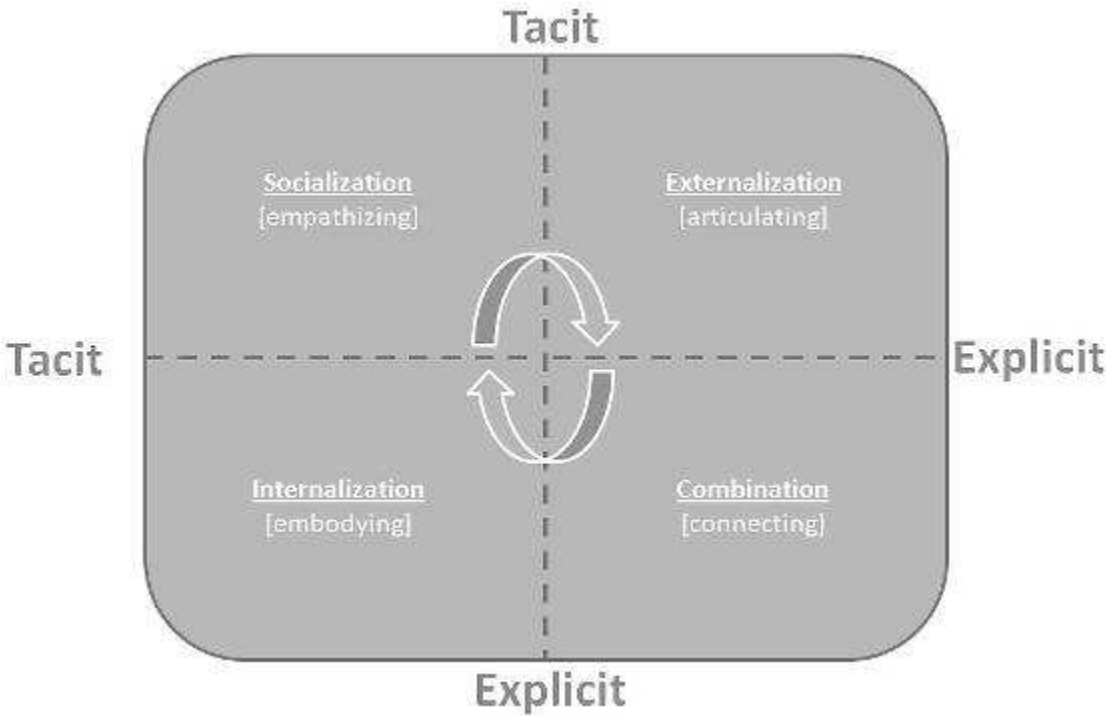

Figure 1 SECI model

Linked Data

Linked Data creates links or called vocabularies between data from different sources. RDF is used to make a statement for describing things in the world. Berners-Lee [1] outlines the set of rules to publish Linked Data.

1. Use URIs as names for things
2. Use HTTP URIs so that people can look up those names
3. When someone looks up a URI, provide useful information, using the standards (RDF, SPARQL)
4. Include links to other URIs, so that they can discover more things

Linked Data uses Uniform Resource Identifiers (URIs) [2] and the Hyper Text Transfer Protocol (HTTP) [7] which are fundamental of web technology. Uniform Resource Locators (URLs) become familiar as addresses for documents and other that can be located on the Web. URI provides a generic mean to identify unique entity of thing that exists.

HTML provides link to document on the web but RDF is above. RDF provides a generic, graph-based data model with which to structure and link data that describes things in the world. The RDF model [3] encodes data in the form of subject, predicate, object triples. The subject and object of triple is both URIs that each identifies a resource, or a URI and a string literal respectively. The predicate specifies how the subject and object are related, and is also represented by a URI.

Subject: *http://dig.csail.mit.edu/data#DIG*

Predicate: *http://xmlns.com/foaf/0.1/member*
Object: *http://www.w3.org/People/Berners-Lee/card#i*

Figure 2 Example RDF links

Figure 2 shows example RDF links. The link states that a resource identified by the URI *http://www.w3.org/People/Berners-Lee/card#i* is member of another resource called *http://dig.csail.mit.edu/data#DIG*.

Web 2.0

Web 2.0 websites allow users to interactive on facilities of "Web 1.0" [16]. Web 2.0 websites typically include some of the following features and techniques. Andrew McAfee used the acronym SLATES to refer to them [10]

Search: Finding information through keyword search.

Links: Connects information together into a meaningful information ecosystem using the model of the Web, and provides low-barrier social tools.

Authoring: The ability to create and update content leads to the collaborative work of many rather than just a few web authors. In wikis, users may extend, undo and redo each other's work. In blogs, posts and the comments of individuals build up over time.

Tags: Categorization of content by users adding "tags", usually one-word descriptions to facilitate searching, without dependence on pre-made categories. Collections of tags created by many users within a single system may be referred to as “folksonomies”

Extensions: Software that makes the Web an application platform as well as a document server.

Signals: The use of syndication technology such as RSS to notify users of content changes.

THE ANALYSIS OF SYSTEM REQUIREMENTS

This section defines system requirements inherited from SECI model framework. We derive the system from knowledge management which combines Web 2.0 and Linked Data. We address fundamental functions required by each function of SECI model component.

The Socialization function creates virtual interactive space for social participation in community. We require virtual Learning Space and knowledge transfer support system from software such as Learning Management System (LMS). To create community participation the social network provides individuals network tied by relationships plus self sharing and broadcasting abilities which leads to collaborative knowledge transfer.

The Externalization Function is an expression tools to convert tacit to explicit knowledge. There are many of tools to express the knowledge such as learning object creator in LMS, Digital resource creator in Digital Library (DL), blog forum and wiki in social network of Web 2.0. Digital repository also needs to store resource created by user.

The combination function implies to interoperability, sharing and integration of explicit knowledge. The concept of Linked Data perfectly fit for this task. The resources that are created as explicit knowledge will be shared as single format over the web.

The internalization function is the final process to transform explicit to implicit knowledge. This task is individual yet measurable. We need assessment and evaluation modules to determine how well users embodying knowledge into them.

Therefore, the requirements from SECI model are as followed:

Table 1 SECI model requirements

Component	Requirement
Socialization	Virtual learning space, Social network
Externalization	Digital repository, Expression tools e.g. learning object creator, Digital resource creator, Forum, Chat, Blog
Combination	Interoperability, Sharing, Integration
Internalization	Assessment, Evaluation

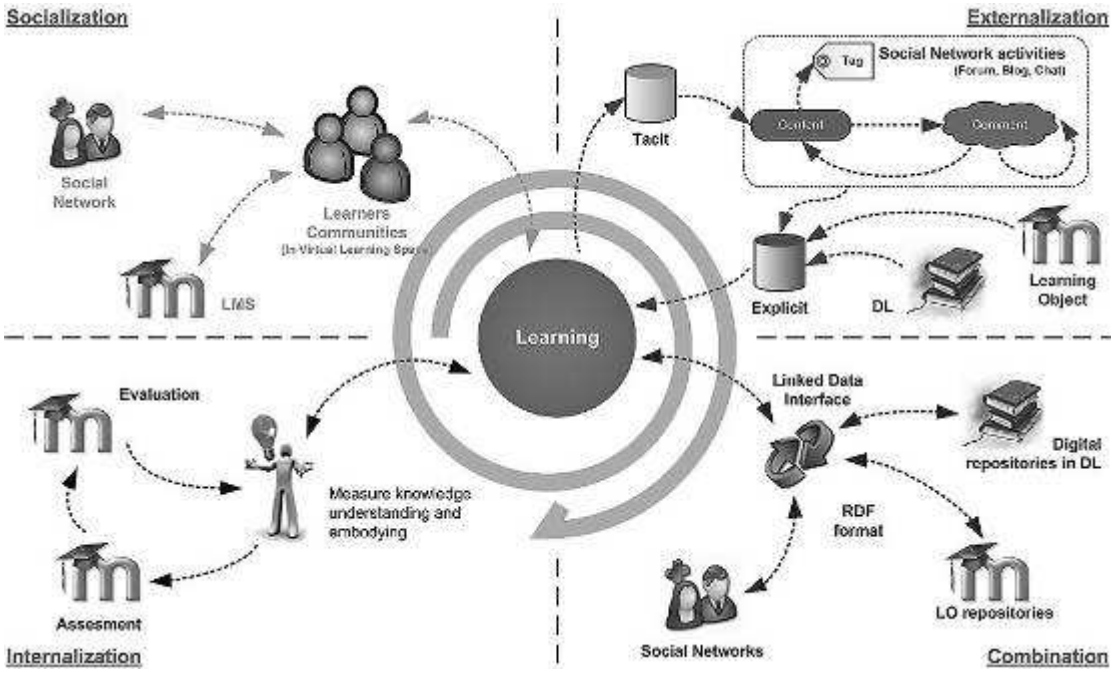

Figure 3 Abstract architecture of SECI model knowledge management

SYSTEM DESIGN

The SECI model knowledge management architecture as described in previous section requires many features more than traditional knowledge management does. We breakdown

requirements and compare to the existent software. We decide to use combination of Learning Management System and Digital Library to implement the system. Features list of correspondence functions are written in table below.

Table 2 Applying LMS and DL features to the SECI model knowledge management

System	Requirement	Application
LMS	Virtual learning space, Social network, Expression tools, Assessment, Evaluation	Moodle
DL	Digital repository, Expression tools	Dspace
Linked Data interface	Interoperability, Sharing, Integration	LiLO

LMS and DL cannot integrate directly because they are implemented independently. To implement interoperability between systems, we apply concept of Linked Data to create an interface based on RDF. This interface acts as a unify portal to exchange RDF resource between integrated systems. The interface is created from customizes PHP application and name it Linked Data Learning Object Exchange (LiLO)

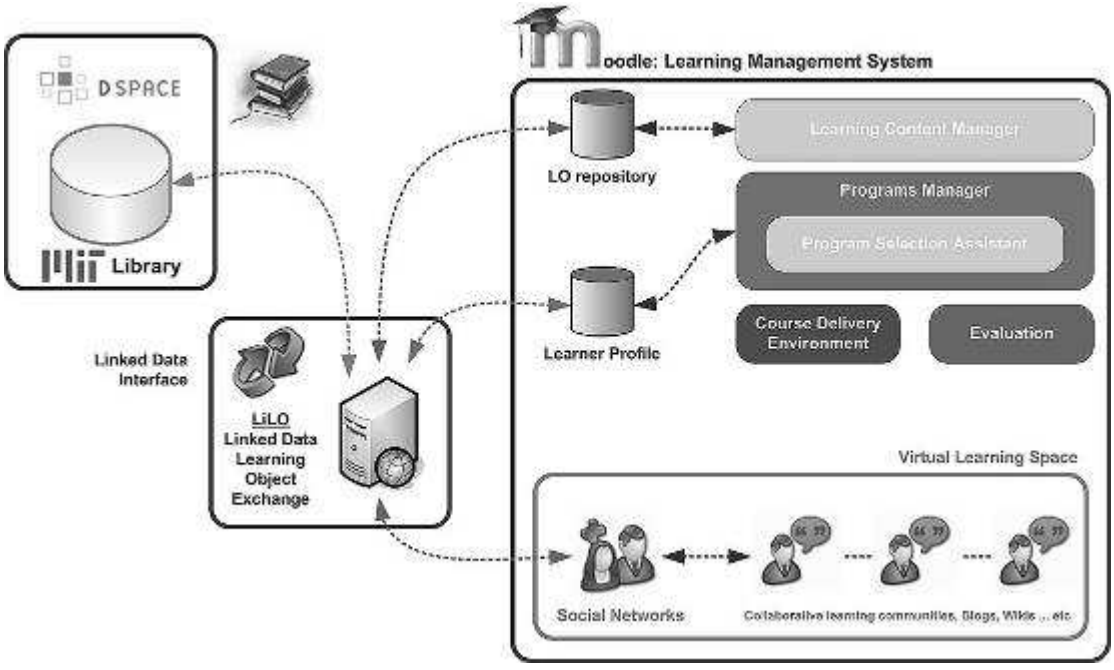

Figure 4 System design of SECI model knowledge management

IMPLEMENTATION

We choose three applications Moodle, Dspace and Linked Data search api from sindice.com. Moodle is LMS which comes with social network features such as blog forum and Wiki. In our research, we use MIT Dspace library as digital repository. Its resources are already attached with RDF links. Our system can import the resource in RDF format and indexes into Moodle local database. RDF publisher converts resource description in Wiki module which

attached with Moodle in to RDF format. A learner can also contribute resource description as well as content in Wiki itself.

LiLO has five main functions.

- RDF search: search Linked Data resource through Sindice.com api
- RDF browser: browse resource description
- RDF editor: edit local resource description
- RDF publisher: publish local resource description
- LO importer: import RDF to local repository

TESTING RESULT

We simulate case study to evaluate how well the system facilitates user. We implement product improvement project based on LiLO application and share knowledge to create this project on Wiki.

Figure 5 Create project improvements

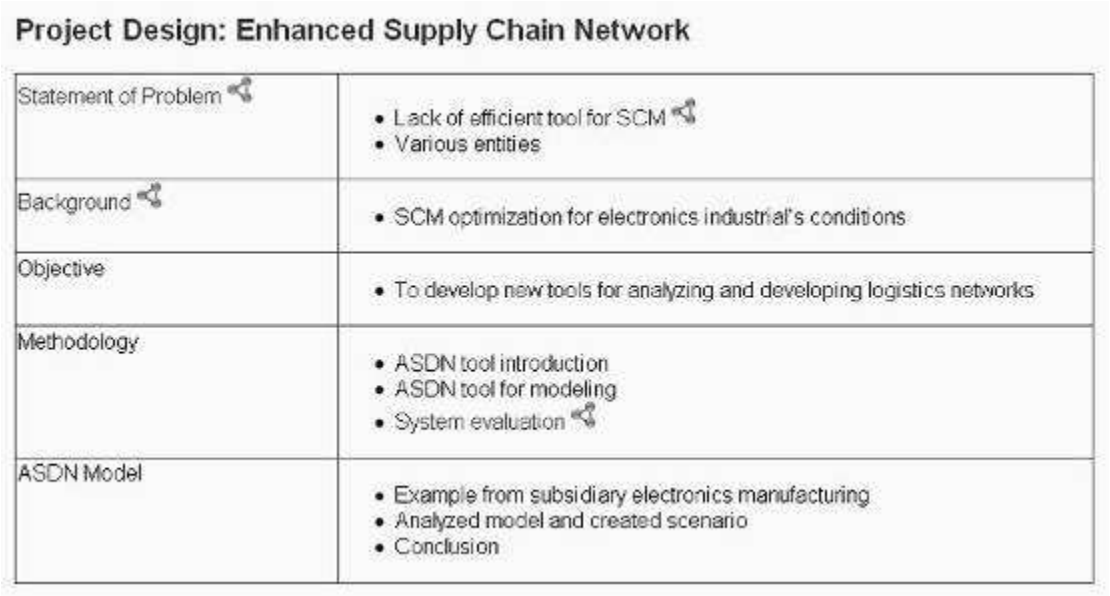

Figure 6 Read Wiki content

RDF icon indicates that the topic is described by RDF triple. The RDF is created automatically when user is editing on Wiki content

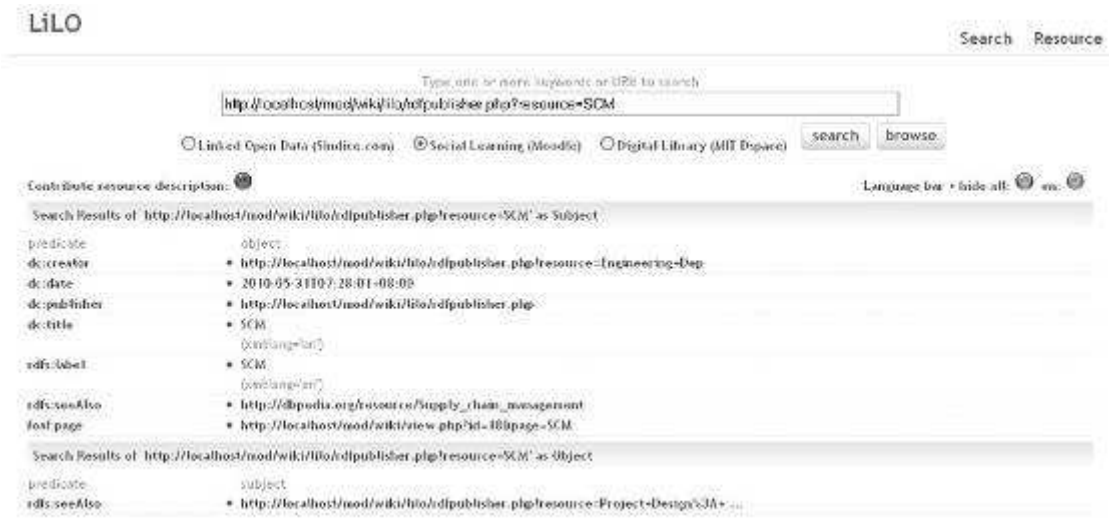

Figure 7 Display Wiki content's RDF

After we clicked in RDF icon of SCM, the system shows RDF content of SCM. Users can read, edit, and add another description to share their knowledge to the members.

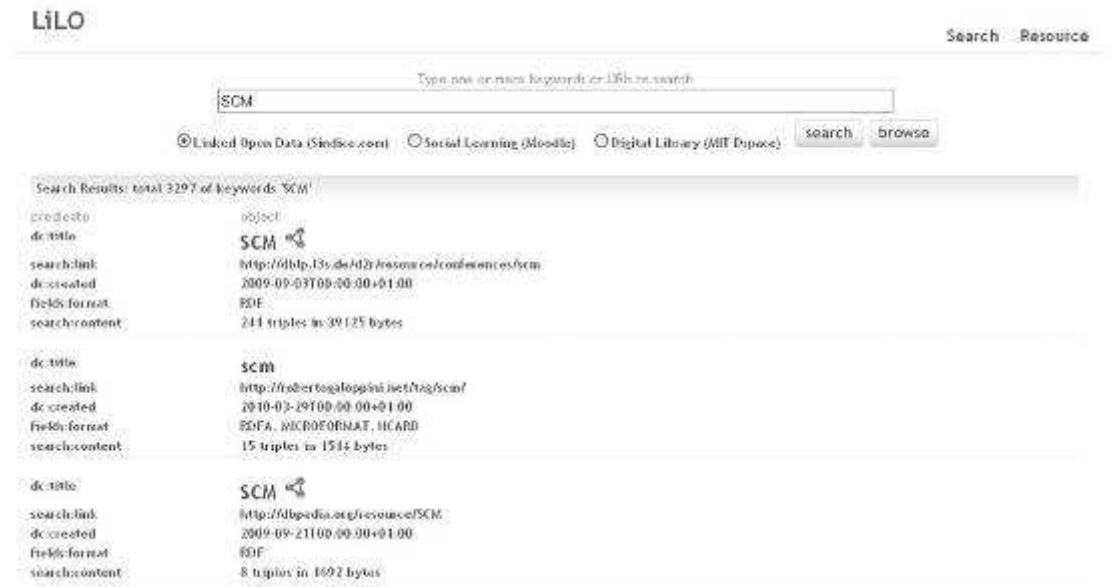

Figure 8 Search for related content on Linked Data

To search for related content, system provides search from Sindice.com API. User can also browse through RDF link.

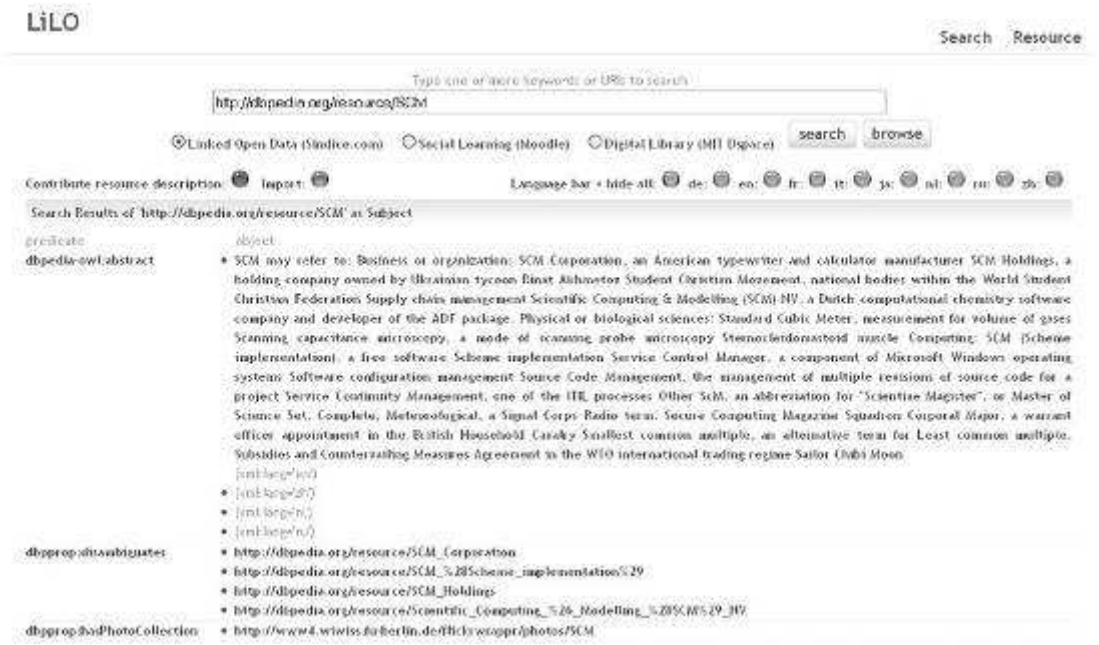

Figure 9 Description of RDF defined by DBpedia

Users can contribute their knowledge by clicking button

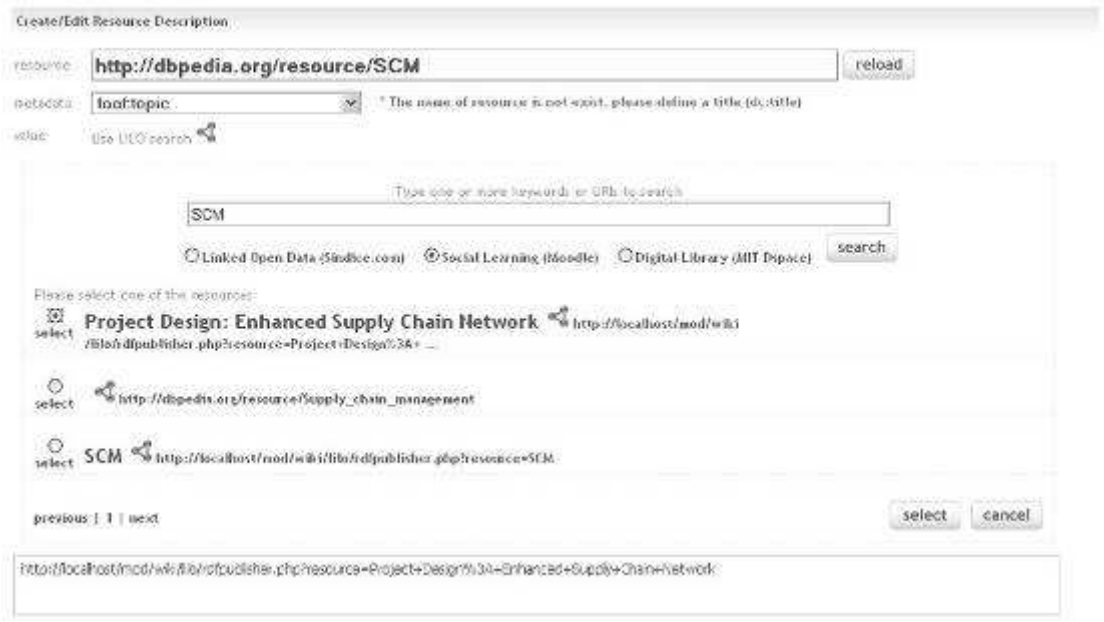

Figure 10 User created description

Custom description will be stored on local server (Moodle). User also can use “LiLOsearch” to find additional link for the resource. The figure 10 shows that user defines resource SCM of DBpedia as a topic of project Enhance Supply Chain Network.

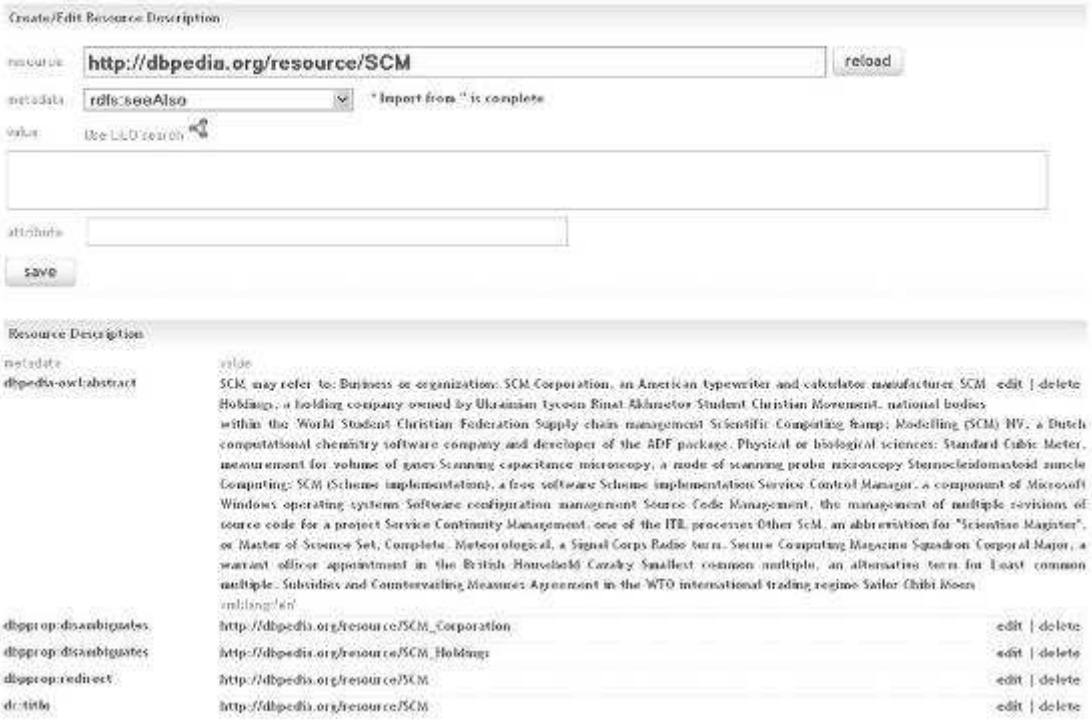

Figure 11 Import descriptions from DBpedia

User can import whole description from DBpedia by clicking Import:

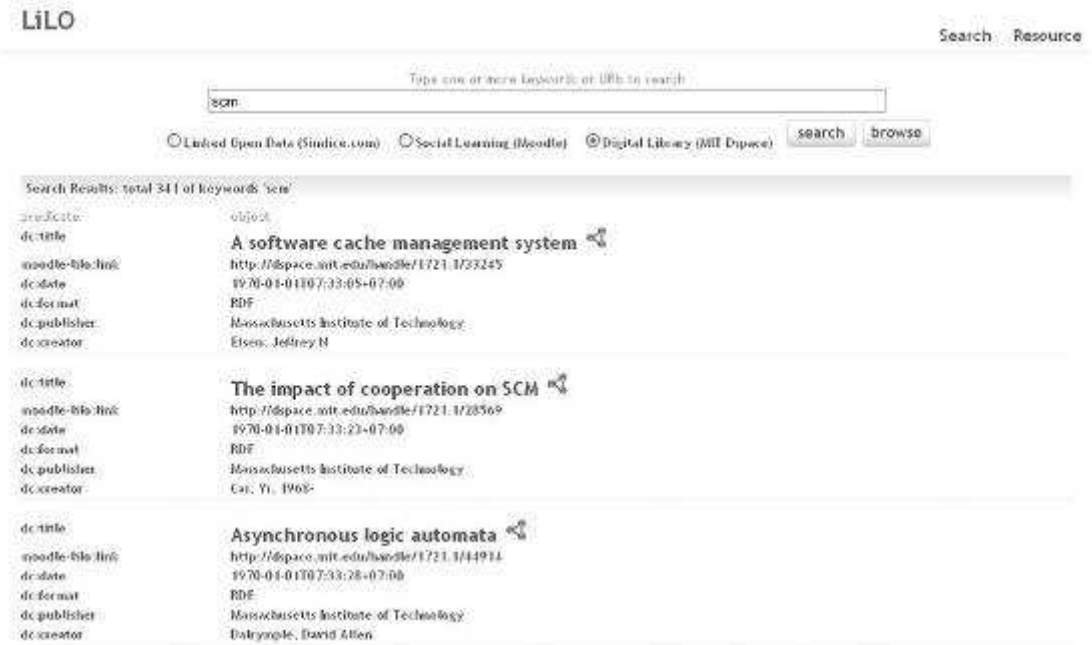

Figure 12 search citation from MIT digital library

MIT digital library provides academic research about SCM related. User can use them as a citation.

CONCLUSION

The main goal of this research, we aim to design appropriate system according to SECI model framework which can handle knowledge transfers in the age of social collaboration. The result of implemented system showed that Linked Data definitely increases discoverability. It expands boundary of learning, sharing, and cooperation in an organization. RDF eliminates heterogeneity of description data. Browser can directly access to resource and dereference to the related ones. These advantages also benefit the usage of learning object in sharing and reusing resources. One of web 2.0 major problem is unpredictable of user created content. Collaboration learning will improve quality of content from time to time through spiral of SECI model.

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CRITICAL SUCCESS FACTORS (CSFS) OF TQM: A STUDY

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ABSTRACT

The global marketplace and domestic and international competition have made organizations around the world realize that their survival depends on high quality. Total Quality Management (TQM) has spread its wings every sphere of the global corporate world and Indian companies are no exception. Post-globalization, top Indian firms, especially in the manufacturing sector, started adopting strategies to not only be competitive globally but also reduce their defect rates dramatically.

Critical Success Factors (CSFs) are internal or external factors that can seriously affect the firm for better or worse. They provide an early warning system for management and a way to avoid surprises or missed opportunities. In the context of TQM, it is essential that the organizations identify a few key critical success factors, which should be given special attention for ensuring successful implementation of TQM program.

The present study will guide the researchers in selecting the reliable set of CSFs for empirical studies. Industries can benefit by adopting the results of this study for effective implementation of TQM.

Keywords: TQM; CSF; Implementation; Competitive

INTRODUCTION

In today's globalize economy, competition is becoming ever more intense. Many companies are trying very hard not only to satisfy their customer's needs but where possible exceed them. This can only be achieved through cost reduction, improvement in product performance, increased customer satisfaction and a constant effort towards world class organizations. In order for companies to survive and grow in the future, it is essential that they deliver high quality goods and services. Those that can deliver quality are the ones that will prosper in the next century.

Companies actually compete on three major issues; Quality, Price and Delivery. If the choice is to compete in the market place on the basis of product or service price, then the level of competition is clearly defined; the low-cost provider wins. However, companies choosing the low cost approach may find themselves losing premium business to competitors while retaining the low-margin business in the long term. In fact, they are also vulnerable to any competitor who can offer value at a lower price. This is why many companies have become aware of the need to make quality is the competitive marketing strategy in a global market.

Large companies for instance, have started to implement total quality initiative in their products and services. The increasing acceptance of Total Quality Management (TQM) as a philosophy of management and a way of company life has taken place for almost three decades.

Many companies understand that TQM is necessary for them to remain competitive, retaining their market share and to be able to respond to changing competitive demand in today business world. Based on some studies (Ross, 1994, Ghobahdian, 1995, Ahire et al., 1996,Gulbro et al., 2000), not all companies are able to implement TQM successfully. This is because it requires a different implementation approach to cater for the varying needs of the industries in order for effective implementation. Small and medium sized enterprises (SMEs), for example, have been slow in adopting TQM when compared to large companies. Their involvement has focused primarily on ISO 9000 certification, and very few had advanced beyond that (Yusof, 2000).

Therefore, the identification of critical success factors for successful implementation of TQM is an important area to be understood. The value of this research is one of the primary steps towards reaching the needs of manufacturing industries that are trying to implement TQM in their business.

OBJECTIVES OF STUDIES ON CSF'S

Different authors have attempted to investigate the CSFs in TQM with differing purposes and objectives. Saraph et al's [1989] main objective was to develop an instrument to measure quality management practices t the divisional level of companies. The critical factors in their instrument measured the `extent of practice' of the elements but have no considered the perceived `level of importance' for implementation. Garvin (1983) conducted a specific empirical study to determine the differences in quality practices between Japanese and American air-conditioner manufacturers. Based on his study, he determines certain practices, which contributed towards quality excellence, undertaken by the Japanese manufactures. They included management commitment for quality, quality programs, policies and systems, comprehensive product design, system for vendor selection and management and workforce management and n integrated system of quality management.

Badri et al (1995) replicated Saraph et al's study in one Middle East country to prove the viability of the developed instrument in n international context. They revealed weakness in the instrument, in which there were elements that needed further clarification, one example was the effectiveness of a quality department in improving quality.

Black and Porter (1996) developed their factors from the Malcolm Baldridge award criteria, on the basis that it is the best established and recognized framework for measuring TQM. Tamimi and Gershon (1995) developed and instrument to measure quality management practices from Deming's 14 points s critical factors. Ahire et al (1996) proposed a set of 12 implementation constructs (similar to factors) of quality management strategies derived mainly from the literature. Their instrument was tested and validated for manufacturing industry thus making it

applicable to the particular industry. Their main purpose was to develop a reliable and valid instrument for measuring quality management practices that affected by proper quality practices but also customer and human resources satisfaction and above all organizational quality performance.

Based on these studies, there were two main areas of focus. The first centered around attempting to systematically present the factors within TQM, and the second, on the factors critical for implementation. Each of them represents a different concept. Critical factors for TQM, s proposed by Saraph et al (1989), were developed because no one at that time had attempted to `theorise' and `formalise' TQM. Most of the TQM practitioners were `preaching' according to their understanding of the gurus' teaching, which made TQM too philosophical. The researcher believes that the set of critical factors formulated by them was intended to address this problem. The second approach on CSFs for TQM implementation proposed by Ahire et al (1996) and Black and Porter hinge around those important and necessary for making TQM adoption success.

Another important aspect to be recognized is that although studies on CSFs of implementation were conducted for companies of all sizes. Even Saraph et al's study did not consider companies having less than 1000 employees. They argued that 'firms with less than 1000 employees were not considered since the quality management practices of these firms were likely to be relatively unsophisticated, or at the very least variable'. This is arguably not true.

Kanji and Malek (1999) and Kanji and Yui (1997) have developed their own set of CSFs based on Kanji's Business Excellence Model. Quazi and Padibjo (1998) conducted a study in Singapore on those SMEs, which were attempting to move towards TQM through a certification route. Their objectives were to help organizations identify their respective training needs for training and consultancy support. Towards that end, they developed a survey instrument to measure quality management practices based on the Malcolm Baldridge/Singapore award criteria. 39 elements were produced from 7 critical factors. However, it could be argued that two of the factors; quality results and customer satisfaction are not appropriate. Porter and Parker (1993) have similarly argued that quality results are a measure of TQM success and customer satisfaction is an implicit goal of the TQM process. Both of them are actually outcomes of TQM, but not critical factors. Using award criteria as success factors without proper scrutinizing them can be misleading. Critical factors should be interpreted as those circumstances or practices which already exist, or those that need to be developed in ensuring the success of TQM implementation.

SELECTION AND ANALYSIS OF TQM FRAMEWORKS

An extensive literature survey has been carried out to select TQM frameworks for this study. The relevant literature has revealed that different countries have adopted similar TQM frameworks in the form of quality awards with a different title. Today, there are more than a hundred quality awards existing in different countries. However, all these quality awards are basically derived from three basic and prestigious awards: the Malcolm Baldrige National Quality Award (MBNQA), the European Quality Award (EQA) and the Deming Prize. This study, therefore, includes only these three basic awards as TQM frameworks along with other

frameworks developed by scholars. Furthermore, through the study of TQM literature, eleven TQM frameworks developed by researchers have been selected. In total, fourteen important TQM frameworks viz. Deming prize, MBNQA, EQA, Saraph et al., Oakland, Flynn et al., Babbar and Aspelin, Ahire et al., Black and Porter, Pheng and Teo, Ang et al., Zhang et al., Nwabueze and Thiagarajan et al., were chosen from the TQM literature for the purpose of establishing TQM CSFs for the construction industry. A detailed analysis of the frameworks with respect to CSFs is carried out and presented in Table 1 Based on the frequency analysis, the CSFs are prioritised as shown in Table 2.

Table 1: List of CSFs as recommended by various authors
Source: Wali, Deshmukh and Gupta, 2003

Table 1. Analysis of TQM Frameworks

	Juran 1974	Ishikawa 1976	Crosby 1979	Feigen-Baum 1983	Deming 1986	Garvin 1987	Saraph et. al. 1989	Lu & Sohal 1993	Porter &Parker 1993	Motwani et. al.	Powel 1995	Black & Porter 1995	Total
1	x	x	x	x	x	x	x	x	x	x	x	x	12
2	x		x	x	x		x	x	x	x	x	x	10
3	x		x	x	x	x	x	x	x	x	x		10
4	x	x	x		x	x	x	x		x	x	x	10
5	x	x	x	x	x		x	x	x	x	x		10
6	x	x	x		x	x			x	x	x		8
7	x				x	x	x			x	x	x	7
8	x		x	x		x	x			x		x	7
9	x	x	x		x		x			x	x		7
10								x	x		x	x	4
11								x			x	x	3
12								x	x			x	3
13									x		x	x	3
14								x			x		2
15			x										1
16									x				1

*Note: 1 - Top management commitment; 2 - Strategic quality management; 3 - Process quality management; 4 - Design quality management; 5 - Education and Training; 6 - Supplier quality management; 7 - Customer satisfaction; 8 - Employee empowerment and involvement; 9 - Business results; 10 - Information and Analysis; 11 - Benchmarking; 12 - Resources; 13 - Impact on society and environment; 14 - Statistical process control; 15 - Culture.

Table 2. Prioritisation of CSFs

Sr. No.	Critical Success Factors	No. of studies in which the factor was extracted	No. of country categories in which the factor is present
1	Top management commitment and leadership	67	23
2	Customer focus	53	21
3	Information and analysis	53	17
4	Training	50	19
5	Supplier management	47	17
6	Strategic Planning	38	16
7	Employee Involvement	32	18
8	Human Resource Management	26	16
9	Process management	26	13
10	Teamwork	22	9
11	Product & Service Design	21	11
12	Process Control	21	8
13	Benchmarking	16	12
14	Continuous improvement	16	10
15	Employee empowerment	16	6
16	Quality assurance	15	12
17	Social responsibility	10	9
18	Employee satisfaction	9	6

Table 2: Most commonly extracted factors across the 76 studies and the 23 countries
Source: Sila and Ebrahimpour, 2003

An early exploratory attempt to arrive at CSF in the Indian context was made by Motwani, Mahmoud and Rice (1994) wherein they arrived at nine critical factors for effective management of quality in Indian manufacturing industry. As the TQM literature in India moved from introductory level discussion on TQM (Lakhe & Mohanty 1994) to more robust research work, the emphasis also shifted from a mere duplicating of western models of quality to trying to develop indigenous models. Wali, Deshmukh and Gupta (2003) made a review of various critical success factors which different authors including the founding fathers of TQM like Deming, Juran, Ishikawa, Crosby, Feigenbaum, and Garvin had recommended. Wali, Deshmukh and Gupta started from the early work of identification of the critical success factors (CSF) by Saraph, Benson and Schroeder (1989) to the more recent one by Ahire, Golhar and Waller (1996). From there, they attempted to identify the critical success factors (CSF) for adoption of TQM in the Indian context. Their study claims that

these 'CSFs are derived based on actual practices followed by Indian organizations and it was based on a statistically validated instrument and factor analysis. It was not based on constructing a priori set of pre-defined CSFs and then matching it with actual practice' (Wali, Deshmukh & Gupta 2003, p. 12).

The study by Wali, Deshmukh and Gupta (2003) is perhaps the first comprehensive empirical study of quality practices in the Indian context. Thus it is worthwhile to look in detail at the twelve factors identified by them. They are listed below in decreasing order of importance.

(i) Leadership, Creativity and quality strategy: Successful quality performance requires that the leadership is dedicated to quality. It must also provide initiative and resource support. It must enable creativity to be nurtured and accordingly chalk out the strategy. Given the importance of leadership, it is not surprising to find that, in all quality awards, leadership issues are placed at the top of the list of criteria. Such leadership will drive quality strategy in an organisation and nurture creativity.

(ii) Worker – Manager interaction : This means that healthy interaction between worker and manager is important from quality point of view. The manager provides the direction for improvement and accordingly, workers are motivated to take initiative. In case of any difficulty, the worker interacts with the manager to improve the situation.

(iii) Results and Recognition : Crosby (1979) considers recognition as one of the most important steps of the quality improvement process. The organisation should reward their employees for their contribution to quality. There should be a quick recognition system for outstanding performance by the employees. These rewards may not be purely financial.

(iv) Work culture : The work culture must be very conducive. There should be an active interaction amongst the peers and support from supervisors. The critical importance of the employee's involvement in the quality process of an organisation should be based on the belief that the best process innovation idea comes from the people actually doing the job.

(v) Information and Data management : Information is the critical enabler of TQM. This factor emphasises that the key processes are regulary measured and quantified. There should be focus on benchmarking which provides a stimilus for improvement. The facts and information should be made available to all. This is mainly relevant for managing quality costs.

(vi) Customer Focus : Quality should be customer driven. …. Employees should be well aware of the concept of internal and external customers. They should care about meeting and exceeding the customer expectations. There must be a focus on customer feedback and accordingly the process should be driven.

(vii) Value and ethics : It is important for the people in an organisation to live up to the highest ethical standards. There should be perception of fair treatment to all. The organization must be guided by the value and ethical standards.

(viii) Communication across the organization: Effective communication channels must exist in the organization between various work units. With the help of information technology, comunication can be made effective. Effective communication is vital in aligning the workforce towards corporate expectations.

(ix) Team working: According to Crosby (1979), team work is a critical element of TQM. Teamwork delivers synergistic enhancement of quality efforts. Employees must demonstrate cooperative behaviour and positive attitude towards working in a team.

(x) Congenial inter – personal relations : The atmposphere in the organisation must behighly congenial to promote active interaction. There must be mutual respect and faith among employees.

(xi) Delegation and empowerment: In a TQM setting, both delegation and empowerment are required. People must share responsibility for the success or failure of their work.

(xii) Process improvement: Employees must identify opportunities for continuous improvement. If employee involvement is key to the attainment of customer satisfaction, managing the process is key to engaging an organisation's employees to take responsibilities for what they are doing in relation to satisfying the customers.

CONCLUSION

The analysis of fourteen of the most prominent TQM frameworks has revealed that out of fifteen CSFs, nine CSFs, are common in most of the frameworks. The analysis further pointed out that none of the frameworks are comprehensive. Apart from the Black and Porter framework, quality culture CSF does not exist in other frameworks even though there is ample evidence in the literature on the culture and success of quality initiatives. Using the twelve CSFs are proposed for Indian Manufacturing firms, namely, Leadership, Creativity and quality strategy, Worker – Manager interaction, Results and Recognition, Information and Data management, Customer Focus, Value and ethics, Communication across the organization, Team working ,Congenial inter – personal relations, Delegation and empowerment, and Process improvement. These CSFs presented act as a guide for Indian manufacturing industry contemplating a TQM initiative.

The present study will guide the researchers in selecting the reliable set of CSFs for empirical studies. Industries can benefit by adopting the results of this study for effective implementation of TQM.

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A STUDY OF ASSOCIATED PERSONALITY TRAIT OF HOLIDAY AND PURCHASE INTENTION

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ABSTRACT

Consumers do things that are related to a specific time-related context; for example, they buy Christmas gifts on Christmas, or have turkeys on Thanksgiving Day. But little research has paid attention to the mental mechanism underlined this phenomena. The authors take a psychological approach to address the question of how the special holidays as contexts are related to consumers' purchase intentions. Mainly drawing on associative network theory and personality trait theory, this authors argue that associated personality traits consumers have with a particular holidays (e.g., Christmas) serve as nodes that activate consumers' related knowledge or memory, in turn influence consumers' identification with that holiday, involvement in it, and purchase intentions (e.g., buying Christmas gifts during Christmas holidays).

A theoretical model is proposed to link consumers' personality trait, associated personality trait of holiday, identification, involvement and purchase intention. First, secondary marketing data analysis shows that three consumers' personality traits (imaginative, up-to-date, and trendy) significantly discriminates those who bought Christmas gifts and those who did not. Secondly, ANOVA is used to identify that there exists significant difference between those who bough Christmas gifts and those who did, on ten associated personality traits of Christmas (sincere leader, original, spirited, imaginative, smooth, trendy, charming, cheerful and reliable).

Finally, the authors use structural equation modeling to validate the theoretical model and compete it with other three alternative models. The results indicate that the customers with more associated traits with the particular holiday are more likely to identify with the holiday. in turn have higher involvement and higher purchase intention. The proposed model demonstrates better fitness than the alternatives.

Key Words：associative network theory, personality trait, identification, involvement, purchase intention

INTRODUCTION

Consumers do particular things in a specific time-related context, for example, they buy gifts on Christmas, have turkeys on Thanksgiving Day, or gather up overnight to celebrate New Year. Marketers have been aware that time-related contexts (e.g., particular holidays) influence what consumers do, therefore they have attempted to promote products by matching a special holiday with things to buy. However, to date little research has been found about the mechanism that time-related contexts influence consumers' purchase intentions.

A host of research papers based on the self-concept has provided solutions to the questions of how consumers relate themselves to objects (e.g. product, brand, or organization) influence their behavioral intentions (Ashforth and Mael, 1989; Sirgy, 1982) .Prior research has suggested that consumers are more likely to favor the objects identified with themselves in self-images (Sirgy, 1982; Sirgy, Grewal, and Mangleburg, 2000), personality (Aaker, 1999), and identification (Bhattacharya and Sen, 2003). Congruity with the objects causes consumers to relate themselves to the object. For example, the self image/product image congruent theory (Sirgy, 1985) claims that consumers favor the product whose "image" are most congruent with their self-images. Other studies (e.g., Aaker,1997; Malhotra ,1988) argue that the greater congruity between the personality traits of consumers and the associated personality traits of an object (i,e, personality traits that a consumer associate with a brand) increases the consumers' preference for that object.

However, Aspara et al. (2008) argue that those relationships with objects fails to illustrate how an individual's affective identification with objects is formed, as well as how that relationship extend to influence attitudes and behaviors. According to Aspara and colleagues, this is a flaw caused by the underlined assumption that an individual's identification with objects is formed through a cognitive process of self-categorization. Simply put, if one can't consciously categorize the object (e,g,. a company), one is unable to identify with it, much less be influenced by it. The problem with this flaw is that it fails to consider consumers' affective-laden links to objects, which can be approached by the memory networks.

Associative network theory (Bower, 1981) suggests that an individual's affective reactions are related to the semantic messages stored in his long term memory, known as "nodes". Nodes are stored information connected by links that vary in different strengths. A "spreading activation" process from one node to another. When the activation of another node exceeds certain threshold level, the information contained in that node is recalled (Collins and Loftus,1975; Keller, 1993). Affective reactions help in activating the corresponding messages to be more accessible. Based on the theory, Keller (1993) advices brand managers to increase consumer-based brand equity by "activating" some nodes of brand knowledge in consumers' memory to spread to activate other relevant nodes so that they are more identified with the brand.

Following the logic, we suggest that when consumers are activated to have more accessible nodes related to an object's associated personality traits (e.g., Christmas is a warm, forgiving, grateful holiday), they are more likely to identify with the holiday. According to social identification theory (Ashforth and Mael, 1989; Bergami and Bagozzi, 2000) and

involvement theory (Celsi and Olson, 1988), if an individual identifies with the object, he is more likely to be involved in it and in turn to be influenced attitudinally and behaviorally (Ahearne, Bhattacharya, and Gruen, 2005; Bhattacharya and Sen, 2003; Cardador and Pratt, 2006). We propose a model based on the rationale,

This paper takes Christmas as a context to construct a theoretical model linking associated traits of holiday, identification, involvement and purchase intention. We review literature and propose the theoretical model in the second part. We illustrate our research method and develop a questionnaire in the third part. We then provide our analysis results in fourth part. We discuss the results and make suggestions in section 5.

REVIEW OF LITERATURE

1. Congruity Theory and Associative Network Theory

The self- concept has been extensively studied in the field of consumer behavior. Special attention has been on how self-concept affects behavior. Sirgy (1985)' self image/ product image congruity theory holds that consumers' behavioral responses are evoked when the consumer perceives the images of products congruent with his/her self images.

Prior research based on the congruity theory examined certain marketplace effects on the formation and change of consumer self-concept and tested the relationships between self-concept and product image, Others examined the effects of self-concept on consumer behavior (for a detailed review ,see Sirgy, 1982; Claiborne and Sirgy, 1990).

According to self image/product image congruity model, the consumer chooses to buy in a certain retail store because he/she matches self-concept with that retailer's image. The model identifies factors that are likely to affect the development of retail patron images, such as retail atmospherics and other retail environment cues.

However, self-image congruity involves the match/mismatch between the retailer's image (or a product brand) and a shopper's self-image. A relevant question, then, is what factors contribute to the formation of a store's image and how strong and accessible (i.e., how to linkage/association work) are the retailer's images to consumers? The rationale behind the importance of congruence for the success of people themselves -- product brand originates from associative network theory (Smith, 2004); it is a theory of how memory operates (Collins & Loftus, 1975).

In brief, this posits that memory consists of individual pieces of information called nodes. Information is recalled from memory when a node is stimulated by a process known as activation. The process whereby one set of nodes (e.g., memory about a holiday, event, and brand etc.) prompts thinking about other 'linked' nodes (e.g., sponsor of the event) is known as 'spreading activation' (Anderson, 1983; Ulhaque & Bahn, 1992). Therefore, the more common links exist between brand and event and the stronger those associations are, the greater the perceived congruence between objects will be. This means that incongruent brand-event relationships have weaker links than congruent relationships and, hence, memory for congruent relationships tends to be superior. Furthermore, it seems easier to reach an image transfer if associative connections already exist between both objects (Koo, Quarterman, & Flynn, 2006).

Most prior research (e.g., Kassarjian, 1971; Sirgy, Grewal, Mangleburg, Park , Chon, Claiborne, Johar and Berkman, 1997) draws on the image congruity theory to explain the

effect of personality traits on identification. However, this paper draws on associative network theory to explore the relationship between personality traits and identification, in an attempt to enrich the stream of research.

2. Memory Connection , Identification

Associative network theory posits that semantic memory or knowledge consists of a series of nodes and links. Nodes are stored information connected by links that vary in different strengths. A "spreading activation" process from one node to another. When the activation of another node exceeds certain threshold level, the information contained in that node is recalled (Collins and Loftus, 1975; Keller, 1993)

Lei, Dawar and Lemmink (2008)'s study of brand portfolio shows that external information is powerful in activating nodes. When a brand node (or "origin brand") is activated by external information, its activation spreads to other nodes (e.g., extended brands) through the associative network. This activation then spreads to another related brand nodes through associative network linkages. In other research of customers' identification with a company (Brown and Dacin, 1997; Fombrun and Shanley, 1990), the authors show that customers' identification with a company is mainly based on their mental connections (nodes) with the images, reputation, brand and other relevant information with the company.

Christmas, one of the particular holidays in a year, is also an image or representation of image, just like a brand. With the upcoming of Christmas as a node, marketers activate the node through the use of promotions and fanciful decorations, rendering more activation of nodes, such as gifts, campaigns and other activities that are related to Christmas. Based on Lei et al. (2008), it is inferred that the more traits consumers associate with Christmas, the easier consumers are connected to Christmas, rendering higher identification with the holiday. However, consumers' idiosyncratic personality qualities must be considered. As a result, this paper adopts consumers' personality traits as antecedents in the theoretical model. The first hypothesis is derived based on the inferences above:

H1: Consumers who associate more personality traits to a particular holiday (i.e., Christmas) are more likely to identify with the image of that holiday.

3. Involvement

I

Involvement, as Zaichkowsky (1985) defined, is "A person's perceived relevance of the object based on inherent needs, values, and interests"(p.342). Johnson and Eagly (1989) categorized three types of involvement:(1)value-relevant involvement, referred to as "the psychological state that is created by the activation of attitudes that are linked to important values" (p.290), that is, one's evaluations of oneself ; (2) impression-relevant involvement, as one's concerns about others' impressions on one's behaviors; and (3) outcome-relevant involvement, the extent to which an information is of personal importance to the receiver of that information. Consequently, level of involvement is a crucial indicator in measuring individual's attitudes toward an object. We defined involvement as "*the perceived relevance of a particular holiday (i.e., Christmas) by a person based on his or her inherent needs, values, and interests*".

Furthermore, by drawing on balance theory (Heider, 1946) and the involvement literature, we posit the relationship between identification and involvement: when the

consumer perceives more traits in the image of a special holiday, he is more likely to identify his personality with that of Christmas. On the ground that the Christmas activities are of positively related to the image of the holiday (i.e., participation in Christmas activities renders an aura of Christmas), consumers tend to consider participation in the activities related to Christmas (e.g., buying Christmas gifts) is highly self-relevant, making the participation in these activities highly involving. We thus reason that:

H2: Identification has a direct and positive effect on involvement.

4. Involvement, Identification, Purchase Intention

Dodds, Monroe and Grewal (1991) argue that purchase intention means the possibility a consumer is willing to consider buying. Consumer's perceived value of a product positively influences his purchase intention on the product. However, Shao, Baker and Wagner (2004) propose that purchase intention is the intention to purchase a product or visit a retailing store. We define purchase intention as "*the probability the consumer is willing to consider buying a product*".

On the other hand, some scholars (Broderic & Mueller, 1999; Nysveen & Pedersen, 2005) propose a direct effect of involvement on purchase intentions. Josiam, Kinley, and Kim (2005) describe that higher-involved purchases are those considered to be important or personally-relevant to the consumer and cause the consumer to seek more information about the alternatives.

According to prior research, we suggest the hypotheses:
H3: Identification has a positive and direct effect on purchase intention.
H4: involvement has a positive and direct effect on purchase intention.

STUDY METHOD

We cross-analyzed the data of personality traits and Christmas gift purchasing behavior drawn from the E-ICP databank, one of Taiwan's professional marketing databank, to discover the relationship between traits and gift-purchasing behavior (bought gifts/did not buy any) for the next stage of research. In the second stage, we designed and implemented a questionnaire survey for data required by structural equation modeling.

Study 1

Twenty traits in the E-ICP databank were measured by a six-point Likert scale of personality in terms of Christmas, with "strongly disagree" (1 score), and "strongly agree" (6 scores). A total of two thousand respondents participated in the measurement task. Among the respondents, 215 bought gifts, whereas 1,785 did not. Each respondent is asked to perceive the Christmas holiday personality by completing the 20-item personality scale.

Based on the secondary data, we analyzed the correlations of the percentage of the gift-purchasers and the non-purchaser on basis of each personality trait of consumers (Aaker, 1997). Correlations are estimated as followed: sincere (r=0.989, p<0.05), rugged (r=0.916, p<0.05), daring(r=0.992, p<0.05), leader(r=0.892, p<0.05), confident(r=0.996, p<0.05), original(r=0.929, p<0.05), spirited(r=0.939, p<0.05), imaginative (r=0.513, p>0.05),

smooth(r=0.955, p<0.05), down-to-earth(r=0.980, p<0.05), charming (r=0.845, p<0.05), trendy(r=0.645, p>0.05), tough(r=0.998, p<0.05), cheerful(r=0.979, p<0.05), sentimental(r=0.885, p<0.05), friendly(r=0.996, p<0.05), up-to-date(r=0.677, p>0.05), unique(r=0.972, p<0.05), intelligent(r=0.991, p<0.05),and reliable (r=0.996, p<0.05).

The data indicate that three traits (i.e., imaginative, trendy and up-to-date) have lower correlation coefficients, implying difference of purchaser/non-purchaser percentages. The differences impelled us to precede ANOVA on these traits. The statistical results suggest that on the three traits of imaginative (F=58.721, p<0.05), trendy(F=51.966, p<0.05), and up-to-date(F=50.968, p<0.05), significant difference exists between purchasers and non-purchasers. Based on the results, it is reasonable that we use the three traits as tentative antecedents to consumers' associated traits of Christmas.

Study 2

Following Hinkin (1998)'s procedures of scale development, we generated the items by reviewing literature for theoretical definitions and existing items of the constructs under examined. We factor analyzed the items to reduce inappropriate ones, but we remained the existing items of personality traits and involvement. We then employed confirmatory factor analysis (CFA) to assure satisfactory validity and reliability of the scale.

From prior works (e.g., Dodds et al., 1991; Broderic & Mueller, 1999; Nysveen & Pedersen, 2005; Shao et al., 2004 ; Zaichkowsky ,1994) we adopted the items of *consumers' personality traits, associated personality traits of Christmas, identification, involvement, and purchase intention*. We used a six-point scale to measure most of these constructs, but a 7-point semantic difference scale of RPII (Zaichkowsky, 1994)to measure involvement. To avoid the problems of carelessness and common method variance (CMV),we adopted some reversed items from RPII personal involvement scale. We had the scale translated and back-translated respectively by two bilingual academicians (Li, 2001), then had a third Chinese academician to check the accuracy of the translated scale.

Our scale has a total of forty-three items: 3 items for measuring respondent' personality traits, twenty items for *associated traits of Christmas*, five for identification, ten for involvement, and five for purchase intention.

The questionnaire is distributed in a paper to a convenience sample, which consists of students and non-students. The first part of the questionnaire contains items regarding respondents' fundamental data, and the items of the second part are arranged in the order of personality traits, associated traits of Christmas, identification, purchase intention, and involvement.

First, we used ANOVA to analyze the relationship between consumers' associated personality traits and the respondents who purchased Christmas gifts, as shown in Table 1. As the table indicates, respondents who purchased gifts are significantly more than who did not on ten traits: sincere, leader, original, spirited, imaginative, smooth, trendy, charming, cheerful, and reliable. As a result, we suggest that consumers who purchase gifts are more likely to associate the particular holiday with these ten traits, than those who do not purchase gifts.

TABLE 1.
ANOVA RESULTS OF ASSOCIATED TRAIT AND PURCHASE BEHAVIOR

Associated Traits	Did purchase (Mean)	Didn't purchase (Mean)	Did purchase (SD)	Didn't purchase (SD)	F-value	Sig.
sincere	4.31	3.96	0.965	1.336	3.876	0.050
ruggedness	2.32	2.44	0.900	1.070	0.607	0.437
daring	2.98	2.69	1.060	1.291	2.450	0.119
leader	2.93	2.50	1.008	1.072	6.415	0.012
confident	3.77	3.44	1.121	1.457	2.673	0.104
original	3.97	3.54	1.111	1.383	4.642	0.032
spirited	4.70	4.29	0.950	1.304	5.453	0.021
imaginative	4.44	3.98	1.037	1.360	6.020	0.015
smooth	4.47	4.13	0.919	1.299	4.156	0.043
trendy	3.99	3.63	1,003	1.331	3.950	0.048
down-to-earth	3.27	3.29	1.078	1.304	0.017	0.897
charming	4.51	4.15	0.991	1.414	3.969	0.048
Tough	3.45	3.25	1.090	1.422	1.060	0.305
cheerful	5.14	4.69	0.902	1.355	7.070	0.009
sentimental	4.67	4.44	0.926	1.287	1.875	0.172
friendly	4.79	4.58	0.917	1.235	1.599	0.208
up-to-date	4.19	3.83	0.978	1.404	3.853	0.051
unique	4.19	4.04	1.104	1.320	0.605	0.438
intelligent	3.45	3.25	0.983	1.229	1.252	0.265
reliable	3.65	3.21	1.124	1.237	5.320	0.022

Because the purpose of our research is to validate the structural relationship of the hypothesized model, we must consider the issue of construct measurement in the level of structured modeling validation: the causal flow between the latent construct and its observed variables or indicators, that is, the formative and reflective measures of the constructs in the measurement model.

According to Coltman et al.(2008), three broad theoretical considerations determine whether a measurement model is reflective or formative: (1) the nature of the construct; (2) the direction of causality between the indicators and the latent construct; and(3) the characteristics of the indicators used to measure the construct(p.1251-52).

Our secondary data analysis indicates that the consumers with higher scores on only three personality traits (imaginative, trendy and up-to-date), rather than all traits, are more likely to have *associated* traits of Christmas. This leads us to suggest that the consumers' personality traits are formative to associated traits of Christmas. The rest of our model is a reflective measurement model.

STATISTICAL RESULTS

A total of 221 questionnaires were recalled, among which 27 being deleted due to missing values, thus 194 (87.8%) were valid. Descriptive statistical analysis of the

respondents is shown in Table 2.

TABLE 2.
SAMPLE PROFIL

Demographics		Number	%	Demographics		Number	%
Gender	Male	41	21.1	occupation	Student	81	41.8
	Female	153	78.9		Employed	111	57.2
Age	under20	9	4.6		Un-employed	2	1.0
	21~30	133	68.6	Income	~20,000	121	62.4
	31~40	39	20.1	disposable	20,001~30,000	33	17.0
	Over 41	13	6.7		30,001~40,000	30	15.5
Education	Senior high	4	2.1		40,001~50,000	6	3.1
	Undergraduate	177	91.2		50,000~	4	2.1
	Graduated	13	6.7	Bought gifts?	Yes	146	75.3
					No	48	24.7

We then examine internal consistency of the constructs. Table 3 shows that three constructs have more satisfactory reliability: identification **(ID)** (.992), purchase intention **(PI)** (.939), and involvement **(INV)**(.940), than consumers' personality trait **(CPT)** (.762) and associated personality trait of holiday **(APT)** (.864). However, all constructs have acceptable internal consistency coefficients. Four constructs, except consumer's traits, are significantly correlated in high and medium magnitude.

TABLE 3. RELIABILITY AND CORRELATIONS OF THE CONSTRUCTS

	Items	Scale	Mean	Std. D	CPT	APT	ID	PI	INV
CPT	3	1~6	3.74	0.93	0.762				
APT	10	1~6	4.11	0.74	0.357**	0.864			
INV	5	1~6	3.54	0.97	0.324**	0.665**	0.922		
PI	5	1~6	3.99	1.17	0.250**	0.540**	0.619**	0.939	
INV	10	1~7	4.71	1.24	0.210**	0.502**	0.595**	0.633**	0.940

Note: Cronbach's α(Diagonals) ; **p< 0.01

Table 4 shows that the factor loadings, composite reliability and extracted variances of the measurement model. We determine the proposed model possesses satisfactory convergence reliability because all *t*-values of factor loadings are significant. We then determine the constructs possess fine divergence validity because all the correlation coefficients in Table 5 are significantly less than 1.

TABLE 4. CFA FACTOR LOADINGS, RELIABILITY AND VARIANCE EXPLAINED

item	CPT		APT		ID		PI		INV	
	λ	t-value	λ	t-value	λ	t-value	λ	t-value	λ	t-value
1	0.90	13.26	0.52	7.37	0.80	13.18	0.89	15.60	0.82	13.82
2	0.41	5.66	0.46	6.33	0.81	13.47	0.77	12.50	0.83	13.95
3	0.91	13.51	0.67	10.10	0.85	14.52	0.81	13.57	0.65	10.00
4			0.74	11.54	0.88	15.26	0.91	16.43	0.89	15.65
5			0.64	9.42	0.84	14.25	0.94	17.25	0.83	13.96
6			0.59	8.61					0.85	14.52
7			0.65	9.57					0.71	11.11
8			0.76	11.92					0.76	12.36
9			0.65	9.63					0.78	12.74
10			0.49	6.86					0.82	13.88
	Composite reliability = 0.81		CR= 0.86		CR= 0.92		CR= 0.94		CR= 0.94	
	Variance explained= 0.60		VE= 0.39		VE= 0.70		VE= 0.75		VE= 0.63	

TABL 5. CORRELATION MATRIX OF DEMENSIONS

Dimensions	CPT	APT	ID	PI	INV
CPT	1.00				
APT	0.28(0.08)	1.00			
ID	0.31(0.07)	0.69(0.05)	1.00		
PI	0.19(0.07)	0.54(0.06)	0.63(0.05)	1.00	
INV	0.17(0.08)	0.51(0.06)	0.62(0.05)	0.61(0.05)	1.00

Note: SD in parentheses

To check if any common method variance (CMV) exists, we used Harman's single-factor test (Podsakoff and Organ, 1986). As a result, the single-factor model is less fit than the four-factor model, manifesting no serious CMV problems are raised. Model fit indicators are shown in Table 6.

TABEL 6. TEST RESULT OF COMMON METHOD VARIANCE

MODLE	χ^2	*df*	NFI	TLI	CFI	RMSEA
One-factor model	3701.21	495	0.84	0.86	0.87	0.18
Four- factor model	1121.19	485	0.93	0.95	0.96	0.082

Finally, we assessed the overall model fit. Table 7 shows the theoretical models in terms of the values of indicators and paths. Consumers' personality traits are formative indicators (γ), whereas the rest reflective indicators (λ). Imaginative (γ=0.32 , *t*=3.70) is the only consumers' personality traits that has a significant influence on associated personality traits. Furthermore, loadings of reflective indicators are significant.

TABLE 7. PATH COEFFICIENTS OF THE THEORETICAL MODEL

	CPT		APT		ID		PI		INV	
Item	$\gamma_{11\sim13}$	t-value	$\lambda_{1\sim10}$	t-value	$\lambda_{11\sim15}$	t-value	$\lambda_{16\sim20}$	t-value	$\lambda_{21\sim30}$	t-value
1	0.04	0.34	0.51	--	0.80	--	0.89	--	0.82	--
2	0.32	3.70*	0.45	5.11*	0.81	12.81*	0.77	13.62*	0.83	13.84*
3	0.12	0.92	0.68	6.48*	0.85	13.58*	0.81	15.13*	0.65	9.97*
4			0.74	6.79*	0.88	14.20*	0.91	19.41*	0.89	15.50*
5			0.65	6.33*	0.84	13.37*	0.94	20.72*	0.83	13.86*
6			0.59	6.03*					0.85	14.41*
7			0.65	6.33*					0.71	11.06*
8			0.76	6.87*					0.76	12.30*
9			0.64	6.29*					0.78	12.68*
10			0.49	5.31*					0.82	13.79*

Note: * *p*<0.05 (two-tailed)

TABLE 8. MATRIX OF TOTAL EFFECTS

Dimensions	APT	ID	INV	PI
APT	--	--	--	--
ID	0.70(6.13)	--	--	--
INV	0.44(5.34)	0.63(8.19)	--	--
PI	0.45(5.46)	0.64(8.63)	0.34(4.34)	--

Note: t-value in parentheses, $p<0.05$ (two-tailed)

TABLE 9. FITNESS INDICATORS OF COMPETING MODELS

	χ^2	*df*	NFI	TLI	CFI	RMSEA
Theoretical model	1115.41	488	0.93	0.95	0.96	0.082
Alternative 1	1135.96	489	0.93	0.95	0.96	0.083
Alternative 2	1111.68	487	0.93	0.95	0.96	0.082
Alternative 3	1113.84	487	0.93	0.95	0.96	0.082

As can be seen in table 9, the theoretical model possesses satisfactory model fit indicators (χ^2=1115.41, *df*=488, NFI=0.93, TLI=0.95, CFI=0.96, RMSEA=0.082), with all hypothesized paths being significant. Estimated path coefficients are shown in Table 7 and Figure 1 (on the next page). The direct effects proposed in hypothesis 1 through hypothesis 4 are all significant ($p<0.05$), as a result, all the direct effects proposed in the model are validated.

We employed competing model strategy to manifest that the proposed model is better by testing three alternative models. The alternative model 1 indicates that identification has no direct effect on purchase intention; the alternative model 2 shows that associated personality of Christmas directly influences involvement; and the model 3 presents that associated personality of Christmas directly and positively influences purchase intention. We compare the three alternatives in Table 9.

Table 9 shows that reduction in the degrees of freedom of the alternative models does not effectively improve chi square statistics (1 degree of freedom reduced is worth at least 3.84 reduced inχ^2) and RMSEA indicator. Moreover, the increased direct effects are not significant. Consequently, it is concluded that the proposed model is the relatively better one among the possible alternatives.

FIG. 1 THEORETICAL MODEL

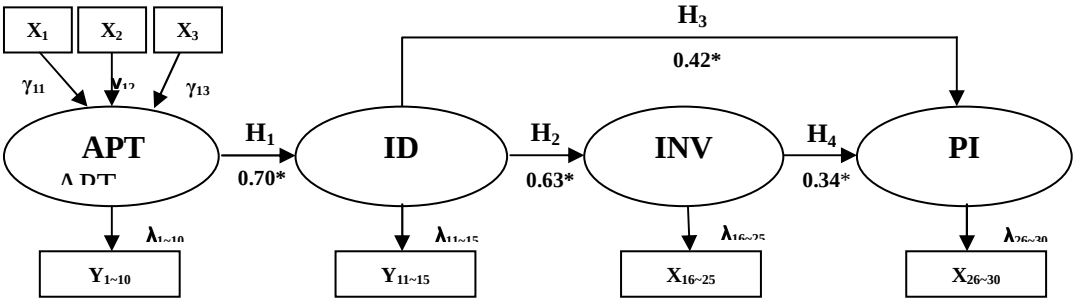
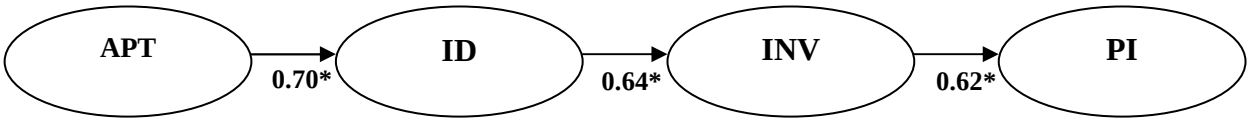
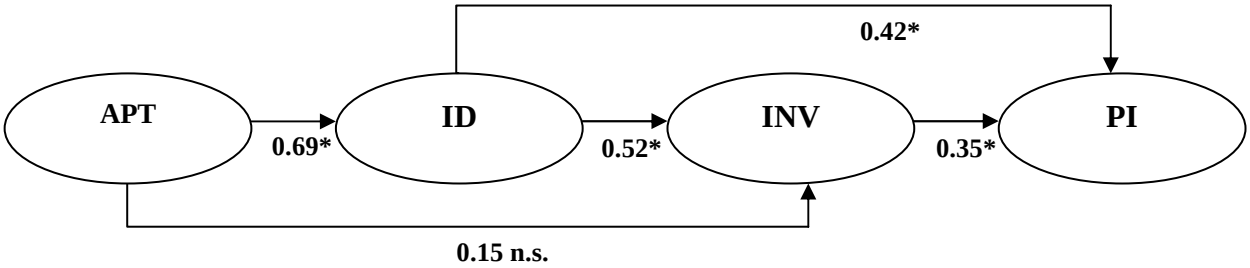


Figure 2 displays the structural coefficients of the three alternative models. From both alternative model 2 and 3, we discern that perceived personality of Christmas does not directly influence on either involvement or purchase intention (n.s., $p>0.05$). By comparing alternative model it is manifested that the proposed model in the present study is significantly better fit than other alternatives.

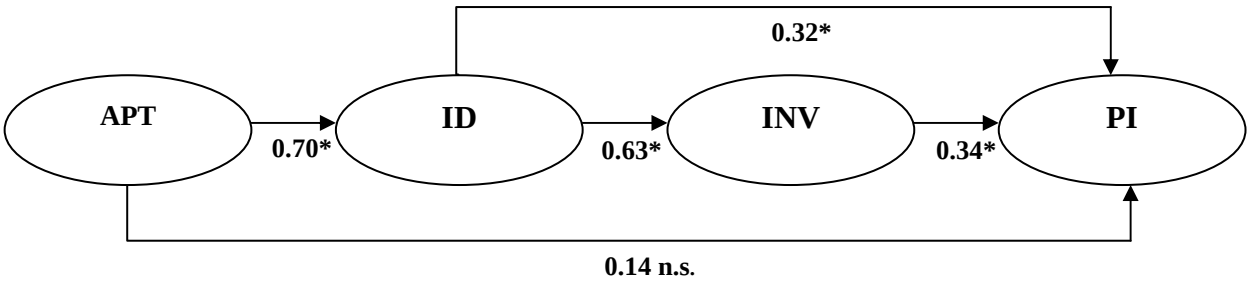
FIG 2. ALTERNATIVE MODELS



Alternative model 1



Alternative model 2



Alternative model 3

CONCLUSION

This paper, drawing on associative network theory , personality theory and balance theory, integrates associated personality traits of particular holiday, identification, involvement, and purchase intention in a theoretical model and validates the proposed model. The SEM-based results indicate that the increase of nodes connected to Christmas also increase identification with it. This is consistent with relevant literature (Keller, 1993; Lei, Dawar and Lemmink, 2008). Meanwhile, this paper also validate the positive relationship between identification and purchase intention, which is consistent with prior research (e.g., Aaker, 1999; Ahearne et al., 2005; Bhattacharya and Sen, 2003; Sirgy et al., 1997). Finally, the positive effect of involvement on purchase intention validated in this paper is also consistent with relevant works (Broderic & Mueller, 1999; Josiam et al., 2005; Nysveen & Pedersen, 2005). The result of model competing also indicates that the proposed model is more robust and parsimonious than the other alternatives.

For theoretical implications, this paper provides empirical evidence that indicate that consumers with imaginative trait are more likely to ten associate personality traits (sincere leader, original, spirited, imaginative, smooth, trendy, charming, cheerful and reliable). with particular holiday. Associative network theory postulates that the consumer with more associated traits of a particular holiday is more likely to identify with that holiday. Consistent with the associative network theory, our proposed model suggests that the consumer's associated personality traits with a particular holiday have an direct effect on identification. However, associated traits of Christmas have only indirect effects on involvement and purchase intention, through the direct effect of identification. Moreover, this paper has a theoretical contribution in validating the relationship between associated traits of objects and identification with that object drawing on the associative network theory, seldom used by prior research on similar topics.

For managerial implications, the result of the study suggests that marketers should invoke consumers' memory of holiday personality traits when attempting to make appeals to consumers by using holidays to promote products or campaigns. According to our proposed model, if the marketer activates consumers' consumers' associated personality traits with a particular holiday, he activates consumers' identification with that holiday and in turn increase their behavior (i.e., purchase intention). In practice, marketers can personify particular holidays by leveraging communication tools such as advertising to increase nodes of the holidays so as to increase consumers' identification with the images of them.

One concern on application is that personality traits in every culture/countries may well be very different. Because the paper draws its sample from Taiwan, the generalizability of personality traits may be limited. But the links in the model remain validated. Take the example of tourists marketing, Governmental tour agency can make use of the research results of this study by adding country-specific personal traits to national festivals or celebrations to activate tourists' (from other Asian countries or the Middle East) personal connections with the festivals and increase their identification with them, so as to increase their involvement and purchase intentions.

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A SUSTAINABLE MODEL (RAMOLAP) FOR DATA INTEGRATION AND DATA ANALYZES IN BUSINESS INTELLIGENCE

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ABSTRACT

Nowadays analyzing the past and present data, predicting future according to them and making useful and right decisions have an important role in companies' success. In this article we propound a short definition of business intelligence and the reasons and advantages of using it as well as complete description of Data Analysis, Data Integration and Data Warehouse in BI. We also present the functionalities of one of the common BI tools. RAMOLAP ideas are discussed in this article that is in fact a solution to problems existing methods of data analysis.

Keywords: RAMOLAP, BI, OLAP, Data Integration

1. INTRODUCTION

The companies and organizations are so vulnerable in front of the new rapid evolutions. By presenting strong and deep analysis, BI helps these businesses to improve their ability of predicting future, therefore they become more flexible and they can find adequate time for making necessary changes. We all know that the organizations can't exist without security technology; similarly they can't be successful without Business Intelligence.
Sometimes because the company past functions has not been analyzed, simple mistakes repeat everyday in the organization and these faults remain hidden from the eyes of managers and employees. Sometimes a simple change can reduce the company cost. Sometimes a little change in marketing method brings an incredible success. How we can recognize the necessary changes? A good method is storing data and analyzing the company operation. With considering the stored data and extract the analysis from it, the hidden mistakes and faults will be revealed and the organization will be able to recognize the cases which need the most changing in order to reach the company goals.

2. What is Business Intelligence?

BI is neither a product nor a system. It is an umbrella term that combines architectures, applications, and databases. It enables the real-time, interactive access, analysis, and manipulation of information, which provides the business community with easy access to business data. BI analyzes historical data—the data businesses generate through transactions or by other kinds of business activities —and helps businesses by analyzing the past and present business situations and performances. By giving this valuable insight, BI helps decision-makers make more informed decisions and supplies end-users with critical business information on their customers or partners, including information on behaviors and trends.[1]

2.1 Why do we need Business Intelligence and who uses Business Intelligence?

In today's struggling economy with competition controlling and shrinking the landscape, it is important to make sound business decisions based on complete data. With the proper Business Intelligent implementation, businesses can make decisions and feel comfortable that they are provided with the proper tools and data needed to believe in their decisions. Without the correct Business Intelligence solution even well planned and executed data warehouse architectures can fail.

Business Intelligence is a decisions support system and database that can provide professionals with the information they need to make the most effective decisions for their organization. It also provides data about the organizations details, such as customers, products, and services. Honestly when a one can access this information rapidly and easily in order to take appropriate action or make the right decision business success is realized. So the larger companies are the most important users of BI tools .But the best approach to BI for smaller companies lies somewhere between these two approaches. The optimal position is one of information balance, existing between formal cube-based systems and simple report writers. The right tool must be able to deliver multi-dimensional analysis, graphing, charting, and more, for a fraction of the cost of an expensive OLAP solution. Moreover, the tool should be modifiable by a user without requiring extensive programming skills. [2, 3, 4]

BI consists of Data Integration, Reporting, Data Analysis, Dashboards and Data Mining that will be explained next.

3. Data Integration and BI

Data Integrity is one of the BI basic bases. Usually the key decision-making processes to be used. The integration of data from different sources for an organization has its own special challenges. Fortunately there are the best methods for data integrity business can progress rapidly. Organizations today have choices beyond the extraction, data transfer and load (ETL) and coding methods. There are the new methods available in the market areas, and each ones have their own advantages and disadvantages and depending on the existing requirements and the organization's budget work well than another.

3.1 How data integrity

Data integrity or apparently (Data Integration) ideas seem simple. Since most organizations save their database to store multiple, there is a way to retrieve data from various sources in order to coordinate them as a unit. For example, imagine a company is in mail preparation and development of a new mobile device. Marketing sector may want to retrieve customer information database and a comparison with production data to create targeted sales list, is required. System data integrity (Data Integration) appropriate marketing sector view, both sources of information to a unit to form, this practice apply to any information that the search will not matter.

3.2 Data Integration Basics

Data integration focuses mainly on databases. A database is an organized collection of data. It's similar to a file system, which is an organizational structure for files so they're easy to find access and manipulate.

There are different ways to categorize databases. Some people prefer to classify them according to the kind of data the databases store. For example, you might classify a database as a media database if all the information stored there is contained in video or sound files.

Another classification method looks at how the databases organize data. A database's organizational arrangement is called a schema. A common organizational technique is to use tables to show the relationship between different data points. Tables are like spreadsheets. Columns define categories of data, while rows are records. A database using this approach is a relational database.

Object-oriented programming (OOP) databases take a different approach to organizing data. The OOP language is a departure from traditional approaches to programming, which follow the pattern of inserting data into a set of instructions and then producing output. The OOP language focuses instead on defining data as objects and then determining how different objects relate and interact with one another.

To create an OOP database, first you'd define all the objects you plan on storing in the database. Then, you'd define the way each object relates to every other object within the database. After you identify an object, you put it into a class, or set of objects. To define a class you have to determine what data each object within that class must have and which logic sequences, called methods, will affect those objects. The objects within a system can communicate with you or other objects using interfaces called messages.

To access information within a database (no matter how it organizes data), you use a query. A query is just a request for information. People and applications can submit queries to databases. A database responds to queries by sending data that meets the original request's parameters. Queries rely on special computer languages such as Structured Query Language (SQL). [5]

4. BI and Data Warehouse

4.1. Data Warehouse

A data warehouse is a database that stores information from other Databases using a common format. That's about as specific as you can get when describing data warehouses. There's no unified definition that dictates what data warehouses are or how designers should build them. As a result, there are several different ways to create data warehouses, and one data warehouse might look and behave very differently from another. [6]

4.2. Why we need Data Warehousing for our business?

- Maintaining Security, quality and Data Integration
- Getting reports and making requests with minimum database knowledge.
- Getting reports from several external sources.
- Analyzing, programming , implementing and maintaining
- Having a place for storing old and new data for storing large amounts of data (about terabyte).
- Choosing correct tools and technologies for storing large amounts of data.

4-3 Life cycle in the data warehouse

Life cycle in the data warehouse projects are divided into five main stages:

-Feasibility Study:
Review and calculate the cost, profit and loses of the data warehouse project
The purpose of this phase: the implementation or non- implementation of the data warehouse project
-Analysis Stage:
studying and analyzing the main steps of data warehouse cycle including extraction analysis, data correction and their transformation
-System Design:
Logical data model obtained by analysis phase is implemented physically in this phase.
-Implementation:
At this stage, as one of the longest and most specialist stages, the data warehouse is made.
- Ongoing Maintenance:
The purpose of this phase is analysing the end users new requirements and their changes through the project implementation, and date updating.

5- Reporting

Having paid attention to the end users and the IT experts, a reporting program can be successful in BI field.
5 .1 various reports
There are several methods of reporting in BI field which can be classified under various groups. We are going to review each one more:

• Static and standard report
- Subject-oriented, before creating the report, the provided information are defined exactly.
-Report with a fixed design and is defined by report designers.
-Static reports often contain some sub reports, do some calculations or implement some advanced functions.
- Reports are produced based on end users' request or periodic schedule.
-Reports are always available through the Web server or shared drives.
Related software:
Cognos Report Studio, Crystal Reports, and BIRT

• Ad-hoc Report
-creates simple reports requested by end users
- Designing the report from the beginning or using a standard report as a model.
Related software: Cognos Analysis Studio

• Interactive reports, multidimensional OLAP
it often involves the public information
- Using dynamic drill-down, slicing, dicing and filtering, users can access the information they need.
-Report with a fixed design and is defined by report designers.
- Reports are produced based on end users' request or periodic schedule.
-Reports are always available through the Web server or shared drives.
Related software:
Cognos Report Studio, Crystal Reports, and BIRT
• Dashboard
- a high level show of organization indexes and performance indicators and organization function
- composed of static and interactive reports
-consists of charts, images, graphics, and ...
Related software:
Pentaho Dashboards, Oracle Hyperion, SharePoint

• Write-back Report
Such reports are spoken directly and connected to the data warehouse that is flexible.
Most applications of this report:
- products correcting and ordering and customer grouping
- the relevant business data correcting and editing
- entering the account numbers, budget estimating and calculating the sales discount
-determining the sales goals
Related software:
Cognos Planning, SAP, Microsoft Access and Excel

• technical reports

This group usually meet with the related needs with the following topics: IT technical reports usually monitor BI system for, produce a statically report of performance and efficiency, data size, volume of work system and user activities ...
-data quality reports: these reports are used as the data cleaning process input.
-Call reporting data: for the system designers and data modellers

6. Data Analysis in Business Intelligence

Data Analysis is a huge part of Business Intelligence. Business Intelligence programs are designed to collect the past as well as the present data of an organization, whether it is financial, productivity data, customer data, trend data ,or any other data company related data that needs to be modified in order to be clear and easy to follow.

The next step is to thoroughly analyze the data that has been collected. Some companies prefer to use charts and graphs others may use tables. No matter the means in which the data is analyzed it is done in a precise and detail oriented manner. Figuratively speaking, no stone is left unturned.

Modern Business Intelligence systems are designed to analyze and cross analyze large amounts of unstructured data. This can range from production metrics to customer attrition figures. These systems provide historical, current, and predictive views of business operations. The systems house data analysis tools that can be applied to virtually any area of an organization, and present the data in a clear, concise manner.

6.1. Data Analysis Basic Definitions in BI

The strength of OLTP databases is that they can perform large amounts of small transactions, keeping the database available and the data consistent at all time. The normalization discussed in Chapter 2 helps keeping the data consistent, but it also introduces a higher degree of complexity to the database, which causes huge databases to perform poorly when it comes to composite aggregation operations. In the context of business it is desirable to have historical data covering years of transactions, which results in a vast amount of database records to be analyzed. It is not very difficult to realize that performance issues will arise when processing analytical queries that require complex joining on such databases. Another issue with doing analysis with OLTP is that it requires rather complex queries, specially composed for each request, in order to get the desired result.

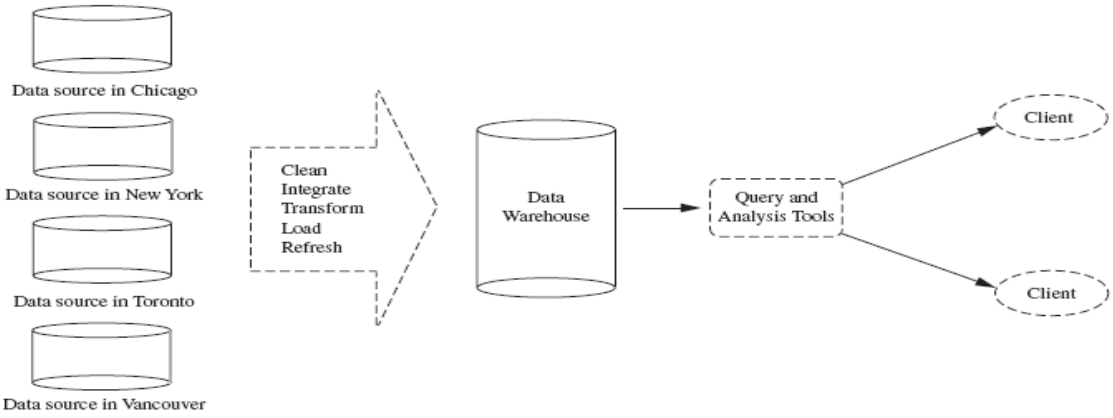

Fig. 1: View of Data Warehouse

OLTP is often used to handle large amounts of short and repetitive transactions in a constant flow, such as bank transactions or order entries. The database systems are designed to keep the data consistent and to maximize transaction throughput. OLAP databases are at the other hand used to store historical data over a long period of time, often collected from several data sources, and the size of a typical OLAP database is often orders of magnitude larger than that of an ordinary OLTP database. OLAP databases are not updated constantly, but they are loaded on a regular basis such as every night, every week-end or at the end of the month. This leads to the few and large transactions, and query response time is more important than transaction throughput since querying is the main usage of an OLAP database.

The core of the OLAP technology is the data cube, which is a multidimensional database model. The model consists of dimensions and numeric metrics which are referred to as measures. The measures are numerical data such as revenue, cost, sales and budget. Those are dependent upon the dimensions, which are used to group the data similar to the group by operator in relational databases. Typical dimensions are time, location and product, and they are often organized in hierarchies. A hierarchy is a structure that defines levels of granularity of a dimension and the relationship between those levels. A time dimension can for example have hours as the finest granularity and higher up the hierarchy can contain days, months and years. When a cube is queried for a certain measure, ranges of one or several dimensions can be selected to filter the data.

The data cube is based on a data warehouse, which is a central data storage possibly loaded with data from multiple sources. Data warehouses tend to be very large in size, and the design process is a quite complex and time demanding task. Some companies could settle with a data mart instead, which is a data warehouse restricted to a departmental subset of the whole data set. The data warehouse is usually implemented as a relational database with tables grouped into two categories; dimension tables and fact tables.

A dimension table is a table containing data that defines the dimension. A time dimension for example could contain dates, names of the days of the week, week numbers, month's names, month numbers and year. A fact table contains some measures. These measures are some aggregate able data that can be counted, summed, multiplied, etc.
Fact tables also contain references (foreign keys) to the dimension tables in the cube so the facts can be grouped by the dimensional data.

A data warehouse is generally structured as a star schema or a snowflake schema.
Figure 2 illustrates an example of a data warehouse with the star schema structure. As seen in the figure, a star schema has a fact table in the middle and all dimension tables are referenced from this table. With a little imagination the setup could be thought of as star shaped.

In a star schema, the dimension tables do not have references to other dimension tables. If they do, the structure is called a snowflake schema instead. A star schema generally violates the 3NF by having the dimension tables being several tables joined together, which is often preferred because of the performance loss that 3NF causes when the data sets are very large. If it for some reason is desirable to keep the data warehouse in 3NF the snowflake schema can be used. Figure 3 illustrates an example of how Figure 2 could look like if it were to be structured as a snowflake schema. [7]

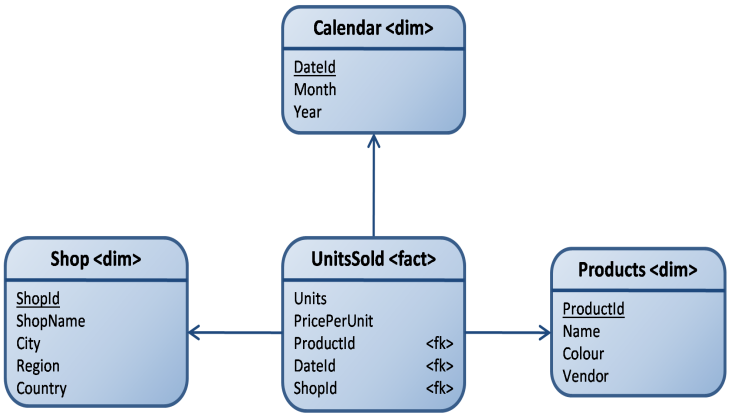

Figure 2: Example of a star schema. The foreign keys are marked with <fk>.

6.2. Cube Architectures

Even though the basic cube principles are the same, the cube can be implemented in different ways. Different vendors advocate different architectures, and some offers the possibility to choose an architecture for each cube that is created.
There are two main architectures that traditionally have been discussed in the field of database research; Multidimensional OLAP (MOLAP) and Relational OLAP (ROLAP), HOLAP (Hybrid OLAP).

Multidimensional Online Analytical Processing is based upon the philosophy that since the cube is multidimensional in its nature, the data should be stored multidimensional.

Thus, the data is copied from the data warehouse to the cube storage and aggregations of different combinations of dimensions are pre-calculated and stored in the cube in an array based data structure. This means that the query response time is very short since no calculation has to be done at the time a query is executed. At the other hand, the loading of the cube is an expensive process because of all the calculations that have to be done, and therefore the data cube is scheduled to be loaded when it is unlikely to be accessed, on regular intervals such as once every week-end or every night. [8]

A problem that has to be considered during working with MOLAP is data explosion. This is a phenomenon that occurs when aggregations of all combinations of dimensions are to be calculated and stored physically. For each dimension that is added to the cube, the number of aggregations that is to be calculated increases exponentially.

Relational Online Analytical Processing is, just as the name suggests, based on the relational model. The main idea here is that it is better to read data from the data warehouse directly, than to use another kind of storage for the cube. As is the case with MOLAP, data can be aggregated and pre-calculated in ROLAP too, using materialized views, i.e. storing the aggregations physically in database tables. ROLAP architecture is more flexible since it can pre-calculate some of the aggregations, but leave others to be calculated on request.

Over the years, there has been a great debate in the research field whether OLAP should be implemented as MOLAP or ROLAP. The debate has however faded, and in the last decade

most researchers seem to argue that ROLAP is superior to MOLAP, among others a white paper from Micro Strategy.

HOLAP: Hybrid OLAP is a combination of MOLAP and ROLAP. In essence, the ROLAP engine contains the detailed data store. The aggregations are built in a MOLAP engine in order to optimize retrieval for high-level reporting purposes. In this setup, the analyst queries on the MOLAP engine and analyses the business. If the analyst needs to investigate the detailed data behind a certain value, then the ROLAP can be queried. A HOLAP product would obviously make this invisible to the user providing a seamless experience.

The disadvantages of MOLAP are that it can handle only a limited amount of data. Since all calculations have been pre-built when the cube was created, the cube cannot be derived from a large volume of data.

But for ROLAP the disadvantages are that the performance is slow and each ROLAP report is an SQL query with all the limitations of the genre. It is also limited by SQL functionalities.

Considering the mentioned problems and limitations of MOLAP and OLAP model, we present a new idea in this article titled “RAMOLAP” in order to improve the speed of data retrieval and quicker responding to analyzer’s requests.

The disadvantages of this model are that it can handle only a limited amount of data. Since all calculations have been pre-built when the cube was created, the cube cannot be derived from a large volume of data.

The disadvantages are that the performance is slow and each ROLAP report is an SQL query with all the limitations of the genre. It is also limited by SQL functionalities.
According to the existed problems and restrictions in MOLAP and ROLAP, RAMOLAP technology is the new idea for retrieving information improvement and responds the queries quickly.

- **RAMOLAP Model:**

This model is consisted of ROLAP and MOLAP, which stores the recent queries like arrays in a temporary cube with MOLAP technology.

The temporary cube is the part of MOLAP. When an analyzer sends a request, it searched. If that cube consists of requested information, the information retrieve, otherwise the request reference to ROLAP and the result stores in temporary cube then returned to analyzer.
The temporary cube update is synchronized with MOLAP updates. Since the update is time consuming, the best solution is that this operation performs in the low time consuming. It means the times in which the requests for the temporary cube and MOLAP are minimum.

For applying the BI elements and components like Data Analysis ,you need a BI tool or software Thus before selecting ,you must be sure that this tool has all capabilities with suitable cost.

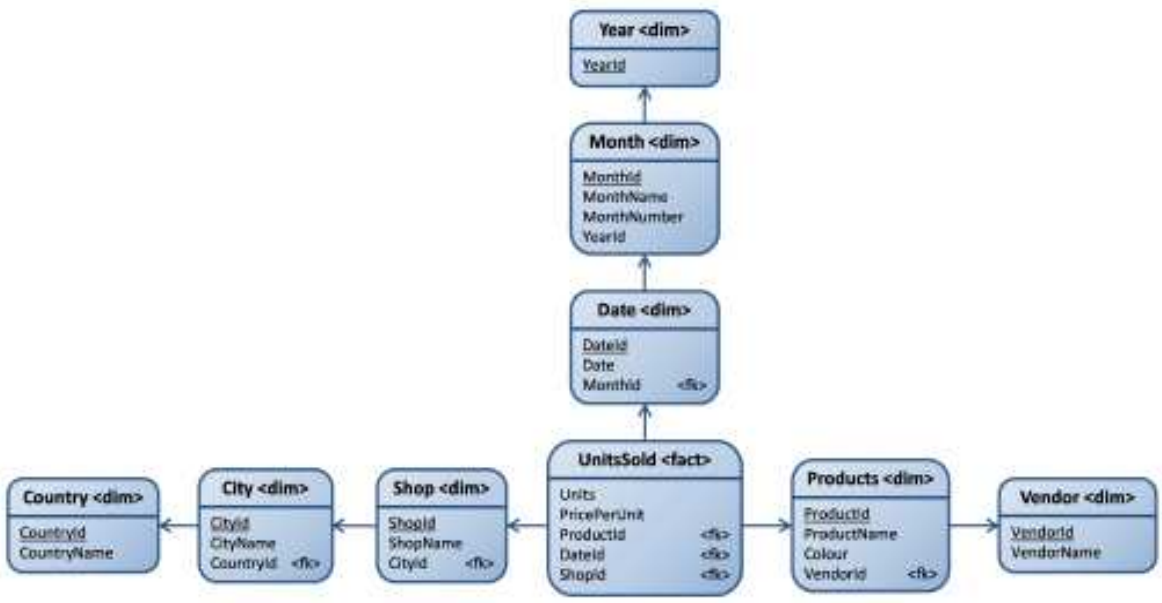

Figure 3: Example of how Figure 2 could be organized as a snowflake schema. The foreign keys are marked with <fk>.

6.3. Key components of a cost-effective BI solution

- Alerts
- Inquiry
- Multi-dimensional analysis tool
- Dashboards
- Quick KPI's
- Graphical presentations of
- Flexible reporting capabilities
- Remote access
- Report automation

There are so many tools and software related to BI, one of them which we mention here is Pentaho.

This tool propounds a large spectrum of BI facilities and capabilities like Data Mining, Data Integration, Dashboard, Interactive Analysis and Query and reporting.

7. Category Pentaho

Regarding to the mentioned subjects in the article, now we are going to introduce one of the most common business intelligent tools. Collection Pentaho is available as one of the most popular tool. In This section besides introducing the software, we also talked about the facilities, properties and all the organs in this collection.

7.1. Pentaho BI Features:

The Pentaho BI Suite provides a full spectrum of business intelligence (BI) capabilities including query and reporting, interactive analysis, dashboards, data integration/ETL, data mining, and a BI platform that has made it the world's most popular open source BI suite.

7.2 .Pentaho facilities and benefits

-Pentaho platform is based on Java standards.
-Management and distribution of reports, calculations, analysis, and dashboards is done through an open source platform.
-Collapse capabilities with data source, portal and applications that use common standards.
-Integrated and comprehensive Schedule and credit measurement
-Extensive facilities for customization using the API, the Web services, modifying patterns, business rules, or even source code.
-Recording and saving some events such as registration and maintenance activities, efficiency and access to content from users
-Optimization and correction of sharing information capability.
-Ability to implement processes with workflow-based projects
[11, 12]

8. CONCLUSION

In this Article BI and the basics are reviewed and then Data Analysis mentioned. Raised the problems related to ROLAP and MOLAP technologies, RAMOLAP technology ideas brought in this article as a best solution. Unclear point in this method is, how and how much to allocate part of MOLAP cube temporary.

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TOURISM, ENTERPRISE DEVELOPMENT AND MULTINATIONAL ENTERPRISE

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ABSTRACT

The world travel and tourism council claims that tourism has become the world's largest industry. International tourism is most of important benefit in host country. Tour guide are one of the key front-line in tourism industry. They are have a chance to provide customer satisfaction with service and knowledge.

This study with quantitative analysis and questionnaire survey method by internet in Taiwan. The expected results of this study show that the customer perception of professional tour guide includes two professional competence dimensions: professional traveling knowledge, professional environment of investment, the customer perception of professional competence of tour guides have high customer satisfied and investment motivation. Therefore, international guides' explanation and providing of business knowledge of local environment, enterprises of Taiwan will recognize global operational development, investment and international trade. Acquiring knowledge of spots and corporate investment resources will enhance people's travels and national competitiveness.

In addition, tourism companies should value growth of business trips, pay attention to quality and quantity of supply and reinforce training for professional guides in order to expands the services, strengthen people's cognition and increase current social positions.

Keywords: Multinational enterprise, tourism, industrial development, tour guide, customer satisfied

INTRODUCTION

In past decades have prompted multinational enterprise (MNE) to pursue the foreign direst investment of strategic assets to strengthen and establish their ownership edge(Yangand Kang,.2007) Investments include those that are directed at accessing knowledge-intensive assets and learning experience (Dunning, 2001) MNEs' worldwide network based on differences in competition in the local environment, industry competition in the host country, and the competitiveness and resources they possess (Bartlett and Ghoshal, 1986, 1989; Kim and Mauborgne, 1995; Gupta and Govindarajan, 1991).These economies not only provide unique location-based advantages and opportunities for multinational enterprises (Ma, X and Delios, A.2007). These challenges emerge from having to operate in host countries that have

a developing market-based system. But have retained vestiges of state-controlled mechanisms (Child, 1994; Stark, 1996).

Fundamental and comprehensive changes in institutions in terms of formal rules (laws, regulations) and informal constraints (customs, norms, cultures) Institutional environments have a substantial and direct impact on the strategy and survival of foreign firms and their subsidiaries.(Delios & Beamish, 1999). Moreover, FDI strategies, such as entry mode and location choice, often need to be adjusted to the industrial characteristics and institutional characteristics of the sub-national regions in which an investment is made. (Ma, X and Delios, A.2007). those that are aimed at enhancing competitiveness by tourism. How and MNE's activities could potentially benefit through the international destination?

International tourism is one of the important beneficiaries and vehicles of its expression (Meethan 2001; Wahab and Cooper 2001). The World Travel and Tourism Council claims that tourism has become the world's largest industry. In many developing countries, the most important reason for a country to attract tourism foreign direct investment (Yew and Beau, 2007). Knowledge and information can be accumulated by traveler's own experiences, recommendations by friends and relatives, and information gathered form mass media such as television, printed material, Why tour guide is the important role of tourism and international investment? The purpose of this study was to develop an enterprise international through professional tour guide that describes environment of investment.

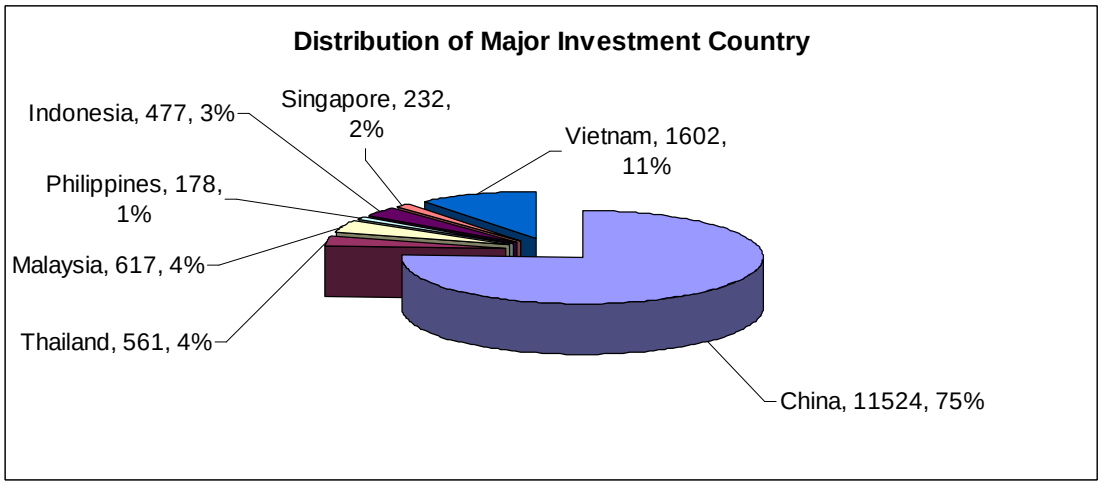
LITERATURE REVIEW

The resource-based approach that although the MNE initially relies on its superior capabilities and Greenfield entries to overcome the liability of foreignness, it will eventually try to secure key resources and knowledge residing in local firms(Chang & Rosenzweig,2001; Delios & Beamish, 1999). Assets, capabilities, experience, transaction costs are factors with the MNE strategic decision-making. However, ownership restrictions limiting the investors' choices of entry mode, or on similarly limiting country-risk factors (Delios & Henisz, 2000; Padmanabhan & Cho, 1996).

Location factors presumably shape the entry mode choice as much as MNE capabilities do. Some scholars insist that location is neglected factor in the analysis of MNE activity and has to be reintegrated into it (Dunning, 1998). The explanations of FDI entry of FDI entry modes as starting point of FDI activity have been given mainly from MNE perspective and refer to MNE experience, proprietary assets and technology, cost saving reasoning, and learning(Somlev & Hoshino, 2005).

In the case of Japanese MNEs by the accepted opinion that the competitive advantage of Japanese products arises from lean production techniques (Takamiya & Thurley, 1985) and such production organization will avoid local interference via wholly owned Greenfield modes of entry (Morgan, Sharpe, Kelly, & Whitley, 2002).In addition to market size and growth and labour endowment, culture is another location-related variable often used in explaining entry mode choice (Chang & Rosenzweig, 2001; Kogut & Singh, 1988).However, cultural distance may also increase the cost of assimilating equity partners when operating a joint venture (Padmanabhan & Cho, 1996).Other authors find that, independently from

cultural difference, investing firm's country of origin is associated with preference for a particular mode, such as the tendency Japanese MNEs have to avoid acquisitions (Chang & Rosenzweig, 2001).

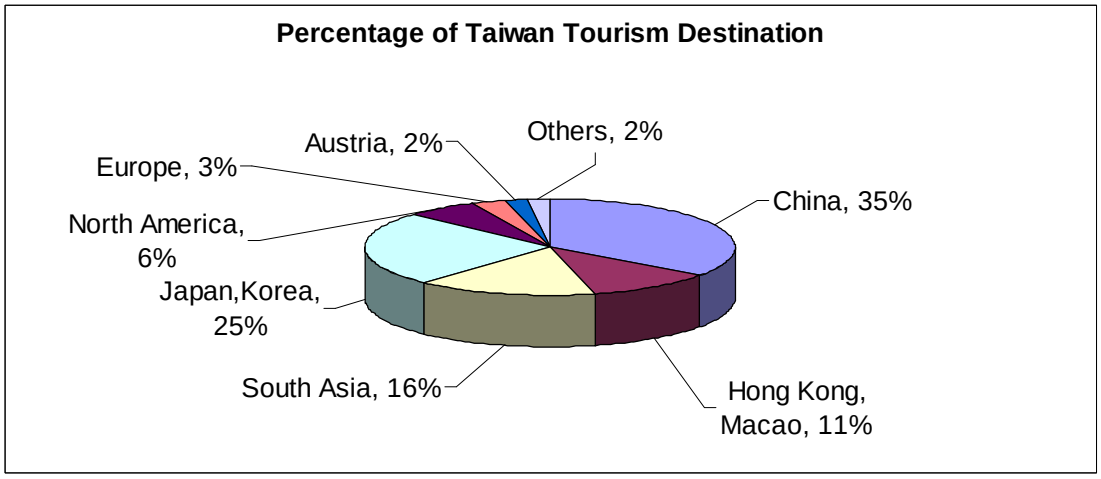


Tourism is one of the world's industries; the World Tourism Organization (WTO)estimates that in the past 40 years, the number of people who have traveled internationally has increased form 65 to 560 million and by 2010 will generate $8 trillion of economic activity (Goekiner, Brent Ritchie, & Mcintosh, 2000).Tourism offers many possibilities to study its process, especially where international tourists meet local manufacturers, retailers, and service providers in the production and sale of globalization goods and service (Cawley, Gaffey and Gillmor 2002; Uamashita 2003).geographers studying tourism have repeatedly stressed the importance of the global-local nexus(Salazar, 2004). Whereas in its original micromarketing meaning glocalizatin referred to tailoring global products to particular circumstances, in the case of tourism and guiding, it involves tailoring local (and localized) products (representations tourists coming from various parts of the world and with different preferences)(Salazar, 2004). Tour guides have also been described by several authors as "an information giver and fount of knowledge" "metor"(Cohen, 1985). Pond (1993) indicated that that role of the guide indudes one who is:

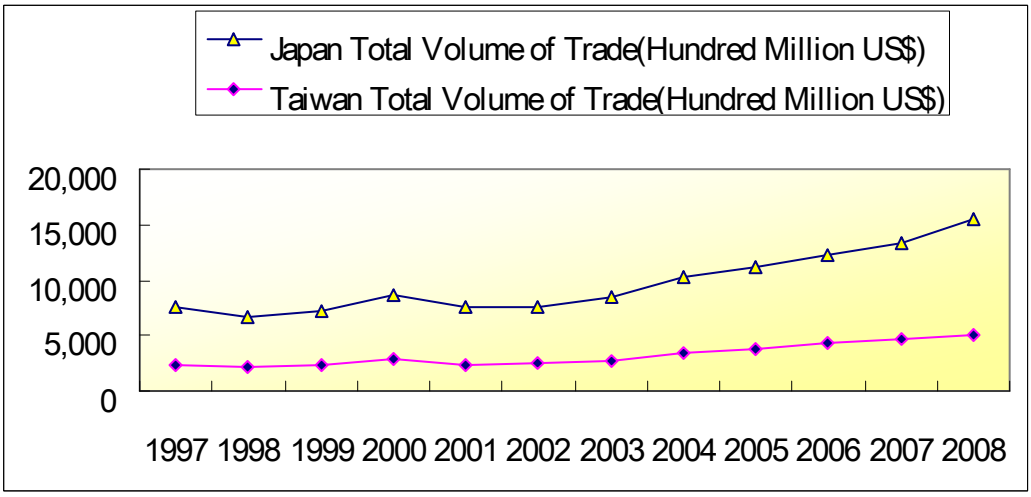
1. a leader capable of assuming responsibility.
2. an educator to help the guest understand the places they visit
3. an ambassador who extends hospitality and presents the destination in a way that make visitors want to return
4. a host who can create a comfortable environment for the guest
5. a facilitator who knows how and when to fulfill the previous four roles.

Successful guides skillfully adapt to the specific expectations of different groups. It is important that citizens from the country visited, but come from another region or belong to a different group(Hichcock 2000).

Between tourism location and geographic dimensions. The consequences of FDI location choices among sub-national regions within a single transition economy (Meyer & Nguyen, 2005). These regions can be attractive in terms of economic-geographic dimensions.



Farmer and Richman build on the cultural cluster and suggest that It is important to effective external environmental factors in a organization. Such as education and political influences, social, low, economic. It is efficiency and contribute to economic in the world. In Japan, they are stronger sense of culture community, Japan exhibit high quality at lower cost products than American, Japan has also taken a long-range approach to its economic growth, Since World War II, Japan enhance its competitive position that success as contributing to the over all success in the international arena. Significant barriers to trade in the international arena and growing, as signal "Japan, Inc.," indicate that a good products.



This study aims to find how multinational corporations acquire information by overseas traveling to serve as criterion for tourism industry, enhance its focus on business travel, and take initiative in the trend of corporate internationalization regarding itinerary arrangement or guides' explanation, develop international operational concepts and international vision, and expand the services to allow travelers to be inspired by foreign operational resources in overseas travel to accomplish the global development of multinational corporations. Content of this study includes (1) basic concept of tourism industry; (1) basic theory of multinational corporations; (3) number of people of tourism and trade in Taiwan and Japan; (4) destinations

of tourism of Taiwan and main investment regions. (5) Comparison between customers' views on importance of guides' tourism knowledge and investment knowledge.

RESEARCH METHOD

This study was collected date used quantitative data form customer who join group tour survey. Data was collected during January to March in 2010. A total of 300 questionnaires were distributed by internet survey. Total 132 survey completed and valid. The FDI scale was referred tothe investigations for this country model developed by Richard Farmer and B. Richman. The components of these sections of the model are as follows: (a) educational-cultural variables; (b) sociological-cultural variables; (c) political and legal variables; and (d) economic variables. Total 29 item in this survey.The questions are further modified according to the professional opinions. Items were 5 point rating scale (1 = not important and 5 = very important) Finally, eight questions of the socio-demographic background of the customer are included. SPSS 12.0 was used for the data analysis. The statistics used included descriptive statistics, reliability analysis, regression analysis, and ANOVA.

FINDINGS AND DISCUSSION

As shown in Table 1 demographic profile of respondents descriptive statistics. The results show that the most of subjects are male contains 65.9%, In the age distribution, most subjects are between 31-40(40.9%) and 41-50(30.3%), middle management (50.0%) are most position in corporation. The most of industry is manufacturing separately 11.4% of steel manufacturing, 16.7% of chemical industry, 11.4% of electric industry.

Table 1. Demographic profile of respondents

	Frequency	%		Frequency	%
Age			**Industry**		
Under 30	6	4.5	Steel manufacturing	15	11.4
31-40	54	40.9	Chemical industry	22	16.7
41-50	40	30.3	Electric	15	11.4
Over 51	32	24.2	manufacturing	5	3.8
Position			Other manufacturing	6	4.5
Staff	28	21.2	Optoelectronics	2	1.5
Middle management	66	50.0	Computer and	8	6.1
Executive	40	30.3	network	21	15.9
management			Digital technology	16	12.1
Sex	87	65.9	Information	2	1.5
Male	45	34.0	electronics	16	12.1
Female			Trade commerce	4	3.0
			Food products		
			Service		
			Logistics industry		

As shown in Table 2 corporation background of 132 profile of respondents descriptive statistics. The results show that the most of corporation established between since year 1980 (29.54%), 1981-1990(32.57%), and 1991-2000(28.03%), Overseas investment from year 1991-2000(53.03%) are highest. The amount of capital under 100 million are highest and business volume of profit between 100million (31.81%) 100-1,000 million (21.96%) and 1,000-10,000 million (31.06%).

It is means that the most of respondents of business is Small and medium-sized enterprises

Table 2. corporation background

	Frequency	%		Frequency	%
Established			**Capital account**		
Before 1980	39	29.54	100 million	60	45.45
1981-1990	43	32.57	100-1,000 million	27	20.45
1991-2000	37	28.03	1,000-10,000 million	32	24.24
Over 2000	13	9.84	Over 10,000 million	13	9.84
Overseas investment			**Business volume**		
Before 1980	8	6.06	100 million	42	31.81
1981-1990	18	13.63	100-1,000 million	29	21.96
1991-2000	70	53.03	1,000-10,000 million	41	31.06
Over 2000	30	22.72	Over 10,000 million	20	15.15

As shown in Table 3 corporation status of investment of 132 profile of respondents descriptive statistics. The results show that the most of industry is electric equipment(37.1%) and next is metal (12.9%), China(54.5%) is the most of investment are highest. China also the most of investment in the world.

Table 3 status of investment

	Frequency	%		Frequency	%
Industry			**Country**		
Agriculture	2	1.5	North America	9	6.89
Food products	1	0.8	South America	4	3.0
Fiber	8	6.1	Western Europe	3	2.3
Wood	2	1.5	Eastern	4	3.0
Paper	1	0.8	Russia	2	1.5
plastics	8	6.1	South Asia	14	10.6
Metals	15	11.4	Japan	7	5.3
Electric equipment	49	37.1	Korea	5	3.8
Tourism	1	0.8	Australia	1	0.8
Transportation	9	6.1	China	72	54.5
Commerce	10	7.6	All of above	8	6.1
Other	17	12.9			

As shown in Table 4 The level of important in tour guide to provide investment knowledge from customer respondents. This study of survey is refer to Richard Farmer and B. Richman Comparative Management and Economic.

Table 4. Customers' views on importance degrees of international guides' providing of investment environment knowledge (N=132)

Item of State		
Political and legal	**Mean**	**Standard. D**
1, Introduction of Labor Standards Act ----------	3.98	0.89
2, Introduction of foreign investment system ----------	4.10	0.80
3, Analysis on local political stability ----------	4.25	0.84
4, Local tax policy ----------	4.06	0.98
5, Local finance policy----------	4.01	0.96
6, Local reward policy ----------	3.96	0.94
Economic		
1, Local financial conditions are positive ----------	4.03	0.78
2, Product techniques are good ----------	3.98	0.88
3, Local economic stability ----------	4.15	0.89
4, Local consumers' purchasing power ----------	3.95	1.05
5, High modern industrialized development or high technology----------	3.78	0.81
6, Long supply of water and electricity and low cost---------	4.01	0.96
7, Good international communication equipment ----------	4.25	0.80
8, Salary level ----------	4.01	0.79
9, Traffic convenience and transportation facility cost-------	4.12	0.86
10, Production and modern facilities ----------	3.93	0.88
11, Rich local resources ----------	3.96	0.94
12, Materials----------	3.86	0.85
13, Local enormous market ----------	3.98	0.84
Socialogical-cultural		
1, Description regarding difference between local religious and national culture and Taiwan----------	3.86	1.03
2, Description regarding local people's attitude toward and acceptance of foreign companies ----------	3.83 3.56	0.91 0.78
3, Description regarding value on techniques----------		
4, Description regarding local labor's diligence and harmony----------	3.80 3.74	0.87 1.05
5, Description regarding interference of local labor union with firms----------	3.84	0.91
6, Description regarding local corporate ethics and industrial morality----------	3.93	0.88
educational- cultural		
1, Description regarding education prevalence ----------	3.81	0.83
2, Cooperation among management, science and engineering or other educational levels and professional techniques----------		

Socialogial-cultural and educational-cultural importance degree is low whereas economic and political importance degrees are high. It means that customers value investment cost and returns.

As shown in Table 5 The level of important in tour guide to provide traveling knowledge from customer respondents. This study of survey is refer to wang (2000). All of item mean over 4.00, show that most of customer to pay much attention to traveling knowledge.

Table 5. Customers' views on importance degrees of international guides' providing of tourism knowledge (N=132)

Item of State		
	Mean	**Standard. D**
1, Provide guide with in-depth professional knowledge -----	4.33	0.80
2, Rich experience in the spots ----------	4.65	0.59
3, Satisfying customers' psychology and service manners expected----------	4.50	0.65
4, Proper arrangement of board, lodging and transportation ----------	4.72	0.59
5, Good communication with local service personnel -------- ----------	4.66	0.61
6, Complete coping with emergency ----------	4.81	0.45
7, Good explanation and translation abilities in the trip------	4.63	0.64
8, In-depth understanding of local traditional cultural knowledge----------	4.59	0.80
9, Hard-working and sincere----------	4.68	0.58
10, Fair and consistent customer service----------	4.65	0.64
11, Good physical strength, active service and manners----	4.51	0.65
12, In-depth understanding of traditional cultural characteristics of different nations ----------	4.62	0.62

CONCLUSIONS

With popularity of overseas travel, tourism becomes one of global critical economic activities. The roles of tourism industry become diverse, and the industry expands services and provides overseas travelers diverse information in order to enhance social level. Taiwan is based on island economy, and it relies on foreign resources and global market as important corporate development strategy. Location of East Asia is close to Taiwan and the Chinese culture in East Asia is similar to Taiwan. It is the priority for tourists and investors from Taiwan. According to foreign investment regions in this study, China is the first (54.5%) and the following are ASEAN (10.6%), North America (6.8%), Japan and Korea (5.3% and 3.8%). Investment locations are mostly in China and Southeast Asia with favorable labor, wages, land and materials. Information and techniques are the advantages of locations in America and Europe, particularly for information electronics industry. Thus, the firms must be highly sensitive to international market. Besides industrial work division and corporate trade effect, enterprises should also absorb international industry information and flexibly adopt international operational strategy to increase industrial competitiveness.

In the time with severe competition of globalization, according to advantage and disadvantage analysis of investment environments and with different investment purposes, the firms will invest in high-tech nations such as Japan and the U.S. for technique and

product R&D and they will invest in nations of EU for different markets. Therefore, by international guides' explanation and providing of business knowledge of local environment, enterprises of Taiwan will recognize global operational development, investment and international trade. Acquiring knowledge of spots and corporate investment resources will enhance people's travels and national competitiveness.

In addition, tourism companies should value growth of business trips, pay attention to quality and quantity of supply and reinforce training for professional guides in order to expands the services, strengthen people's cognition and increase current social positions.

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CONSUMERS' PERCEPTION ON MOBILE PAYMENT SYSTEM APPLICATION IN MALAYSIA

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ABSTRACT

Mobile payment system enables users to make payment via Short-Message-Service (SMS). The objective of this paper includes determining consumers' requirements so that firms can provide more functional mobile payment systems that deliver customers wants. This paper examines the key determinants of mobile payment in Malaysia through three perspectives: consumer features, business features and technology features. Survey questionnaires were distributed to about 300 mobile payment users in Malaysia using convenient sampling method with a valid response 247. Data collected were analyzed using regression technique to determine the significant levels of interactions between the dependent and independent variables. The outcome could help firms to improve the quality of mobile payment systems. This could also be relevant to Malaysia's goal of building a knowledge-based society by 2020. This research would also provide useful data that could help the industry determine customers' needs within Malaysian context. The empirical insights from this study would also be useful for theory building.

Keywords:M-payment usage, M-payment system, E-commerce, E-banking, Malaysia.

INTRODUCTION

The increasing Internet and mobile applications have sharpened global awareness that technology advancement can drive the ability to manage firms better. However, technologies innovations are meaningless if people do not value these innovations as a way to meet their needs. Firms need to keep up-to-date with the pace of technology to improve their information infrastructures in order to grow both nationally and globally. Mobile payment system enables users to make payment via Short-Message-Service (SMS). The mobile technology is undeniably an important application for mobile commerce (m-commerce) (Hu et al, 2008b). However, the factors which determine mobile payment (mobile payment) usage are equally or more important. Thus, firms need to understand the benefits of m-payment, which could help in satisfying customers and possibly enable the firms to access greater business opportunities.

The simplest and oldest form of payment for any business transaction is what may be called the barter system, which enabled the exchange of goods or services for another. Fast forward to the 21st century, the most common payment system is through legal tender, cheque, debit, credit, or bank transfer. In business transactions, payment can be made by an invoice, which would result in a receipt. In addition, the use of electronic payment methods has been

increasing in the past 2 decades and they include the magnetic stripe card, smartcard, contactless card, and mobile handsets. As the technology and communication systems improve, the transition from online to mobile payment system improves as well. In the future, every individual would be able to make payments via their mobile payment devices such as cellular phone, smart phones, and personal digital assistants (PDAs), or mobile terminals. Thus, the m-payment will become a new trend for individuals and corporate entities to make payments for their business dealings.

To address the key issues in this research, we aim to identify the determinants of m-payment from customers' perspective. Mobile payment can be defined as a wireless-based electronic payment for m-commerce to support point-of-sale / point-of-service (POS) payment transactions on user's mobile devices (Gao et al, 2005). The determinants in this paper are divided into three constructs including consumer features (price, convenience, and content reliability); business features (visibility, system quality, and customer service); and technology features (security, SMS services, and transaction process). Finally, these three constructs will be measured and examined to understand consumers' perspective on mobile payment usage in Malaysia.

CONCEPTUAL DEVELOPMENT

The proliferation of science and technology has improved methods of paying for purchases. The advancement of mobile devices has created a new business concept. Consumers will find it an inexpensive alternative means to ease their difficulties in making payments for goods and services. For example, consumers can make payment via mobile devices from anywhere at anytime and for anything. Technologies such as SMS can create a simple transaction for an e-banking and e-payment process, which could provide lots of convenience to consumers. Furthermore, consumers can easily credit the payment into their bank account with just a simple SMS. Based on the foregoing, we develop the consumer features construct in the framework and we will use three variables to describe the construct.

In addition, the mobile technology sector is fast growing in size. The concept of mobile payment (m-payment) has created a much more dynamic approach to collect payment from consumers by sellers. For example, a firm that implements an m-payment system can directly receive payment from the bank with the approval of the consumers. There will be 3-tier interaction between consumer, firm and the bank. The m-payment shall be visible to all types of mobile devices. These include the system quality and the customer service by the firm that implements the m-payment system. Based on the foregoing, we will develop the business features construct in the framework and we will use three variables to describe the constructs.

Addressing consumer features and business features may be inadequate for a firm to enhance the m-payment system. Firms, therefore, would require technology features to manage the entire flow of the point of sales (POS) to ensure smooth operations. This will include the provision of adequate security for m-payment such as authentication. A firm will implement an SMS service for their consumer feedback and enquiry. Effective transaction process for the m-payment will also increase the mobile payment usage. Thus, we will examine the impacts of consumer features, business features and technology features on the mobile payment usage. In each of the input variable, we will discuss three sub-items. The model

generated could be analyzed from both consumer and business perspectives, but in this paper we will focus on the consumer's perspective.

Figure 1 represents the research framework for this paper and illustrates nine independent variables for the three constructs: price, convenience, content reliability, visibility, system quality, customer service, security, SMS services, and transaction process. We also generated nine hypotheses – three for each of the constructs namely consumer features, business features and technology features – to test the influence of the independent variables on mobile payment usage in Malaysia. Table 1 presents the dimensions of the variables we to examined in this paper, the operational definitions and the selected sources of the definitions and related works.

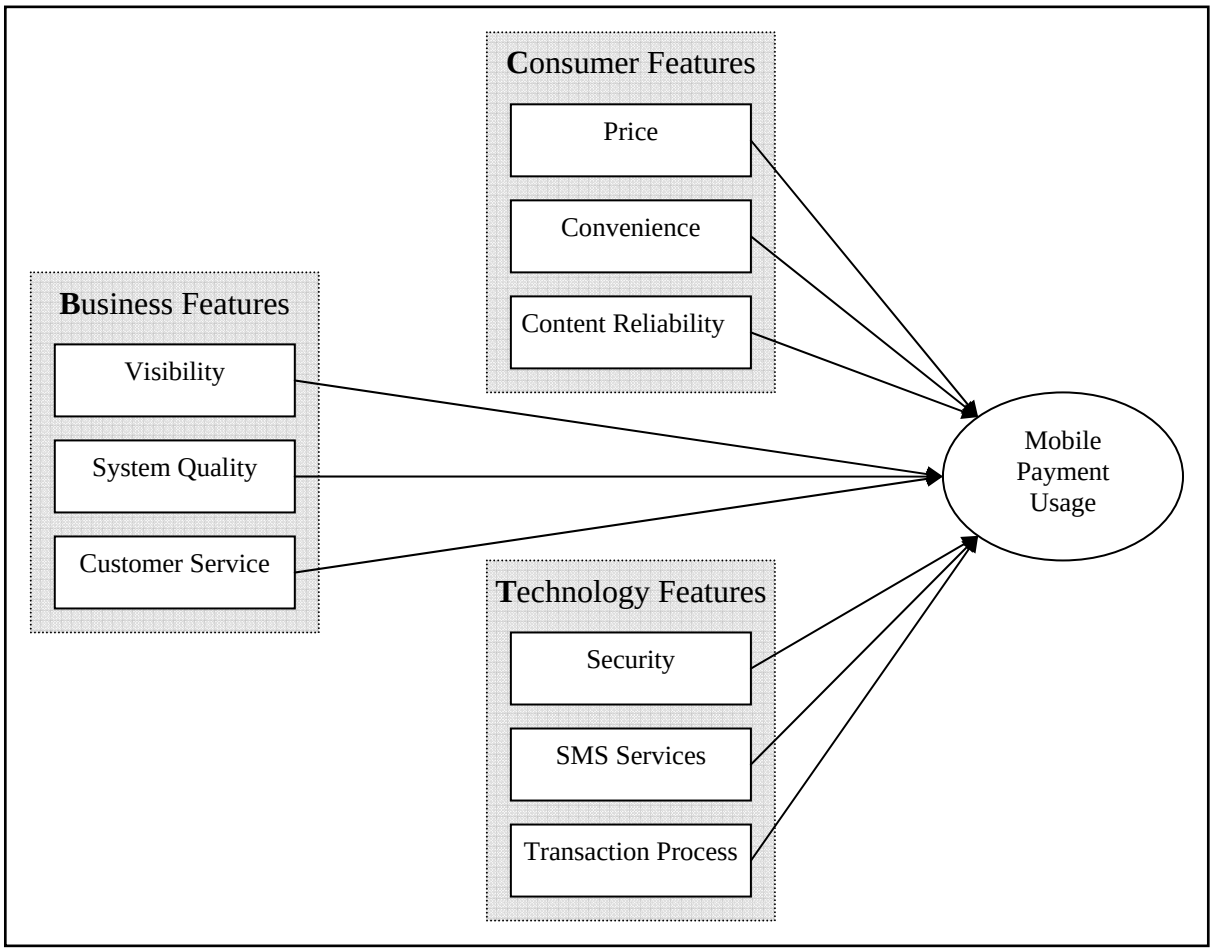

Fig. 1: Research Framework

Table 1: Variables, Description, and Sources

Factors	Operational definitions	Sources
Price	Degree to which a person believes that he/she should pay for using m-commerce.	Cheong and Park (2005), Choi et al (2008), Varshney (2008).
Convenience	Degree to which a person believes that navigating or engaging in transactions through m-commerce would be free of effort.	Cheong and Park (2005), Choi et al (2008), Kim et al (2005).
Content Reliability	Degree to which a person believes that the mobile portal will enhance the products or service quality provided	Cheong and Park (2005), Choi et al (2008), Wu and Wang (2005).
Visibility	Degree of how much represent able of the display, site design or visual information provided by the mobile portal.	Choi et al (2008), Kim et al (2005), Wei and Ozok (2005).
System Quality	Degree of connectivity or availability provided related to the line of the services by the mobile portal.	Choi et al (2008), Varshney (2008).
Customer Service	Degree of assistance provided related to enquires, issuers, problems, or feedbacks on usage or transaction process.	Choi et al (2008), Vlachos and Vrechopoulos (2008).
Security	Degree of authorization, authentication, and privacy statements related to mobile transaction.	Choi et al (2008), Khalifa and Shen (2008), Me et al (2006).
SMS Services	Degree of auto-response services provided by mobile portal related to mobile transaction.	-
Transaction Process	The level at which a person can operate a systematically efficient point-of-sales in mobile transaction.	Choi et al (2008), Kim et al (2005).

Consumer features in m-payment can be defined as any distinctive, singular, typical or special feature or features, which may be used to distinguish a customer or group of customers from any other consumer group of consumers in buying or payment process for products or services. These features will be different from one consumer to another consumer. This article identified three consumer features that could influence mobile payment usage in among consumers and they include price, convenience, and content reliability.

Price in m-payment can be defined as the degree to which a person believes that they should pay for the price of using m-commerce (Cheong and Park, 2005; Choi et al, 2008; Varshney, 2008). Businesses such as retailers will offer low prices to capture higher store traffic while consumers will respond differently indicating varying levels of price consciousness (Choi et al, 2006; Kukar-Kinney, 2007; Tan et al, 2009). For example, the m-payment can be integrated with common price strategies such as low-price services, mobile point accumulation for complete transaction, and zero-fee SMS transactions for e-banking or e-business. Furthermore, the lower fee of m-payment will encourage more users to use mobile payment services.

According to Poon (2008), one of the determinants of e-banking usage in Malaysia is reasonable fees and charges. In addition, price plays a major role in purchasing process in the retail firms' perspectives (Alvarez and Casielles, 2008). As for m-payment, reasonable fees and charges should be applied in order to capture wider market share of mobile users. Smart consumers are insistent on making price comparisons within the products or services to measure the quality and performance (Tan et al, 2009). A minimum transaction fee for SMS

transaction fee will make the consumers keen to use m-payment. Thus, mobile service providers (MSP) that provide lower fee to consumers will enhance the possibility of consumers to use m-payment. Hence the following hypothesis:

Hypothesis 1: Price will significantly affect m-payment usage.

Convenience in m-payment can be defined as the degree to which a person believes that navigating or engaging in transactions through m-commerce would be free of efforts (Cheong and Park, 2005; Choi et al, 2008; Kim et al, 2005). In retailing, a consumer satisfaction will increase when the consumer value increase with higher return on investment (ROI) (Ramaseshan, 2006; Tan et al, 2009). As such, a firm can implement an m-payment system in their businesses to increase consumer loyalty. The usage will allow their consumers to make payment with the concept of "3A" that is "Anywhere, Anytime, Anything". The concept allows consumers to make payment from any location without the boundary of time to purchase any products or services.

According to Zhang (2008), the biggest advantage of mobile payment is the opportunity to conduct trading anytime and anywhere and it is characterized by mobilization and individualization. Consumers with mobile devices can easily make payments by sending SMS to a system application. This SMS will then be authenticated with the related e-banking system for complete transaction process. In addition, consumers may not need to queue-up like in retail industry to make payment or even find a PC for online payment. As such, consumers can get products or services faster, which can lead to customer satisfaction. Thus, the convenience m-payment provides would enable consumers to use m-payment system. Hence the following hypothesis:

Hypothesis 2: Convenience will positively influence m-payment usage.

Content reliability in m-payment can be defined as the degree to which a person believes that the mobile portal will enhance the quality of products or services provided (Cheong and Park, 2005; Choi et al, 2008; Wu and Wang, 2005). In a research (Choi et al, 2008), content reliability is proven to be significant influence in mobile system satisfaction (m-satisfaction) and mobile loyalty (m-loyalty) in digital music transaction industry in Korea. The type of product or service transacted will be in the form of virtual products, digital content, information, etc. Consumers who use the mobile portal, which provide a good quality products or services will enhance the consumer's trust and ability to re-purchase the goods. In like manner, the content reliability will enhance re-purchase power from the consumers in m-payment.

The system requirement for m-payment will allow products to be personalized or customized upon request by consumers (Hu et al, 2008a). For example, Web content in mobile application can be viewed via either browsers or micro browsers. The content accuracy and precision provided by m-payment companies will be a key determinant for m-payment usage. If the data are reliable and up-to-date, this will increase the trust of the consumers to make payment via mobile payment system. The growth of e-banking and e-business with the advancement of technology will enhance the usage of m-payment. Thus, the content

reliability in m-payment could change the manner of business being conducted and may enable great m-payment usage. Hence the following hypothesis:

Hypothesis 3: Content reliability will positively influence m-payment usage.

Business features in m-payment can be defined as any distinctive, singular, typical or special feature or features, which may be used to distinguish a firm or business entity from any other firms or group of business entity in the industry in creating the buying or payment process for products or services. These features will be different for different industries. This article identified three business features that could influence mobile payment usage among consumers and they include visibility, system quality, and customer service.

Visibility in m-payment can be defined as the degree of representation made possible in the display, site design or visual information provided by the mobile portal (Choi et al, 2008; Kim et al, 2005; Wei and Ozok, 2005). The information must be able to be represented in the display using various types of mobile techniques and consumers should be able to appreciate the content. The content and the pre-details of the m-payment must be able to shown in the mobile screen. Reliable and detail information for m-payment is encouraged by the firm and this should be well arranged and organized. For example, the overall design of the screens offered by m-payment must be able to satisfy consumers' requirements.

In addition, the overall design of the screens offered by m-payment must be able to be constructed in a way convenient to the consumers. According to Delic and Vukasinovic (2006), the m-payment services can be categories into three key mobile payment transactions, which include SMS based applications, micro point of sales (mPOS) based applications, and Internet based applications. All these services should be visible in the m-payment so that the consumer visualizes the information. For example, if a user uses SMS based application, the user should be able to send a string of SMS in their mobile screen to the mobile provider in order to make a successful transaction. Thus, the visibility in the m-payment will affect the usage of the m-payment services. Hence the following hypothesis:

Hypothesis 4: High visibility in m-payment will positively influence m-payment usage.

System quality can be defined as the degree of connectivity or availability provided by the firm, which is related to the line of services by the mobile portal (Choi et al, 2008; Varshney, 2008). According to Chen & Zhou (2008), service quality on mobile commerce demonstrates user perception towards vendor service level, which includes on-time service, timely response and personalization. With good system quality, consumers will able to use the services to make payment. For example, consumer can make their payments by debiting the items purchased into their bank account. Next, by the end of the month, the consumers just need to pay the total amount for buying product or services. Thus, a good system quality can increase the rate of success of access to m-payment.

In mobile applications, the system quality must be able to have data-mining logic system. For example, if there is a technological problem in the system, then the m-payment must be able to identify the error by providing a next page loaded with information. The system, as much as possible, should be error free to avoid unnecessary wait of time and frustration.

Furthermore, the consumer should only disconnect the access to m-payment due to a technological problem. If the system quality of the m-payment is good, then this will encourage more users to use the m-payment system. By applying the 3A concept, the adoption of m-payment would increase as well. Thus, an m-payment should have a good integrated system quality. Hence the following hypothesis:

Hypothesis 5: System quality will positively influence m-payment usage.

Customer service in m-payment can be defined as the degree of assistance provided by a firm in relation to enquires, problems, or feedbacks on usage or transaction process (Choi et al, 2008; Vlachos and Vrechopoulos, 2008). According to Ball et al (2005), service personalization is important and that it is related in multiple ways to loyalty. For example, consumers can ask for an issue related to failure of their transaction process. The customer service provided by the m-payment system to assist the consumer would be helpful to ease their plight. Such service will encourage the consumers to use the m-payment. Thus, the consumers would feel at ease in using the m-payment to conclude their business transactions.

In addition, consumers also expect the time-to-response (TTR) to inquiries by the mobile service provider to be fast. Their answers on inquires should the useful and able to solve related problems. The m-business and e-business should recommend the content specification when the user is accessing the m-payment. For example, the consumer can ask for a location map via their mobile devices by making a small payment to a GPRS system. Furthermore, there should be several methods for the user to submit their enquiry about the m-payment. These could include the details about the content and services. Thus, a reliable customer service would be a key factor to encourage m-payment usage. Hence the following hypothesis:

Hypothesis 6: Customer service will positively influence m-payment usage.

Technology features in m-payment can be defined as the system used to manage customer information, products and services need. A good technology feature will enable information to be process from databases with data mining execution. Effective m-payment system will enable better understanding of customer need, which would drive m-payment usage. This article identified three business features that could influence mobile payment usage among consumers and they include security, SMS services, and transaction process.

Security in m-payment can be defined as the degree of authorization, authentication, and privacy statements related to mobile transaction (Choi et al, 2008; Khalifa and Shen, 2008; Me et al, 2006). According to Mohd and Osman (2005), the security of a payment method is undoubtedly crucial if the payment method is to gain widespread acceptance. As a whole, security can be view from five perspectives namely confidentiality, authentication, integrity, authorization, non-repudiation, and accessibility. For example, the typical content for authentication of a SMS for a top-up system (Delic and Vukasinovic, 2006) as below:

Amount<space>**TopupNumber**(optional)<space>**AccountNameCode**(optional):**GreetingMessage**(optional)

Next, the message will be sent with defined content to short number (E.g. 8585) to complete the process.

In Malaysia, for example, you may receive advertisement from a mobile service provider. For example, this SMS sent by mobile service provider: "RM0. Keep yourself updated with the latest 2010 World Cup Qualifiers! Get match previews, goal alerts, stats & results from Maxis. Sent ON WCQ to 22006. RM0.30/SMS". In order to activate, just type "ON WCQ" in the SMS and send to 22006. This will be charged RM0.30 per SMS into the user's mobile account. With mobile technology, consumers are able to make purchase of the information through the m-payment system. The firm that plans to implement m-payment system should emphasis the authorization, authentication and privacy statement to be able to gain consumers' confidence in the use of m-payment. Thus, proper security plays an important role in determining m-payment usage. Hence the following hypothesis:

Hypothesis 7: High security will positively influence m-payment usage.

SMS services can be defined as the degree of auto-response services provided by mobile portal related to mobile transaction. The enquiry by consumers to the mobile service provider should be in auto-reply system. For every successful transaction, there should be a reply indicating the success or failure of the process. It will be good if the system will prompt the user to their mobile devices. It also can generate an email to the user indicating their transaction had been completed. For example, if a consumer enquires about a movie ticket, the system will send a response to the consumer within seconds, which charge a minimum fee. Thus, the consumer will be able to get the information need without the hassle to look online.

In addition, Maxis Communications Berhad (Maxis) launched the AeroMobile system, which enables post-paid consumers to make communication services such as voice calls, SMS, e-mail and GPRS (InTech, 2009). The service will be billed to their consumers' monthly phone bill as with any other international roaming calls. The consumer will be able to make and receive voice calls at RM15 per minute, or send or receive data at RM100 per megabyte. For SMS, each SMS sent is charged at RM3 per message while receiving SMS if free of charge. These SMSs and data usage are frequent amongst travellers and business travellers. If a firm utilizes the m-payment system, they will capture this uncontested business opportunity. Thus, an effective m-payment should have relevant SMS services to enable proper implementation process. Hence the following hypothesis:

Hypothesis 8: SMS services will positively influence m-payment usage.

Transaction process entails the unambiguous and independent execution of a set of operations on data in a relational database, which treats set of actions as a single event (Choi et al, 2008; Kim et al, 2005). If any part of the transaction process fails, the entire transaction fails and all participating resources are rolled back to their previous state (Pete, 2001). For example, the consumer can make a micros point of sales (mPOS) with their mobile application. Upon success, a bank will credit their bank account, which indicates payment being made. Thus, the cost and time for purchasing the products and services will reduce with effective transaction process.

A good system is needed for transaction processing and must pass the ACID Test: atomicity, consistency, isolation and durability (Pete, 2001). Transaction processing systems may consist of computer hardware and software hosting a transaction-oriented application that performs the routine transactions necessary to conduct business. For example, PosPay (2009) is Malaysia's first Ringgit-based Virtual Account, which provides an alternative to traditional online payment system. It enables customers to open virtual accounts for payments for online shopping transactions, utility bills, mobile content downloads, and the reloading of points for online games. PosPay payment services make it easy for customers to process micro-payments without fear of credit-card fraud and for merchants to process transactions and receive payment easily and without hassle. Hence the following hypothesis:

Hypothesis 9: Effective transaction process will positively influence m-payment usage.

RESEARCH METHODOLOGY

The main aim of this research is to determine the influence of consumer features, business features, and technology features on m-payment usage. Thus, the main research question for this study will address factor that will have significant influence on m-payment usage based on the hypotheses discussed in the earlier section. Based on the aforementioned, we will collect the primary data for this research through survey questionnaire. The survey questions will be developed to address the key constructs and the variables outlined above. Journal articles, institutional reports on knowledge management systems and marketing will form bases for the secondary data. We would also consider face-to-face interview to provide some verifications for the data collected through questionnaire. We will use convenience-sampling method to select the participants in this research. One thousand survey questionnaires will be distributed to Malaysian consumers in three locations in Malaysia including Kuala Lumpur, Malacca, and Selangor.

QUESTIONNAIRE DESIGN

The questionnaire consists of two sections, section A and section B. Section A address background data of respondents such as age, income level, education level, gender and knowledge and communication technology awareness. Section B solicited responses on the key constructs of the research framework including the consumers' features, business features and technology features. In measuring the variables, all questions were designed using a 5-point Likert scale where "1" represents "strongly disagree" and "5" represents "strongly agree". The respondents' feedback were coded according to the levels of respondents' agreement. The overall score represent the summation of the scores received from respondents on individual item and this will be assign to each respondent.

PILOT SURVEY

The objective of a pilot survey was to measure the face validity and reliability of the survey questionnaire for this research (Babbie, 1990; Sekaran, 2003). We conducted a pilot study using a group of 20 consumers who had some experiences in the use of mobile devices to

make payment. The suggestions, comments, and critiques from these participants were evaluated and incorporated into the survey before generating the final survey questionnaire. Finally, the revised and complete questionnaires were sent to the consumers who use or intend to use mobile devices to make payment.

RESULTS

Table 2 Demographic Profile

		Frequency	Percent	Cumulative (%)
Gender	Male	131	53.0	53.0
	Female	116	47.0	100.0
Age	20 and below	12	4.9	4.9
	21 - 30	185	74.9	79.8
	31 - 40	37	15.0	94.7
	41 - 50	8	3.2	98.0
	51 - 60	5	2.0	100.0
Marital Status	Single	190	76.9	76.9
	Married	57	23.1	100.0
Ethnicity	Malay	68	27.5	27.5
	Chinese	120	48.6	76.1
	Indian	36	14.6	90.7
	Others	23	9.3	100.0
Location	Kuala Lumpur	80	32.4	32.4
	Melaka	94	38.1	70.4
	Selangor	73	29.6	100.0
Education	SPM	6	2.4	2.4
	STPM	10	4.0	6.5
	Diploma	29	11.7	18.2
	Degree	178	72.1	90.3
	Master	21	8.5	98.8
	PHD	3	1.2	100.0
Monthly Income	RM2,000 and below	80	32.4	32.4
	RM2,001 - RM4,000	112	45.3	77.7
	RM4,000 - RM6,000	36	14.6	92.3
	RM6,001 - RM8,000	10	4.0	96.4
	RM8,001 - RM10,000	7	2.8	99.2
	Above RM10,000	2	0.8	100.0
Job Status	Student	38	15.4	15.4
	Employed	191	77.3	92.7
	Self-Employed	12	4.9	97.6
	Unemployed	6	2.4	100.0

From the Table 2, it had shown the demographic profile that consists of the 247 respondents. The demographic profiles are gender, age, marital status, ethnicity, location, highest education level, monthly income and job status. Respondents for this study are typically employed, have average income, ages between twenty to thirty years old and are still single.

Table 3 Technology Profile

		Frequency	Percent	Cumulative (%)
Q11_Mobile_Provider	Maxis	142	57.5	57.5
	Celcom	38	15.4	72.9
	Digi	67	27.1	100.0
Q12_Year	0 - 3 years	12	4.9	4.9
	4 - 6 years	98	39.7	44.5
	7 - 10 years	118	47.8	92.3
	11- 15 years	13	5.3	97.6
	More than 15 years	6	2.4	100.0
Q13_Knowledge	Yes	137	55.5	55.5
	No	110	44.5	100.0
Q14_Try	Yes	170	68.8	68.8
	No	77	31.2	100.0
Q15_Plan	1 month later	47	19.0	19.0
	3 month later	14	5.7	24.7
	6 month later	7	2.8	27.5
	1 year later	4	1.6	29.1
	Not decided	175	70.9	100.0
Q16_Use	Yes	127	51.4	51.4
	No	120	48.6	100.0
Q17_Payment	Yes	51	20.6	20.6
	No	196	79.4	100.0
Q18_Experience	Not friendly	28	11.3	11.3
	Not secure	127	51.4	62.8
	Enjoyable	19	7.7	70.4
	Ease to use	73	29.6	100.0
Q19_Ease	Yes	174	70.4	70.4
	No	73	29.6	100.0
Q20_Trend	Yes	180	72.9	72.9
	No	67	27.1	100.0

From the Table 3, it had shown the technology profile that consists of the 247 respondents. The technology profiles are the preliminary questions which enquire about the respondent preferences on mobile phone provider and number of year for using mobile devices. This is further enquired about their understanding of m-payment and their preferences. Respondents are typically felt that the m-payment concept will be a future trend in Malaysia.

Table 4 Mean analysis for Price

Item ID	Item Description	Mean (n = 247)	Std Dev
PR1	A low price level for using m-payment is appropriate.	6.56	0.677
PR2	A low price level for contents received is appropriate.	6.50	0.686
PR3	Banks charge lower SMS transaction fees.	6.16	0.774
PR4	I can afford prices for access to m-payment.	6.02	0.821
PR5	I will use m-payment during promotion price.	6.25	0.806

Table 4 presents the mean and standard deviation for the responses on price. From the result, the average mean for price is above 6.00 (PR1, PR2, PR3, PR4, and PR5). From the result, the respondents strongly agree that a low price level for using mobile payment (PR1 = 6.56) and contents received (PR2 = 6.50) is appropriate. The respondents agree that banks charge lower SMS transaction fees (PR3 = 6.16) which they could afford the prices to access the mobile payment services (PR4 = 6.02). Furthermore, respondents also agree that to use m-

payment during promotion price by the mobile service provide (PR5 = 6.25). Thus, we can conclude that price will affect the mobile payment determinants.

Table 5 Mean analysis for Convenience

Item ID	Item Description	Mean (n = 247)	Std Dev
CV1	The overall process of m-payment is easy.	6.01	0.848
CV2	Approach to content after access to m-payment is easy.	5.88	0.830
CV3	Navigating the content is easy.	5.68	0.868
CV4	I will use m-payment with good functionality.	6.68	0.561
CV5	I am able to use m-payment anywhere it is accessible.	6.60	0.610

Table 5 presents the mean and standard deviation for the responses on convenience. From the result, the average mean for the price is above 5.50 (CV1, CV2, CV3, CV4, and CV5). The respondents strongly agree that a good functionality (CV4 = 6.68) and accessibility (CV5 = 6.60) will determine mobile payment usage. This is followed by the ease of the overall process of m-payment (CV1 = 6.01) and the ease of approach to content after accessible (CV2 = 5.88). However, the lowest mean is the ease of content navigation (CV3 = 5.68). Thus, we can conclude that convenience will affect the mobile payment determinants.

Table 6 Mean analysis for Content Reliability

Item ID	Item Description	Mean (n = 247)	Std Dev
CR1	Various contents are offered via m-payment.	5.64	0.990
CR2	Contents in m-payment are reliable.	5.40	1.010
CR3	Contents provided will be valuable to me.	6.37	0.726
CR4	I will use more if contents are always available.	6.58	0.585
CR5	I will use m-payment when there is additional information.	6.31	0.600

Table 6 presents the mean and standard deviation for the responses on content reliability. From the result, the highest mean for the content reliability is the contents availability (CR4 = 6.58). This is followed by the valuable of the contents (CR3 = 6.37) and the availability of additional information (CR5 = 6.31). In additional, respondents are agree that various contents are offered through m-payment (CR1 = 5.65). However, most of the respondents have concern with the content reliability which shown the lowest mean (CR2 = 5.40). Thus, we can conclude that content reliability will affect the mobile payment determinants.

Table 7 Mean analysis for Visibility

Item ID	Item Description	Mean (n = 247)	Std Dev
VS1	The information is visible with different mobile devices.	5.53	0.978
VS2	Content and pre-details are shown in the screen.	5.54	0.957
VS3	Information and detail for m-payment is well arranged and organized.	5.49	1.085
VS4	I will use m-payment if overall design of screens offered is satisfying.	6.01	0.939
VS5	I will use m-payment if overall design of screens offered is convenient to me.	6.15	0.932

Table 7 presents the mean and standard deviation for the responses on visibility. From the result, the respondents prefer to use mobile payment if the overall design of screen is convenient (VS5 = 6.15) and satisfying (VS4 = 6.01) to respondents. Respondents agree that respondents' preferences will depend on how the content and pre-details available in screen (VS2 = 5.54) and how visible of the information with different mobile devices that have different size of screen (VS1 = 5.53). Furthermore, the information and detail for m-payment which is well arranged and organized will encourage respondents to use m-payment (VS3 =

5.49). Thus, we can conclude that visibility is valued by the consumers as a determinant of m-payment.

Table 8 Mean analysis for System Quality

Item ID	Item Description	Mean (n = 247)	Std Dev
SQ1	The rate of success of access to m-payment is high.	5.62	0.571
SQ2	A next page should be loaded even if having technological problem of system.	6.55	0.595
SQ3	An access to m-payment due to a technological problem should be cancel by user.	4.45	1.042
SQ4	I will use m-payment if the system quality of the m-payment is good.	6.19	0.772
SQ5	I will use m-payment if the application is accessible anywhere.	6.24	0.778

Table 8 presents the mean and standard deviation for the responses on system quality. From the result, the highest mean for the system quality is SQ2 = 6.55 which indicate that a next page should be loaded even if the mobile payment system is having a technological issue. This is followed by respondents preferences to use m-payment if the application is accessible anywhere (SQ5 = 6.24) and a good system quality (SQ4 = 6.19). Next, respondents agree that the rate of the success of mobile payment accessibility is high (SQ1 = 5.62). However, respondents felt that an access to m-payment caused by technological problem should not be cancel by user (SQ3 = 4.45). Thus, we can conclude that system quality will affect the mobile payment determinants.

Table 9 Mean analysis for Customer Service

Item ID	Item Description	Mean (n = 247)	Std Dev
CS1	Time-To-Response (TTR) on inquiries is fast.	5.93	0.857
CS2	Answers on inquires is useful and helps in solving my problem.	5.77	0.674
CS3	There is content specification recommended when accessing m-payment.	5.38	0.699
CS4	I can submit inquiries in various ways (E.g. SMS, Telephone, Internet).	5.59	0.759
CS5	I can ask for more detail about the content and services.	5.51	0.743

Table 9 presents the mean and standard deviation for the responses on customer service. From the result, respondents agree that the Time-To-Response (TTR) on inquiries is fast by using m-payment (CS1 = 5.93). This is followed by the usefulness and helpfulness in problem solving via inquires (CS2 = 5.77). Respondents prefer customer service that allow mobile payment inquiries submission via various method such as SMS, telephone or Internet (CS4 = 5.59); availability to ask more details about the content and services (CS5 = 5.51); and the content specification recommendation when accessing the m-payment (CS3 = 5.38). Thus, we can conclude that customer service will affect the mobile payment determinants.

Table 10 Mean analysis for Security

Item ID	Item Description	Mean (n = 247)	Std Dev
SC1	Security policies of mobile company are reliable.	5.59	0.845
SC2	Syntax for SMS transaction is simple to follow.	6.07	0.646
SC3	Password is needed for transfer money.	6.67	0.497
SC4	I am comfortable with the syntax for a SMS transaction.	6.08	0.617
SC5	I think my private details are not exposed to other people.	5.55	0.799

Table 10 presents the mean and standard deviation for the responses on security. From the result, the highest mean for the security is SC3 = 6.67 which indicate that respondents prefer to use password for transfer money in mobile payment process. This followed by the

respondents' comfortable with the syntax for a SMS transaction process (SC4 = 6.08); the ease of SMS transaction syntax to follow (SC2 = 6.07); reliability of security policies from the mobile providers (SC1 = 5.59); and respondents' perception on the private details that are not exposed to other people (SC5 = 5.55). Thus, we can conclude that security will affect the mobile payment determinants.

Table 11 Mean analysis for SMS Services

Item ID	Item Description	Mean (n = 247)	Std Dev
SS1	Auto-reply by mobile provider is good.	5.50	1.059
SS2	An email received indicates that the m-payment is made.	5.76	1.050
SS3	An SMS received indicates that the completion of transaction.	5.82	0.980
SS4	I can receive answer from m-payment enquiry.	5.35	0.950
SS5	I can receive notification of m-payment availability.	5.35	0.976

Table 11 presents the mean and standard deviation for the responses on SMS services. From the result, the average mean for the SMS Services is exceeded 5.00. For example, respondent agree that an SMS to receive indicating completion of transaction (SS3 = 5.82). They also prefer to have email notification service (SS2 = 5.76), auto-reply service (SS1 = 5.50), call-answering service (SS4 = 5.35), and availability notification service (SS5 = 5.35). The overall result shown that respondents were somewhat agree with the SMS services provided will determine the m-payment usage. Thus, we can conclude that SMS Services will affect the mobile payment determinants.

Table 12 Mean analysis for Transaction Process

Item ID	Item Description	Mean (n = 247)	Std Dev
TP1	Speed of m-payment is rapid.	6.25	0.611
TP2	Navigation response time is satisfying.	6.13	0.600
TP3	Time completion for transaction is satisfying.	5.79	0.643
TP4	I am comfortable with the each step of transaction process.	5.77	0.698
TP5	I am comfortable with the m-payment into my bank account.	5.71	0.789

Table 12 presents the mean and standard deviation for the responses on transaction process. From the result, the mean for the transaction process are within 5.71 and 6.25. This shown that the respondents agree that transaction process will affect their usage. The respondents felt that the speed of m-payment is rapid (TP1 = 6.25); followed by the navigation response time is satisfying (TP2 = 6.13); time completion for transaction is satisfying (TP3 = 5.79); respondents' comfortable with transaction process step (TP4 = 5.77); and respondents' comfortable with direct link to bank account for m-payment (TP5 = 5.71). Thus, we can conclude that transaction process will affect the mobile payment determinants.

Table 13 Cronbach's Alpha Analysis

Variables	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items
PR	0.592	0.603
CV	0.799	0.797
CR	0.805	0.822
VS	0.837	0.838
SQ	0.780	0.812
CS	0.703	0.709
SC	0.858	0.863
SS	0.869	0.870
TP	0.668	0.672
MP	0.883	0.889

Cronbach's alpha will generally increase when the correlations between the items increase. Cronbach's alpha measures how well a set of variables measures a single unidimensional latent construct (Cronbach, 1951). The value for Cronbach's alpha of 0.6 or higher is acceptable (Nunnally, 1978). The Cronbach's alpha coefficient ranged from 0.592 to 0.883. The variables were accessed for reliability using cronbach's alpha, which shows the following results: Price (0.592), Convenience (0.799), Content Reliability (0.805), Visibility (0.837), System Quality (0.780), Customer Service (0.703), Security (0.858), SMS Services (0.869), and Transaction Process (0.668). For the variable TP, the Cronbach's Alpha is 0.668 which consider near to 0.70 and are consider reliable for the further analysis (Hair et. al., 1998). Furthermore, dependent variable for Mobile Payment Usage (MP) emerges with the highest Cronbach's alpha coefficient with 0.883. Thus, the reliability test reveals that all of the independent variables emerged with Cronbach's Alpha of more than 0.60. Thus, the data on these variables are reliable and consistent for the further analysis.

Table 14 Correlation Matrix.

	XPR	XCV	XCR	XVS	XSQ	XCS	XSC	XSS	XTP	XMP
XPR	1.000									
XCV	.506	1.000								
XCR	.437	.649	1.000							
XVS	.404	.559	.603	1.000						
XSQ	.466	.662	.664	.757	1.000					
XCS	.506	.609	.604	.641	.730	1.000				
XSC	.373	.396	.349	.419	.547	.548	1.000			
XSS	.350	.462	.415	.493	.590	.547	.796	1.000		
XTP	.529	.649	.632	.675	.729	.730	.608	.606	1.000	
XMP	.642	.786	.800	.831	.856	.752	.503	.548	.791	1.000

The output in Table 14 shows that all the variables state significant positive relationship (All p-value = 0.000 < 0.05) with mobile payment usage (XMP). Table 14 reveals the correlation matrix of the conceptual variables. A one-tail test at 0.05 significance level, indicates that there are positive relationships among dependent variables and the independent variable.

Table 15 Multiple Regression Analysis (R and R^2).

Model	R	R^2	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.970[a]	0.941	0.938	0.12244	1.980

a. Predictors: (Constant), XPR, XCV, XCR, XVS, XSQ, XCS, XSC, XSS, XTP
b. Dependent Variable: XMP

Let Y = mobile payment usage (XMP)
X = Price (XPR), Convenience (XCV), Content Reliability (XCR), Visibility (XVS), System Quality (XSQ), Customer Service (XCS), Security (XSC), SMS Services (XSS), and Transaction Process (XTP).

From the Table 15, R = 0.970 and R^2 value = 0.941. This means that 94.1% of the variation in Y can be explained by all 9 predictors (or accounted for by) the variation in X.

Table 16 Multiple Regression Analysis (ANOVA Test).

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	56.200	9	6.244	416.544	0.000[a]
	Residual	3.553	27	0.015		
	Total	59.753	246			

a. Predictors: (Constant), XPR, XCV, XCR, XVS, XSQ, XCS, XSC, XSS, XTP
b. Dependent Variable: XMP

From the ANOVA table, the F-value (416.544, 237) is large by a small p-value = 0.000 < 0.05. This means at least one of the nine-predictor variables can be used to model mobile payment usage.

Table 17 Multiple Regression Analysis (Coefficient Equation).

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1 (Constant)	-.110	.132		-.834	.405					
XPR	.200	.021	.189	9.620	.000	.642	.530	.152	.653	1.531
XCV	.166	.021	.189	7.842	.000	.786	.454	.124	.431	2.321
XCR	.185	.019	.226	9.514	.000	.800	.526	.151	.443	2.256
XVS	.200	.017	.310	12.037	.000	.831	.616	.191	.378	2.643
XSQ	.189	.027	.215	6.988	.000	.856	.413	.111	.264	3.787
XCS	.016	.026	.016	.616	.539	.752	.040	.010	.356	2.806
XSC	.012	.025	.013	.476	.635	.503	.031	.008	.321	3.119
XSS	-.021	.017	-.035	-1.263	.208	.548	-.082	-.020	.323	3.096
XTP	.068	.033	.061	2.085	.038	.791	.134	.033	.296	3.374

a. Dependent Variable: XMP

Table 17 show the estimated coefficients which indicate the ß (constant) is –0.110, $ß_{XPR}$ is 0.200, $ß_{XCV}$ is 0.166, $ß_{XCR}$ is 0.185, $ß_{XVS}$ is 0.200, $ß_{XSQ}$ is 0.189, $ß_{XCS}$ is 0.016, $ß_{XSC}$ is 0.012, $ß_{XSS}$ is –0.021 and $ß_{XTP}$ is 0.068. However, there of the variables are not significant (XCS,

XSC, and XSS). The result show 6 hypothesis are significant whereby (p-value = <0.05). The significant indicate that there is a linear relationship between the dependent variable (mobile payment usage) and the predictor variable (Price, convenience, content reliability, visibility, system quality, and transaction process). Therefore, the equation model is as below:

Mobile payment usage = –0.110 + 0.200 (Price) + 0.166 (Convenience) + 0.185 (Content Reliability) + 0.200 (Visibility) + 0.189 (System Quality) + 0.068 (Transaction Process)

CONCLUSION

We hope that, based on the findings of this research, industry players would be able to understand specific key factors that tend to influence the decision to use and in the process appreciate consumers' need in deploying m-payment system. An effective mobile payment system will not only be valuable to the firms, particularly as these firms try to expand their customer base, it will also be valuable to consumers as it will provide higher level of convenience in business transactions including the payment of bills. M-payment will enable the transaction process to be completed within a very short period. Consequently, consumers would be satisfied with the quality of m-payment and this will generate more profit to the firm implementing the system. Finally, the three constructs discussed in this paper are considered important factors for firms to take into consideration as they develop approaches for serving their existing and potential customers. Our assessment is that firms that effectively deliver on these three constructs would be able to increase mobile payment usage in their respective business, which could have an expanded effect in the overall business operations in Malaysia.

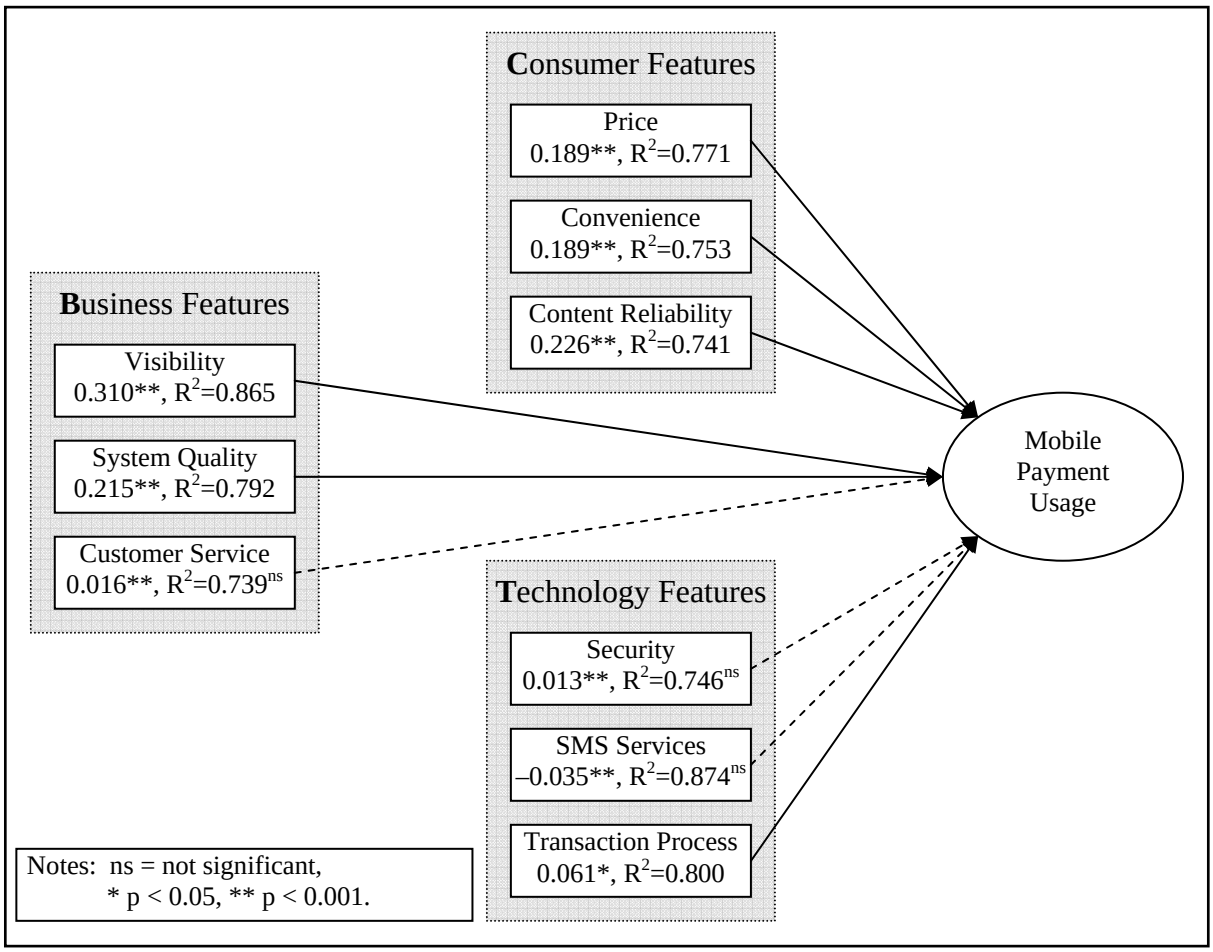

Fig. 2: Structural Model.

Figure 2 shows the structural model for the mobile payment usage. There are three variables which are not significant. The model shows that price, convenience, content reliability, visibility, system quality and transaction process will influence the consumer in determinant their mobile payment usage. This model concept can provide some critical knowledge for mobile network operators (MNOs) to focus on these variables to improve the mobile payment system. Financial institution and bank can focus on their investment on the mobile payment system in order to increase their return-of-investment (ROI) of the mobile payment user. In additional, merchandisers can push the adoption of m-payment readers in their point-of-sales (POS) system to boost the m-payment usage.

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A Q METHODOLOGY STUDY ON INTERNATIONAL VISITORS' TOURISM IMAGES OF TAIPEI CITY

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ABSTRACT

Today competition among world cities for tourism market is growing; cities need to find effective ways to develop attractive tourism images that can distinguish themselves from their competitors. As each individual perceives overall tourism environment differently, the tourism market is segmented by the destination images held by tourists of a destination. The purpose of this study is to explore the tourism image of Taipei City among international visitors and market segments based on their images of Taipei as well. Q methodology was used to discover and explain the underlying segments of international visitors in Taipei city. Five distinct groups of tourist were extracted from 77 photographic Q-sorts. Findings in this study support that tourism market is not uniform and the tourist product is a mix of a variety of different features and activities. Thus, a generic marketing strategy may not be applicable for all international visitors, marketing plan and tourism products/services offered need to be tailored according to visitor preferences for different destination images. This article concludes with implications of research findings and suggestions for future research.

Keywords: Tourism, destination image, Q methodology, Q-sort

INTRODUCTION

Tourism is one of the fastest growing sectors of the global economy, in either developed or developing countries, and tourism sector can boost foreign investment and local economic development (Rogerson, 2002). In past two decades, the concept of city marketing has been wildly recognized and applied to urban planning and transformation of city image. In order to compete in the global tourism market, cities or places must to find effective ways to develop attractive tourism images that can distinguish themselves from their competitors.

Destination image is an important factor to tourist decision-making behaviors and satisfaction of travelling experiences (Crompton, 1979; Jenkins, 1999). As Crompton (1979) emphasizes that most responsive target markets are usually formed by groups of people with positive images. Therefore, identification of such consumer subgroups would help destination marketers to formulate target group-specific offers and to develop strategies that can further enhance their destination images and make the tourism destination stand out from competitors in travel and tourism market (Leisen, 2001). By understanding different destination images perceived by tourists, local governments can strengthen the inherent characteristics of nature images of a tourism destination, and destination marketers are able to integrates the newly reformed images into tourism marketing planning that and therefore design a highly focused and cost-effective promotional campaign (Selby and Morgan, 1996).

The purpose of this study is to identify subgroups in international visitors based on their images of a tourism destination. A successful promotion of city tourism should care not concern about the pragmatic problems of city administration and local economic development, but also local tourism resources and the tourism and leisure needs of visitors. Attractive characteristic of a tourism destination is often a crucial factor influences the development of tourism; thus, understanding the images of Taipei City among foreign visitors has important practical positioning and marketing implications. This study attempts to examine the tourism images of Taipei among international visitors based on their images of Taipei as well. This study applied Q methodology to examine the perceptions of tourists attractions of a group of international students of one university in order to identify the images of tourists attractions that by foreign visitors in Taipei. Finally, discussion and suggestions are made based on the findings of the Q-sorts, and these suggestions may be used as a reference for the promotion of Taipei City as a tourism destination.

LITERATURE REVIEW

Reynolds (1965, p.69) defined an image as a "... mental construct developed by the consumer on the basis of a few selected impressions among the flood of total impressions; it comes into being through a creative process in which these selected impressions are elaborated, embellished and ordered". Destination image has been applied in all kinds of context,

includes images projected by tourism marketers or stereotypes and destination images held by individual tourist (Jenkin, 1999). Past studies revealed that tourism image is a tourist's perception of the overall tourism environment. The image of a place is usually a key factor in attracting visitors and a tourism destination is chosen not only based on its environments, also the imagery of the destination, and it has a great influence on tourist decision making process of destination choice (Crompton and Ankomah, 1993; Gartner, 1989; Kent, 1990; Chon, 1990; Richards and Wilsom, 2004). The measurement of destination image has been of great interest to tourism researchers and practitioners; however a conclusive definition of destination image in is still lacking (Echtner and Ritchie, 1993).

It is generally agreed that a tourism destination is a composite of various attributes, each individual tourist perceives destination attributes differently and form different attitudes toward the same destination (Baloglu and Brinberg, 1997; Walmsley and Young, 1998); for example, a tourism spot may have attractive natural scenes, some remarkable pieces of architectures or local cultural features, a tourist might be only attracted to natural scenes of a place but cultural features. As tourists receive information of tourist attractions from different channels, and form images in minds, Gunn (1972) divided tourism image into two parts: organic image and induced image. Organic image is a feeling which a person holds toward an attraction even though the person has not been to the place while induced image is often created by information dissimilated by business owners in tourism sector such as travel brochures, advertisements and posters. As noted by Gunn (1972), it is possible that consumers may not physically visit a place or have no access to the information regarding a tourist place; but memories and impressions of that place may still be developed in the consumers' minds and retained even though these memories may not be consistent with impressions. Gartner (1986) argued that consumers may perceive tourism image as a brand, because tourism images represent perceptions among visitors, tourism marketers, and travel agents toward tourism activities or attributes of tourist places. Accordingly, destination image is complex, multi-dimension, very subjective and often focused at various target people (Richards and Wilson, 2004).

In order to understand tourists' perceptions toward a tourism destination, Jenkins (1999) suggested the adoption of modified-induced images that represent the results of actual travel experience of the destination in tourism destination studies. Most studies measure destination image by using descriptive statements with Likert-type scales (Mackay and Couldwel, 2004). Pike (2002) reviewed 142 articles on destination images studies from year1973 to 2000, about 80 percent of these articles used structured studies. However, there is a call for the use of multi-approach or unstructured instruments in tourism destination image studies in recent years (Jenkins 1999; Mackay and Couldwel, 2004). It has been criticized that the traditional use of descriptive statements for measuring participants' preferences to certain characteristics of tourist locations do not necessarily comprise the image they have in the real environments (Kunkel and Berry, 1968; Selby and Morgan, 1996; Jenkins, 1999) or may suffer from a

difficulty to cover all or unique attributes of a tourism destination image (Selby and Morgan, 1996).

Today, tourism information that visitors access is dominated by visual images, such as photographs of scenery, landmarks, and icons found in travel brochures, films, television advertisements or the internet (Jenkins, 2003; Singh and Lee, 2009). Besides, photographic imageries appear as `snapshots' of real world, and may be seen as a true portray real places, people, and events (Markwick, 2001); it is recommended to incorporate visual techniques into tourism studies and use more creative ways such as maps and photographs to help participants to recall and provide richer data (Jenkins 1999; Fairweather and Swaffield, 2001; Cruz, Qulroz and Herrero, 2007). All of these facts taken together indicate that photographic or visual imageries can be a powerful tool to measure perceptions or attitudes among tourists, as they are likely to influence visitors' perception of a tourist place and enhance travel intentions.

METHODOLOGY

Instead of using demographical, socioeconomically, geographical or behavioral variables that are often seen in tourism market segmentation studies (Davis, 2007), Q methodology was adopted in this study to discover market segments of international visitors in Taipei City based on their perceptions and preferences of different mix of landscape characteristics and tourism activities. Q methodology was originally developed by William Stephenson to examine people's subjectivity in psychological studies (Stephenson, 1980) and has been applied to a broad range of academic domains including political psychology, communication sciences, critical psychology and social constructivism (McKeown, Hinks, Stowell-Smith, Mercer and Forster, 1999). Q methodology is a technique that combines qualitative and quantitative methods for the assessment of values and preferences of people; and it is different from the traditional use of factor analysis in psychometrics, persons rather than tests are correlated in Q methodology (McKeown and Thomas, 1988; Watts and Stenner, 2005). Individuals are asked to rank-order Q-sort statements, which are then intercorrelated and subjected to factor analysis; therefore, "factors" identified in Q methodology represents shared ways of thinking or underlying commonalities of subjective meaning (Howard, 1998; Shinebourne, 2009). According to Schlinger (1969), participants were also invited to provide reasons for choosing their top and bottom ranked photographs; and such valuable information can help researchers to understand and interpret the meaning of participants' Q-sorts.

In comparison with other research methods such as surveys, Q methodology enables researchers to operate with considerable freedom and participants to express individual thoughts and attitudes easily, and therefore allows for a higher degree of internal validity (Stephenson, 1953). Although Q methodology has ever been used in landscape perception

studies; the use of graphics as Q-sort items in such studies is still not common (Davis, 2003). Q-sort items can be developed from various sources, such as interviews, literature reviews, mass media or personal experiences of researchers (Stainton Rogers, 1995; McKeown et al., 1999; Watts and Stenner, 2005). Recently, some studies demonstrated the combination of imageries and Q methodology is a suitable way for identifying types or cluster of people that share similar views (Fairweather and Swaffield, 2001; Gabr, 2004; Cuz et al., 2007).

This study used a multi-step process to develop photographic Q-sort items. First, 50 university students majored in Tourism were recruited to nominate tourist attractions that they believed to best represent the tourism images of Taipei City; and a total of 99 tourist attractions was generated. Next, four professors in Tourism and two senior tour guides from local travel agents were invited to judge the prior list of tourist place in terms of their representativeness of destination images of Taipei City. As a result, 37 tourist attractions appeared on the earlier list were chosen and three places were added by these judges. Among these chosen tourist places, 25 tourist attractions are located in Taipei City and the remaining places are actually located in Taipei County. Taipei City is located in northern Taiwan and surrounded by Taipei County geographically. These two administrative areas also share common transportation systems (i.e., bus system and Mass Rapid Transit System, MRT), life circle and natural tourism resources as well. Practically, it is not unusual that travel agents and tour operators incorporate attractions from both areas in trip planning for Taipei City. According to the criteria specified in Stainton Rogers (1995), a sample of 40 to 80 photographs is considered satisfactory for Q-sorting, more than this number would cause difficulties during the sorting process of photographs. Therefore, 40 chosen tourist places in Taipei is an appropriate number for Q-sort and the set of Q-sort items has been validated through multi-step process.

The selection and production of the photographic Q-sort items began with an online search, and then photographs of 40 tourist places were collected from the official website of Department of Taipei Information and Tourism and other well-know tourism websites in Taiwan. The selection of photographs was based on a sampling frame of various landscape types including broad landscape settings and features (Fairweather and Swaffield, 2001). Moreover, attractions and recreational activities that promoted to/and or visited by international tourists and local tourists were also included (Davis, 2003). These images from the web pages were further printed onto 4x7cm laminated cards with geographic or administrative place names. Final set of photographic cards was checked by two doctoral students for any difficulties in visual identification.

Participants were first instructed to rank cards into two piles based on what they could see in the photographs. In one pile were placed those cards they like and in the other pile were placed those cards they dislike. Then, participants were guided by the same criteria to put each item on a ranking position in a forced quasi-normal distribution from “most-preferred”

to "least-preferred" (illustrated in Table 1). After the completion of Q-sorts, participants were asked to write down reasons for choosing the two top and the two bottom-ranked photographs, as well as their personal information (i.e., duration of staying in Taipei, nationality, gender, age and leisure activities) and source of travel information and travel mode regarding traveling in Taipei.

TABLE 1.
EXAMPLE OF FIXED QUASI-NORMAL DISTRIBUTION RANKING

	Most preferred						Least preferred		
Scores	**-4**	**-3**	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**
Card numbers	**2**	**3**	**5**	**6**	**8**	**6**	**5**	**3**	**2**

This study employed purposive sampling methods and 77 international students from a well-known university in Taipei were recruited. This university offers a wide variety of programs to international students and is also known for its great number of international students and diversity among international students. The demographic breakdown of the 77 international students was: were recruited, there are 46.8% male, 53.3% female; 16.9% Europe, 18.2% North East Asia, 28.6% South East Asia, 3.9% North America, 24.7% South America, 7.8% other; mean age of 23 years (SD=3.1). Most of them had been staying in Taipei for more than 2 years (40.0%). Internet and recommendations from local friends are the most common source of travel information. MRT and bus are the most preferred choice of transportation.

RESULTS

Data were entered into SPSS 13.0 and analyzed by using an inverse factor analysis with varimax rotation, to extract factors and to calculate factor loadings (McKeown and Thomas, 1988). According to Schlinger (1969), a loading of ±0.47 or greater would be considered significant and showing a meaningful relationship between the respondent and the factor type ($3\times 1/\sqrt{n} = 3\times 1/\sqrt{40} = 0.47$). Other criteria used to determine valid factors include eigenvalues greater than 1 and at least one participant who loaded on that factor (Brown, 1980). Five factors were extracted and accounted for 59.7% of the variance of the rotated matrix. Table 2 shows the factor score of each image which reflects the importance of that image in defining the factor. The following interpretation of extracted factors is based on the six top and six bottom-ranked photographs, as well as participants' explanations for choosing those photographs.

TABLE 2:
LIST OF IMAGES AND SCORES FOR EACH FACTOR

Images	Factor				
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
1. Tapei 101	1	3	3	3	3
2. Nation Palace Museum	0	2	1	0	0
3. Longshan Temple	0	-1	-2	0	-1
4. Peitou Hot spring	1	1	1	1	-1
5. Shilin Night Market	1	-2	2	1	-3
6. Tamsui Old Street	1	0	2	0	2
7. Fort San Domingo	-1	1	0	1	1
8. Taipei Hsingtien Kung	-1	0	-1	-2	-2
9. Jioufen Old Street	2	-1	-1	2	0
10. Wulia	1	1	1	-1	1
11. Yingge Pottery Old Street	-2	0	-1	0	0
12. National Chiang Kai-Shek Memorial Hall	0	3	0	-1	0
13. Yehliu-Bizaare Rocks	2	0	0	1	2
14. Keelung Miaokou	0	-1	-1	0	-1
15. Sanshia Old Street	-1	0	-1	-1	0
16. Jinguashin Gold Ecological Park	-2	-1	-1	0	-1
17. Yangmingshan National Park	3	2	2	1	1
18. Maokong	2	1	0	1	-1
19. Taipei Story House	-1	1	-1	-2	-1
20. Fulong Beach	1	1	0	-1	1
21. Dihua Street	0	-2	-2	-2	-1
22. Nation Museum of History	-1	1	-1	-2	0
23. Hsimending	-2	-2	2	-1	0
24. Taipei Zoo	0	1	1	0	0
25. Miramar	0	0	1	0	1
26. Tanshui Fishermen's Wharf	1	0	1	0	2
27. Baisha Bay	3	2	1	1	2
28. Pingshi	1	0	0	2	1
29. East District Shopping Area	-3	-2	1	2	0
30. Roahe St. Night Market	0	-2	-1	1	-1
31. Xinyi Commercial Center	-1	-1	1	3	0
32. Gongguan Night Market	-1	-2	1	0	-2
33. The Grand Hotel (Taipei)	-2	1	0	-1	2
34. Tonghua St. Night Market	-1	-2	-1	0	-2
35. Presidential Building of Taipei	-1	0	-1	-2	0
36. North Coast National Scenic Area	2	2	0	0	2
37. Bisha Fish Harbor	0	0	-2	-2	0
38. Din Tai Fung (Restaurant)	-2	-2	-2	2	-1
39. Shung Ye Museum of Formosan Aborigines	-2	-1	-2	-3	-1
40. Dalongdong Boaoan Temple	0	0	-2	-2	-1

Factor 1: Nature-lover

Individuals loading on this factor prefer predominantly natural or highly scenic landscape such as mountains, bushes and white sand beaches. The activities and experiences they dislike include visiting art or historical museums, business districts and shopping. As 65% participants in this group were Asian, they believe the shopping centers and shops in Taipei City are not much different from their home countries. The comments show that participants believe that it is worthful to stay in Taipei for a longer time to enjoy a wide variety of natural tourism resources. Individuals in this segment indicate high intention to visit Taipei again and would like to recommend Taipei as a travel destination to their friends.

Factor 2: Iconic landmarks follower

50% of participants in this group were European, and their six top-ranked photographs represent landmark buildings in Taipei, for example, Taipei 101 building, Chiang Kai-shek Memorial Hall and National Palace Museum. These participants are interested in visiting historic or cultural sites as those sites reflect the social progress in Taiwan. Besides, these attractions are normally highly promoted by Department of Taipei Information and Tourism as must-see spots in Taipei. However, the written comments indicate that this group definitely is not fond of Taiwanese style, local food and dislike night markets due to the over crowdedness and distinct odor.

Factor 3: Shopping tour experience

This group likes to visit places with tourism features and attractions that promoted by local government and travel agencies, such as Taipei 101, Shilin Night Market and Miramar (shopping center). These international visitors' comments show that they like to try novelties, experience something interesting and enjoy shopping in both local night markets and boutique shops. Based on participants' descriptions, they want to see and visit places with modern style and hedonic shopping experiences; on the other hand, places like temples, museums and traditional markets are less attractive to them.

Factor 4: Food hunting experience

The six top-ranked images show places for shopping (i.e., Taipei 101 and East District Shopping Area) and crowded, local food specialties (i.e., Din Tai Fung restaurant, night markets, and Jioufen Old Street). Their written comments indicate that they respond

positively to local food and enjoy food eating as well. This group dislikes places or sites of historical interest such as temples and museums. Apart from personal interests, the comments also reveal that museums in Taipei are not fascinating and are lack of unique features and this lower their intention to visit these sites again.

Factor 5: Beaches and Coasts

Most top-rank photographs in the particular group represent the natural elements, such as coast scenes and beach views, but not completely lacking iconic buildings (i.e., Taipei 101). Similar to factor 1, this group also appreciates natural scenes, particularly beach and coast scenes. However, crowded night markets and temple activities are least attractive to this group.

DISCUSSION AND CONLCUSION

As noted by McLellan and Foushee (1983), tourism destinations normally mix both positive and negative perceptions, this study have identified five tourist groups based on the Q-sort data and each group reveals international visitors¡¦ preferences to different travel experiences. There were notable differences among the participants' reactions to the images of Taipei City. Factor 1 and factor 5 prefer natural scenes, but factor 5 emphasizes on beach and coast views. Factor 2 likes to visit iconic landmarks as promoted but is less attracted to traditional markets. Factor3 looks for fun shopping experience and factor 4 likes to try food with local taste, but both factor 3 and factor 4 find museums are not interesting and lack of and religious activities among temples are pretty the same.

Today tourism has become a popular global leisure activity; countries are competing fiercely in the world tourism market to attract more international tourists. Tourism marketing for cities or places expands to become an important part of a nation's tourism competitiveness; it is a key challenge for city government to create and manage a clear and consistent destination image. Given destination perceived by different visitor groups, destination marketers need to be aware that tourist perceptions of city as a travel destination are not uniform.

The results of this study suggest that some international tourists would be attracted by those tourist places that are highly promoted by local governments. For example, Taipei 101 is a new iconic Taipei landmark which successfully put Taipei under spotlight and become a must-see for any visitors; nevertheless, there are other unique travel experiences that

international visitors are seeking cannot be overlooked. The findings also underline the importance of image assessment in the evaluation of major tourism market. By identifying the international tourists' destination images, destination marketers are able to develop promotional campaigns that emphasize the distinct images of a tourism destination and communicate the right messages to target audiences.

This paper has applied Q methodology to investigate the possible destination images of Taipei City that international visitors have, as the research participants were drawn from student samples, it is suggested to use a representative sample drawn from a larger population of inbound visitors, for example, interviewing foreign inbound visitors at the international airports. Another limitation to this study is its photographic Q-sort materials which were taken from the websites rather than the actual environments and only one photograph provided for each tourist place; and this method of taking photograph samples for real environments would raise concerns about the representativeness of the destination images of a place and the validity of this study. Although Q methodology have been evaluated as validated method with advantages such as the ability to include various type of landscape settings and focus on respondent (Fairweather and Swaffield, 2001), future studies may take different research design, such using a multi-method approach that combines visual Q-sorts and verbal questionnaires to validate the findings cross methods.

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AN EXPLORATORY STUDY OF HUMAN RESOURCE MANAGEMENT PRATICES IN AN OVERSEAS JAPANESE FIRM. ARE THERE ANY BARRIERS TO ADOPTING THE JAPANESE HRM PRACTICES?

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ABSTRACT

Japanese HRM is considered by the Japanese manufacturer as the central of Japanese production system. In view of this importance, they tend to reproduce and export their HRM when they set up plants abroad. However investigations revealed that most Japanese subsidiaries around the world do not resemble the Japanese HRM practices but instead follow the local practices. Due to the differences, the study shall focus on the transferability of Japanese style HRM to their subsidiaries abroad. In particular, the reasons that prevents the transfer, if the HRM practices which have not been practised are examined. Studies investigating the transferability of Japanese style HRM are more generally in the Western nations and tended to only focus on white-collar category. Far fewer studies have explored transferability from the perspective of blue-collar category and in South East Asian nations. Additionally, findings are often limited to only the electronic manufacturing industries. Nevertheless, we believe our perspectives could have much more to tell. We therefore, close the gap by using a case study approach that addresses on the HRM practices of a Japanese subsidiary in Malaysia (non-electronic manufacturing industry) from both the blue and white-collar categories. General findings for both the white-collar and blue-collar workers suggest that most of the Japanese HRM practices are either absent or limited from the subsidiary. In fact some of the practices resemble a hybrid model. Although culture, labour market conditions and regulations seem to be the three biggest barriers in the transferability of the practices, findings suggest that some practices are deliberately left out by the parent company to minimize cost.

Keywords: Japanese Human Resource Management, Transfer, Cross-Cultural Management, Human Resource Management, Case study

INTRODUCTION

The success of Japanese firms in the 1980s has been a focus point of comparative management research by scholars around the world. Among them are such as Vogel (1979), Ouchi (1981), Pascale and Athos (1981) and Fukada (1988). According to Maragtas (1993), one of the main ingredients of the Japanese firms' success is due to their human resource development strategy. Along the line, Ouchi (1981), Jenkins and Florida (1999) and Masabumi (2005) attributed the success of Japan's economics from its unique Human Resource Style of Management (HRM). The Japanese HRM is said based on a set of principles such as community orientation, groupism, and egalitarianism (Ishida, 1986). As most of the Japanese multinational companies (MNEs) continue to grow rapidly around the globe, attention has then since shifted towards the way their subsidiaries are being managed and if the Japanese style HRM could be transplanted in a foreign environment. Calori and Dufour (1995) commented that Japanese have a tendency to reproduce their corporate culture and to export their management models abroad. Ishida (1986) illustrated how a Japanese manager tries to 'Japanize' the host countries by formulating a basic strategy to become inward-oriented. On the reasons why multinationals transplant their practices abroad, Pil et al. (1999) concluded that it is the logical next step in global strategy. Even if foreign subsidiaries are adopting to the Japanese practices, the implementation can be very complicated (Rosenzweig & Nohria, 1994). For example, Jain (1987) illustrated the tension between management and local employees of a Japanese subsidiary. Differences in culture between the parent and host countries are often cited as the reason for the tension as Japanese work practices are developed in an unique cultural value (Marsland & Beer, 1980) and as such the transferability of the Japanese style HRM to the subsidiaries abroad is often controversial.

RESEARCH OBJECTIVE

There are a numerous literatures on the transferability of Japanese HRM practices in Western countries like United States and United Kingdom (Florian & Becker-Ritterspach, 2005). Unfortunately, not many have considered whether the HRM practices are applicable in South East Asian countries like Malaysia (Cool et al. 1985; Cunningham et al. 1996). Even if they were, most findings are often limited to the perspective of manufacturing firms. Likewise the findings on the transferability of Japanese HRM to Western nations are often concentrated on the white-collar category and far fewer have explored the transferability from the blue-collar category's perspective. Hence, our paper aim to contribute by bridging the existing gaps in the literature through investigations of the following research issues;

i. Do the HRM practices of the Japanese subsidiary resembling country-of-origin or localization?
ii. What are the impacts that prevent the transfer of Japanese HRM practices, if some these practices have not been adopted?

LITERATURE REVIEW

The Japanese Human Resource Management

There could be hardly any business person from the West which does not have an idea of what Japanese Human Resource Management (HRM) practices are (Wickens, 1992). Marsland and Beer (1980) explained that the Japanese Human Resource Management (HRM) are based on American ideas, but applied in Japan with traditional values regarding to hierarchy and groups. Based on these HRM practices, life-time employment, enterprise unionism, seniority-based wage system and promotion are identified as the foundation for most of the Japanese firms (Sano, 1985) while the practices of generalist selection, training and job allocation are developed around them (Dalzell & Joe, 2000).

Japanese lifetime employment refers to the practice of hiring fresh graduate and other young employees without experience and to continue their employment within the company over a period of time until the age of 55 or 60 (Wickens, 1992). During the employment period, an employee could be transferred to any firms within the group (Ornatowski & Sloan, 1998). Termination however only existed under extreme circumstances (Vladimir, 1984) such as criminal behaviour (Sonfiel, 1984), severe economic crisis or in the event that the firm goes bankrupt. Underperformance will not lead to termination as the employee are either transfer or retrain (Hatvany & Pucik, 1981). Upon retirement, an employee will usually receive a large payment and could be relocated to any satellite firms but with lower salary (Sonfiel, 1984).

Japanese employers prefer to hire fresh/virgin and inexperience employees (Chalmers, 1988; Inohara, 1991). It is not common to hire employees with work experience. Recruitment according to Vladimir (1984) is conducted yearly in colleges. Students who pass the final round of interviews, are selected to sit for company entrance examination and the exam could be in an essay form with various topics. Interestingly most organisations prefer to hire graduates from top school as this is an indicator of an employee's 'later ability' (King, 1983; Vladimir, 1984). The tendency of such practices is as high as 2/3 throughout of Japan (Vladmimir, 1981). Since the practices of hiring are conducted in colleges and universities, advertisement is unnecessary (Kono, 1982). Apart from the student potential ability (Mua, 1993), the selection process will emphasis on candidate's personality (Inohara, 1991) and moderate views (Vladimir, 1984).

Appraisal system is often tied with variables such as desirable personality traits and behaviours, namely; creativity, team performance results and co-operation (Hatvany & Pucik, 1981). Most Japanese firms prefer to emphasize on a person's behaviour (e.g. integrity, morality, loyalty, cooperative spirit) than on output (Ouchi & Jaeger, 1978; Schneider, 1988).

The numbers of years of service or age plays an important role in determining the salary structure especially in promotion and pay. Hatvany and Pucik (1981) commented that the slow practices are influenced by the seniority based system. A new recruit could continue with an automatic pay increases and promotions with the rest of his peer at the same time, before a formal evaluation is being made (Sonfiel, 1984). Ironically, the first promotion

could occur after 10 years. For example, Vladimir (1984) illustrated that 16 years is needed to reach the position of a General Manager from the lowest position. In view of the lifetime employment system, most Japanese firms prefer to promote employees from within the organisation (Pang & Oliver, 1988).

The career paths is based on a generalist perspective and less on the in-depth operational knowledge (Linowes & Richard, 1993). As such, job rotation is continuous during the 10 years (Sonfiel, 1984) and could be in the form of across sectional or functional (Pil et al. 1999). As most of the employees follow a generalist career path, the job description for most firms remain unclear (Nonaka, 1988; Kubo & Saka, 2002). With regards to the policy of lifetime employment (Pang & Oliver, 1988), training is intensive with lots of emphasis given on education (Pang & Oliver, 1988; Bamber, Shadur and Howell, 1992).

Holistic concern refers to the degree employees views each other and show concerns of supervisors for their subordinates (Linowes and Richard, 1993). The examples of holistic concern are such as company outings/retreats for all members of an employee's family or after work drinking. A typical annual office calendar usually comprises of 2 overnight trips, monthly Saturday afternoon recreation, 6 average office parties and etc (Hatvany & Pucik, 1981). According to Linowes and Richard (1993), a firm that express greater interest in each employee's life will yield greater employee satisfaction while the participation by employees in after-hours gatherings help to foster harmony and cooperation (Salmer, 2001). Hatvany & Pucik (1981) suggested that holistic concerns also include spending time to talk to employee about every-day matters or non-job related matters.

On the welfare system, most Japanese firms offer a wide variety of benefits. For example, semi-annual bonuses, retirement pensions, commuting allowances, meal subsidies, medical cares and family allowances (Jain,1990). Kono (1982) for example illustrated that Toyota provides houses for 4200 families and dormitories for 17,200 bachelors, has 7 resort houses for employees usage, distribute loan for home ownership, stock, pay large bonus during summer and at the of the year.

Finally, Japan's union are predominantly enterprise based although national level union does exist. However, the eligibility to join enterprise union is only limited to employee of the particular firm. In exchange for appropriate behaviours, the unions would guarantee cooperative behaviour by their members (Salmer, 2001). The enterprise union according to Hasegawa (1986) helps to resolve workplaces dissatisfaction with management, focus on wage increases and tend to avoid confrontation which helps to preserve harmonious labour-management relations (Marsland & Beer, 1980).

The Malaysian Human Resource Management

Malaysia is a former British colony with a multi-ethnic social structure. According to Smith and Abdullah (2004), the compositions are such as Malay (60 per cent), Chinese (30 per cent), Indians (10 per cent) and others. In view of the different multi-ethnic society of different believes for each of the races, it's often hard to identify a distinguishable HRM style which is regarded as Malaysian. A study by Chim and Maniam (as cited in Chew, 2005) summarized that the basic structure of Malaysia HRM practices are replicas of British

HRM practices introduced during the colonial days, influenced by the diverse cultures of Malaysia's multi-ethnic society on various management practices and the increase of Malaysian companies replicating the modern Western HRM style while maintaining the general values shared by most Malaysian. A study by Hirano (as cited in Chew, 2005) supports the above and categorised Malaysian HRM practices into 2 categories which is the British oriented values and ethnic oriented values.

Wilkinson et al. (2001) concluded that most employees in Malaysia are known to be less loyal compared with the other Asian society and a typical turnover was about 3-4 per cent per month. The sentiment was supported by Shukri (as cited in Aziz, 1996), in which he describes loyalty as one of the reasons why there as a slow transfer of Japanese management to subsidiaries in Malaysia. Kwabe (as cited in Chew 2005) revealed that Malaysian employees are money oriented and will job hop with less hesitation.

On the hiring process, recruitment in Malaysia is done in an ad-hoc basis or whenever the needs arise. Jain (1990) indicated there is a mix of hiring process in Malaysia, with practices depending on the type of position to be filled. This findings again is consistent with research conducted by (Chong & Jain, 1987; Putra, 1993) which they indicated of no particular set of recruitment pattern for either the entry level of middle levels position for countries like Singapore and Malaysia. It is also common for most of the firms in Malaysia to hire experienced employees from other companies (Chong & Jain, 1987).

Most training in Malaysia firms are unstructured, short in duration, ad hoc and mainly are given emphasis on production workers (Abdullah, 1995). In some small local firms, budget is not available for training (Abdullah, 1995). Malaysian local firms reluctant to train employees beyond the necessary skills, as additional skills is often associated with higher pay and is a treat for staff retention. The situation was so alarming that the government had to interfere by coming up with a Double-deduction Incentive Scheme in 1988 and the Skill Development Fund in 1993 to encourage training (Abdullah, 1995). Most firms in Malaysia are heavily oriented towards the on-the-job training (Jain, 1990; Koike & Inoki, 1990). On-the-job training is advantages for most Malaysian employee as it is cheap, effective and relevant to the requirement of the firm (Abdullah, 1995). Mirza and Juhary (1995) revealed that lectures, case studies, seminars and role playing is heavily used in training for most of the Malaysian white-collar personnel.

The promotion practices are usually conducted from within the organisation (Jain, 1990; Wilkinson et al. 2001). It was also said that seniority plays an important role in rewards and promotions as many large overseas Chinese business followed the traditional Confusion value system (Ying et al. 2007). On the appraisal method, Lim (1995) concluded that most Asean organisations prefer objective appraisal which they could account for the duties and responsibility towards the job.

Employers are often hesitant to dismiss employee so that they could preserve harmony at the workplace and local community (Zhu et al. 2007). The statement is true as dismissal of a certain ethnic is often regarded as a racial discrimination and thus could lead to a lot of unnecessary publication. There is also no specific policy used for termination, and retrenchment is often the last resort (Jais, 1990).

In the Malaysian context, union can generally be classified into the following two categories: national union and in-house union (Legal Research Board of Malaysia, 1989). Union formation, whether it is national or in-house is legally permitted by the government of Malaysia. The workers have right to form or associate with unions which is provided for under the Malaysian Industrial Relations Act 1967 (Legal Research Board, 1988) and the Employment Act 1955 (Legal Research Board, 1991). Both in-house or national union have similar rights, responsibilities and restrictions under the labour laws. However, most employers prefer in-house unions rather than national unions because the employees' interest are dependent on the success of the company, hence making it easier to reduce the rigidly of formal systems, when such need is necessary.

Localisation Versus Country-Of-Origin

One of the centre debates in the literature of MNCs (Multinational Corporations) is the extent to which the foreign subsidiaries resemble and behave like those of the local firms versus the extent to which of the practices resemble the parent firm. Similarly, Rosenzweig and Singh (1991) described this as the tension between global integration and local adaptation. In response to the pressure, MNCs have adopted three different strategies. They are ethnocentric, polycentric and geocentric. To illustrate, Caligiuri and Stroh (1995) explained that the management practices of the foreign subsidiaries could resemble the parent home country (ethnocentric), conform to local practices/the subsidiaries home country (polycentric) or the geocentric strategy, of which is a balance between global integration and local adaptation. Interesting findings however revealed that only part of the home country's practices has been exported to overseas Japanese subsidiaries (Dedoussis, 1995).

According to Brewster (1995), Jackson and Schuler (1995), local contextual factors such as labour market conditions, unionization, legal and socio-political environment and home-country culture influence the transfer of human resource practices to the overseas firms.

National culture influence the HRM practices (Hofstede, 1983). Hofstede (1980) further commented that since countries differ in their values, firms from countries with certain culture values are able to adapt their HRM practices to local conditions compared with certain countries which do not share the same culture values. Fukuda (1988) on the other hand considered the export of Japanese management an issue of whether the practices can or cannot 'fit' into the social-cultural environment of the host country. This is not surprising as Japan social cultural tradition does influence the Japanese management practices (Timothy, 2001). Rehder (1979) for example illustrated that performance and achievement of common group goals is embedded from the 250 years of Tokugawa religion. Ishida (1986) on the other hand characterized Japan as a society of homogeneous, class consciousness, group-oriented society, hence most firms will follow a policy of egalitarianism in supporting their human resources practices.

On the other hand, Schuler et al. (1993) commented that firms need to obey to the local environment and regulations which at the end may influence the HRM practices of MNCs operating at the host country. For example working hours and unionization recognitions are

often related to local practices as they are controlled by local regulations (Rosenzweig & Nohria, 1994) and national labour laws (Brewster, 1995). Likewise trade unions also play a role in influencing the HRM practices (Brewster, 1995), especially during collective bargaining. DiMaggio and Powell (1983) describe the home practice resemblance as a result of complying to local laws as 'coercive isomorphism'. In another situation, foreign subsidiaries may also seek to imitate local firms when there is uncertainty in environment. This is explained by the 'mimetic processes' (DiMaggio & Powell, 1983). In conclusion, all of these pressures would finally lead the foreign subsidiaries to resemble the local environment when compared against their parent firm.

Benson (1995) explained that the transfer of the HRM practices abroad could also depends on the local labour conditions of the host country. The stability of the workforce influence the transfer of practices and the investment in human capital (Pfeffer, 1994). Even if there is a stable workforce in the internal labour market, the quality of HRM is influenced by the external factors such as educational and vocational set up (Hiltrop et al. 1995). As a consequence of the impact of national cultural characteristic and various institution factors, many MNCs may adapt their practices to local conditions hence showing localization.

RESEARCH METHODOLOGY

The case firm chosen for this case study is a large Japanese wooden manufacturing firm in Perak which produces wooden component parts and builders joineries such as unfinished laminated boards, painted hand rails, and stair case boards, etc. The firm was established in 1994 with over 90 per cent investment from Japan and has presence in all South East Asia nations. The products manufactured by the subsidiary are widely used by local furniture suppliers spread over various locations in the country and also for exports to Japan. Since the subsidiary had been able to sustain its business profitability in recent years, it had been transformed into a holding company with 3 additional subsidiaries under its wing. The group today has an approximately 600 employees on site

As the paper aims to investigate whether there are any barriers to transferring the Japanese HRM practices abroad, qualitative methods were selected because it provides an epistemological position (Bryan & Bell, 2003) and address to the questions starting with 'why' and 'how'(Yin, 1994). All issues were addressed to the key personnel of the firm such as the Chief Executive Officer, Managing Director and Human Resource Director through an in-depth interview because they are assumed to understand Japanese HRM practices much more than the other employees within the firm. The instrument used in the in-depth interviews was an open-ended and a semi-structured interview schedule. Three types of interview style however were considered; structure, semi-structured and in-depth. Semi-structured interview was preferred as it combines the attributes of the in-depth interview but having the flexibility to vary the sequence of the questions. Before conducting the interviews, respondents were promised confidentiality to facilitate candid responses. The interview questions were developed around human resource management practices such as Employment Policies and Practice, Remuneration Systems and Welfare Benefits, Career Development Practices, Training and Development and Workplace Relationship Practice. Each interview lasted about one to two hours per session. The data was

recorded and subsequently transcribed. Other sources of evidence were also examined such as the HRM policies, internet-enable company website and yearly annual reports. As most of the respondents were able to speak fluent English, there was no requirement to conduct the interview in the Malaysia native language (Malay Language) or Japanese. Lastly, we also applied a triangulation method which consists of an interview with two randomly chosen employees.

FINDINGS

Employment Policies and Practices: Staffing Practices

The Japanese subsidiary has never adopted the practice of lifetime employment policies from Japan. Instead the subsidiary's policies and practices for both blue and white-collar employees resemble the local practices. For example, termination is based on misconduct, unsatisfactory work performance and in the event of an economic crisis. Similarly layoff policy does not exist in the subsidiary. Retirement age is also consistent with the local practices at 55 for male and 50 for female. Based on the interviews with the Managing Director, Japanese are said to be sceptical of the local employment legislation, therefore they abide strictly to the local law. This explains why layoff policy does not exist in the subsidiary. The Japanese instead, follow the Malaysia Local Labour Act when terminating an employee. Likewise, the retirement age of 55 for male and 50 for female are also in accordance with their individual contract of employment for retirement. Further examination indicated that lifetime employment policies have not been favoured here due to the current labour market condition. According to the Human Resource Director, Malaysia's employees are not loyal and would not hesitate to job hop when better opportunity arises.

Employment Policies and Practices: Recruitment

The Japanese subsidiary's recruitment practices for both the blue and white-collar employees resemble very much like the local practices which are ad-hoc, less preference for recruitment of fresh graduates/from elite university and prefers experienced employees. The Chief Executive Officer concluded that the nature of the labour market in Malaysia as one of the reasons why the subsidiary's practices resemble local practices. For example, the recruitment in the subsidiary is based on demand and on ad hoc basis due to the high turnover rate in most organisations and the uncertainty in demand. It was also hard to recruit top students from the best university in Malaysia as most would prefer to work in big towns like Kuala Lumpur. On the interview test, the Human Resource Director emphasized on simplicity for both the blue and white-collar employees. Interviews are said to be centre around work problems and decision to whether to employ the potential candidate is based on his/her ability to answer the question. He added again that simplified processes, was due to the insufficient of good employee in the job market. Interestingly, the subsidiary prefer to hire housewives as the ideal employee when selecting the production workers. The Managing Director commented that past experience indicated that it was better to recruit female employees as they are more obedient and housewives are usually preferred as they do not job hop as often as other single female employees, as job security is important to them. The subsidiary also prefers to hire blue-collar employees after March every year. This again is due to the local labour condition in Malaysia as all local university intakes

commence in April and to avoid unnecessary investment, they would rather to hire after March each year.

Remuneration Systems and Welfare Benefits: Welfare System and Concern

The Japanese subsidiary's welfare and remuneration benefits for both the blue and white-collar employees resemble very much like the local practices. For example, the benefits such as yearly local trip, bonus (once a year), insurance, medical coverage, meal allowances, dormitories, shuttle bus, uniform and food allowances during overtime are common for most of the manufacturing firms in Malaysia. Similarly the benefits are also not extended to family members, unlike in Japan. On the after work drinking practices, findings revealed that it was not in favour by the management. Likewise the practice of spending time with employee on every matter which inclusive of personal life which is a common practice in Japan was also not applied here. Based on the interview, the Chief Executive Officer considers the welfare benefits as a costly affair hence they do not follow the practices like in Japan. Moreover he added that most manufacturing firms in Perak, Malaysia do not extend benefits above an employee's contract of employment especially in a non-unionized organization. The after work drinking practice was not in favour due to culture and religion differences. For example, the Muslim employees in Malaysia are prohibited by religion to consume liquor, hence the practices was not favour here. Likewise the practices of spending time with employees on every matter are not applicable due to culture issues. The Managing Director further explained that employees are usually not comfortable in revealing their personal matters. On the similarity of some welfare benefits within firms in Malaysia, according to the Human Resource Director, it was due to legislation. For example, insurances scheme implemented by the government known as SOCSO are statutory requirement and most companies in Malaysia are required to purchase them.

Remuneration Systems and Welfare Benefits: Promotion System

The Japanese subsidiary's promotion system for both the blue and white-collar employees resembles very much like the local practices. According to the Chief Executive Officer, promotion for white collars employee is very much based on merit and is determined by the results from the performance appraisal. Seniority has never been considered before, as it is a threat to the organisation's due to a high turnover rate in Malaysia. On average, he added that it takes a year before an employee is eligible for promotion. On the preference for promotion, the three key personnel stressed on the importance of internal promotion, irrespective of any position under the while-collar category. However, findings revealed that the practice has never been fully implemented due to the shortage of capable employee within the subsidiary. Most of them agreed that external promotion was more frequent at times. Promotion system for the blue-collar employees however suggested on the practice of seniority based. According to the Human Resource Director, promotions to team leaders and supervisors often occurred after 2 and 3 years respectively. He added that it was important to reward based on seniority in order to discourage employees from hopping away to rival companies. The expertises of senior employees are needed to train younger staff.

Career Development Practices: Career Path

The Japanese subsidiary's career path policies for both the blue and white-collar employees neither resemble the local or parent's practices. For example, job rotation for the white collar category, is modified unlike in Japan or Malaysia. According to the Human Resource Director, as most employees recruited are experienced workers, job rotation is not appealing. Therefore, the rotations are limited within different sections of the department and not cross sectional and functional like in Japan. For example a job rotation for a typical engineer in the particular subsidiary is between different sections of Material Department, Production Control and Operation and not on Marketing, Human Resource, etc. Similarly, job rotation for the blue-collar category is modified. As most manufacturing here do not practise job rotation for the blue-collar category, the subsidiary patterns however involves cross sectional, twice per year, all within the same operation department. For example, the employee could be rotated between Sanding Machine Section, Finger Joint Section, Moulder Section and Press Section which is all within the operation department. The Managing Director however added that it was part of the firm's strategy due to the high turnover rate in Malaysia. He further added that the trainings are necessary in the event that they need to backup their colleagues. On the preferences of the type of employees, the Managing Director stressed that the subsidiary would prefer a generalist who could do everything with the same pay. He shared that the preference was part of the parent's company group strategy.

Career Development Practices: Training and Development

The Japanese subsidiary's training and development policies for both the blue and white-collar employees neither resemble the local nor parent's practices. For example the number of days spent for training for both the blue and white-collar employees are more than the local firm's average but lesser compared to Japan. For example, a white-collar employee spent an average of 10 days on training while the blue-collar employees spend an average of 6 days on training in a year. The Chief Executive Officer added that the average are more when compared to other local firms, because Japanese firms emphasized a lot on culture, Japanese language, safety and health. He however agreed that most trainings are design specifically towards production maintenance and not to improve overall skills of the employee. The Chief Executive Officer added that they were reluctant to train more than the required skills because there is a strong tendency the said employee will job hop after receiving sufficient training as experienced by them in the past. On the blue-collar employees, although they spent more than a higher average days on training, compared with their counterparts from other manufacturing firms, they are not required to attend courses which are not directly relevant to their task suggesting that there is no opportunity for upward mobility. The Human Resource Director emphasized that it was unnecessary to train blue-collar employees more than the necessary skills as they are mostly foreigners who would return to their home country after the contract expires in 3 years time. In addition he said that it was not hard to recruit foreign workers in Malaysia.

Workplace Relationship Practice: Union

The workplace relationship practices of this subsidiary neither resemble the local practices nor the parent's company practices. Findings from the Chief Executive Officer revealed that the Malaysian Government forbids the formation of national union but allow in-house union

to be formed. The rules nonetheless were applicable only to the electronic industries and not heavy machines industries. Local firms nonetheless are excluded from the rulings. However the subsidiary did not belong to any national union or in-house union. The Human Resource Director claimed that the national or in-house union practices were not adopted due to cost factor and parent's company decision to discourage in-house union. He added that in-house union for example would do more harm than good for both parties. Therefore, in order to deal with the worker's problem a JCC (Joint Consultative Committee) was set up by the subsidiary. The JCC (Joint Consultative Committee) is a representative body to liaise with the management (which is not registered under the Trade Unions Act) to discuss on workers minor daily problems. He added however that JCC has no legal right to discuss salary adjustment and other monetary benefits or go on picket if the firm fails to meet their demand.

CONCLUSION

The core elements associated with the Japanese HRM are almost completely absent from the subsidiary. Although some HRM practices still remain, nonetheless it has been modified. Local environment conditions, culture and regulations seems to be the three biggest barriers in the transferability of the HRM practice. However interesting findings revealed that some practices are deliberately left out by the parent company due to labour-cost minimization. It looks clear that Japanese firms only transfer low cost practices abroad as indicated in this study.

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THE RELATIONSHIP BETWEEN ORGANIZATIONAL CULTURE AND JOB OUTCOMES: A LITERATURE REVIEW AND RESEARCH AGENDA

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1. INTRODUCTION

Organisation culture plays an important role in the management and organization theory which frequently attracts many studies and discussions due its potential influence on job related outcomes (Chow et al., 2006). Suitable organisation culture helps organisation to upgrade their efficiency and effectiveness of its (Ooi & Arumugam, 2006).
This paper reviews the past research and supplements this work by investigating the relationship of organisation culture and job related outcomes.

2. LITERATURE REVIEW

2.1 Theory of Organizational Culture

Organizational culture as we know is not only rooted by its values, beliefs, ideologies and assumptions, it is also affected by various facets of organizational well-being (i.e. plan, interpersonal relationship and approach) in order to shape its structure (Schneider 1980; Joyce & Slocum 1982; Seihl & Martin 1990; Dension & Mishra 1995; Carroll & Harrison 1998; Cabrera & Bonache 1999). Instead of sharing the philosophies, ideologies and beliefs, organizational culture also been said could assist to provide conventional solutions to the problems that arise within the organization (Kilmann et al., 1985; Schein, 1997; Marcoulides and Heck ,1993) as these elements have been widely spread throughout the organization.

2.2 Job-related outcomes

Job-related outcomes can be defined as the results derived from any work situations, activities or processes that focused on employees' performance (Meyer et al., 1989; Odom et al., 1990; Igbaria, 1991; Birnbaum and Somers, 1993; Babin and Boles, 1996). Job-related outcomes' elements could consist of job satisfaction, job involvement and job commitment (Guimaraes, 1996). Tett and Meyer (1993) agreed that employees with high level of commitment towards the organization will probably stay longer with the organization

compared with those with lower commitment. Job satisfaction can be defined as an important role to identify the relationship on how an organization fulfils the employee's needs (Locke, 1969). Gray et al., 2003 emphasized on the importance of job involvement as it is associated with other organizational outcomes. Furthermore, Guimaraes (1996) accentuated that employees with high job involvement will be more satisfied and also can be anticipated that they could demonstrate their full commitment towards the organization (O'Driscoll and Randall, 1999).

3. RELATIONSHIP BETWEEN ORGANIZATIONAL CULTURE AND JOB OUTCOMES

3.1 Trust

Organizational trust is the confidence of an individual has in terms of the level of perceived integrity, fairness and reliability of organization (Lypnack and Stamps, 1997). The key indicators which involve trust are loyalty, competence, consistency, openness and integrity (Robbins, 2001). Trust has been identified as a significant element of the social system and can act as a social capital (Seligman, 1997). Researchers and scholars have conducted much research about the importance of trust in organizations and the relationship with satisfaction, involvement and commitment of an employee in their job. This leads to our first research proposition:

P1. Trust is positively related to job outcomes.

3.2 Innovation

Increasingly, innovation is viewed as an important element in organizations, in order to; improve its performance. (Nooteboom, 1999; Tanner, 1998; Roberts, 1998). West and Farr, 1990 defines innovation as the institution and enforcement within a team, organization; or wider society, of the organization process or procedures which are new to adjust and improve the performance.

The outcomes of the past studies by Lee Y.D. and Chang H.M. (2008) found a positive relationship between innovation and employee satisfaction. As quoted by Tonnessen T., (2005) suggested that there is a better application of employee's involvement and commitment in innovation throughout the organization gives efficiency and improvement in the working environment. Against this background, our second research proposition is:

P2. Innovation is positively related to job outcomes.

3.3 Communication

Communication is one principal practice in management of an organization. Brunetto and Farr-Wharton (2004); and Smidts et al., (2001), claims that communication in an organization

is a process whereby members or groups convey information in many different aspects and within various areas along with the intention to achieve the organizational goals Neher (1997); Myers and Myers (1982) examined the correlation between organizational communication and employees work attitudes. This takes us to our third proposition:

P3. Communication is positively related to job outcomes.

3.4 Supportiveness

Eisenberger et al., (2001) argued that the social exchange within the organization between employees and employer are not only being based on monetary values, but also on socio-emotional. One of it is the supportiveness in organization. Supportiveness element is seen to be essential as it is part of the organizational culture, which later influences the employees' work attitudes (Aizzat, Mohamad & Lye, 2008) to achieve the organization's objectives.
Furthermore, research also agreed that high level of perceived organizational support will be linked with positive job outcomes (i.e. job commitment, job involvement and job satisfaction). Other studies also agreed that a supportiveness element has positive relations with job satisfaction (Thomas & Ganster, 1995; Nye & Witt, 1993; Beehr et al., 1990). Therefore, our fourth research proposition is:

P4. Supportiveness is positively related to job outcomes.

3.5 Emphasis on rewards

When employees had performed their tasks well in the organization, they will expect rewards in return. Rewards could consist of intrinsic rewards, extrinsic rewards, social and organizational rewards (Buch & Tolentino, 2006). Organizational rewards have been said that could directly affect the productivity, quality and profitability of one organization (Buch & River, 2001). Intrinsic rewards are the rewards that received by the employees because of their contributions and participation activities that increased their own job satisfaction, personal growth and responsibility (Buch & Tolentino, 2006). On the other hand, extrinsic rewards are those rewards that employees received from the organization that due to their job performance. According to Alderfer, (1969) social rewards are the results of when employees are satisfied with their need of feelings that are associated with the sense of belonging towards the organization. Against this background, our fifth research proposition is:

P5. Emphasis on rewards is positively related to job outcomes.

3.6 Competitiveness

Competition within employees in the organization would enhance the job outcomes; particularly it will affect job satisfaction (Sauers & Bass, 1990). Competition among these employees would allow them to demonstrate their own capabilities and perform their task well (Crowley, 2004). Competitiveness is one of the organizational culture factors that

sometimes known as social comparison phenomenon. The development of social comparison theory by Festinger in 1954 has suggested that individuals will compare themselves with others within the organization in order to sustain their competency level (Suls & Wheeler, 2000; Fletcher, Major & Davis, 2008). Research done by Fletcher et al., (2008); had exhibited that the competitiveness factor in organization is positively related with job commitment and job involvement, where employees in high level of trait competitiveness will feel greater job satisfaction which later leads to higher performance. According to the above evidence, our final proposition is:

P6. Competitiveness is positively related to job outcomes.

4. CONCEPTUAL RESEARCH FRAMEWORK

From the above literature review, a research framework is developed to investigate the influences of organizational culture facets on job outcomes. The relationship between organization culture and job outcomes is exemplified in Figure 1.

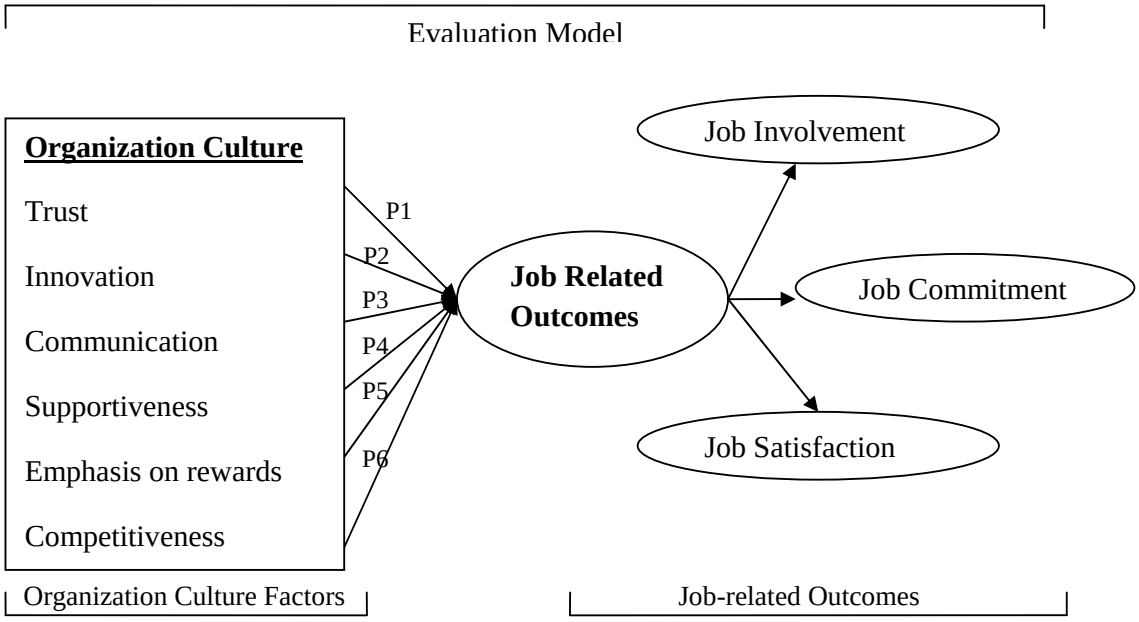

Figure 1. A model of effects of organization culture facets on job outcomes.

6. CONCLUSION

This research is an initial attempt to examine the relationship between organization culture and the job outcomes. To establish the model in practice, future study and survey will be conducted using multivariate analysis to test the propositions in order to validate and develop the model.

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EXPLOITING ENTERPRISE-UNIVERSITY COOPERATION IN THE INTERNATIONLIZATION PROCESS OF SME

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ABSTRACT

This single case study illustrates a Finnish SME cooperating with Chinese universities in the internationalization process to China. The reasons to utilize enterprise-university cooperation are to access to the supplementary competence and to enter the Chinese market. The Finnish SME realizes the enterprise-university cooperation through the social relationship of its Chinese employee. The Finnish SME exploits the enterprise-university cooperation on R&D activities, HRM practices and marketing channel establishment in China. The case study provides an idea that SMEs could – besides traditionally focusing on suppliers and customers – explore university in a target market as potential partner in the business networks for their internationalization. Moreover, exploiting the relationship with university can provide more assistance on the operations of the SME in the target market rather than merely on R&D activities.

Keywords: enterprise-university cooperation, internationalization, SME

INTRODUCTION

The internationalization of Small and Medium Sized Enterprises (SMEs) attracts the attention of many researchers. Internationalization is variously defined mainly from such perspectives as process, relationships, networks, and firms' operations [1]. Based on the resource-based view, Ahokangas [2] defines the internationalization as "a process of mobilizing, accumulating, and developing resources stocks for international activities". Reid [3] points out that the internationalization process of SME is more innovative and strongly influenced by managerial variables. At the same time, resource constraint, lack of brand recognition, and inadequate management are significant barriers in the internationalization process of SMEs [4].

With the boom of the "born global" companies, network theory is developed to explain the phenomenon of rapid internationalization process of SMEs [5]. Network theory focuses on the impact of the informal and formal business relationships on the growth and internationalization of firms [6]. Networking is regarded as a major way for the SMEs to solve the problem of resource constraint [7]. Mtigwe [8] states that the network of a firm puts

effort to the internationalization process of the firm as a third party so that a rapid internationalization is possible.

Networks of a firm are studied from different perspectives by researchers. Hailinen and Törnroos [9] identify the network from vertical and horizontal dimensions. On the vertical levels, the networks can be classified into such as, geographical levels from local to international, value chain levels including supplier, manufacturer, distributor and customer, and business setting level including industry, company, department and individual. On the horizontal level, the firms have either competitive or cooperative relationship within a specific network level. However, Brandenburger and Nalebuff [10] proposed a mindset combining competition and cooperation in a value net of a firm which comprising suppliers, competitors, customers, and complementary. In their study on networks in the context of business incubators and SMEs, Smilor and Gill [11] identify six types of actors in a small firm's business network. They are large and small firms, universities, public sector such as state and local supporters, and professional advisers such as trade and other associations, chambers of commerce etc. (Figure 1). These actors are assumed to support small firms in their internationalization.

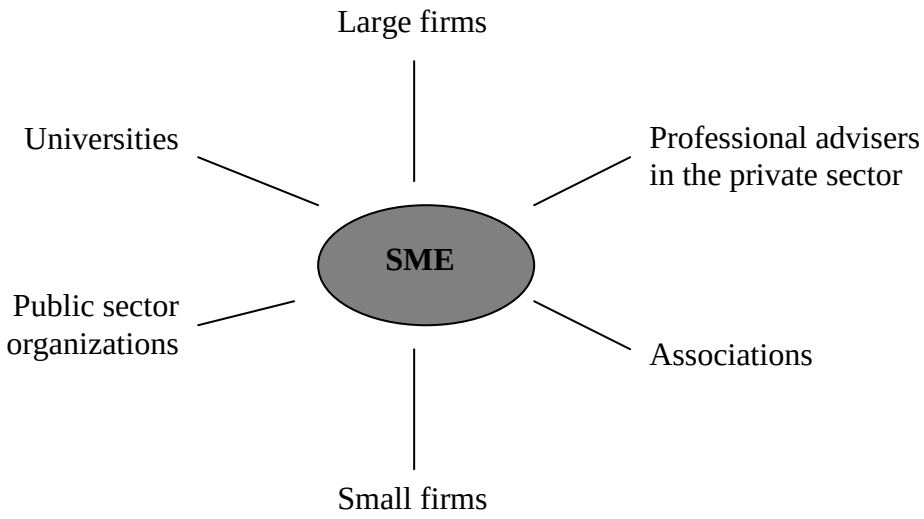

Figure 1. The business network of a small firm (adapted from [11]).

Ritter et al. [12] state that the research focus is switching from understanding business networks to managing business networks. They believe that the ability of a firm to successfully develop and manage its relationships with other firms can be regarded as a core competence of the firm. It is even can be an important source of competitive advantage [13]. Coviello and Munro [14] state that the network of small firms impact on the foreign market and entry model selection in their internationalization process. The study of Johanson and Vahlne [15] suggest a network model for internationalization process which focuses on experiential learning with partners and incremental commitment on time and resource.

Although there are some case studies in the existing literature, Ritter et al. [12] suggest that more empirical studies are needed to reveal the network management in terms of network development and firm's performance in network context. Nummela [16] also notes that business network is supposed to provide some assistance to small firms, whereas there is little empirical evidence in the existing literature. In their study on SMEs, Bell et al. [17] and Rothwell & Dodgson [18] argue that not all of the potential partners in the network are aware by SMEs. Furthermore, SMEs do not know how to exploit the relationships with the different partners in the network. These problems show that probably very few SMEs could effectively utilize the advantages of their networks [16].

Based on the network proposed by Smilor and Gill [11], this paper reveals some empirical evidences of university-enterprise cooperation in the internationalization process. It addresses two research questions. The first research question is: "Why does SME cooperate with the university in a foreign country?" The second research question is: "How does SME exploit the relationship with the foreign university in the internationalization process?" Koze and Lewin [19] put exploration and exploitation logic into their framework for raising the odds of successful partnerships. Exploration refers to "experimenting with or establishing new assets and new capability". Exploitation refers to "the elaboration and deepening of existing capabilities and to incremental improvements in efficiencies". The logic of exploitation will be applied to this paper. The paper tries to answer the research questions through illustrating how a Finnish SME exploits the cooperation with Chinese universities to support its operations in the internationalization process to the Chinese market. Moreover, the study also shows some evidences that exploring the non-traditional partner in the networks to support the internationalization process of SMEs.

The paper organized as follows. First, it describes the network study in the internationalization process. Research questions are proposed to learn the enterprise-university cooperation in the internationalization. Second, research method of the study is presented. Third, case study is described to illustrate a Finnish SME utilize enterprise-university cooperation in its internationalization process to China. Consequently, the case study is discussed. Finally, the conclusion and research limitation end up the paper.

RESEARCH METHOD

This paper is a part of a project which studies the internationalization process of Finnish companies, especially SMEs, to Chinese market. As mentioned in the research background, more empirical research is expected to show the interaction between firms and their networks in the internationalization process (cf. [12], [16]). It leads to taking qualitative study into account in the research, as qualitative methods can be used first to better understand the phenomenon about which remains unknown; second, to gain new perspectives on matters about which is already known much, and third, to gain more in-depth information that may be difficult to convey by quantitative means [20]. A case study is one of typical methods of qualitative research. Yin [21] states the case study is the preferred strategy when 'how' or 'why' questions are being posed, when the investigator has little control over the events, and when the focus is on a contemporary phenomenon within some real-life context, especially when the boundaries between phenomenon and context are not clear cut. The project explores the practices of Finnish companies in the process of internationalization so that more research

questions are proposed on 'how' and 'what' aspects. Consequently, qualitative method is assumed to fit the research questions, as it can generate rich information which is not obtainable by utilizing statistical sampling techniques [22].

The case companies of the project are selected from those companies who are currently operating in Chinese market. The data are collected from the case companies through a structured questionnaire and a face-to-face interview. The interviewees are the persons in the management level of the case companies, who are the right persons to the investigation as they are personally involved in the internationalization process to China. The structured questionnaire is designed to gain some basic information of the case companies in the internationalization. All the case companies answered the same questionnaire. The other questionnaire of the interview is designed based on their answers of the first questionnaire in order to get more in-depth information. Therefore, the questionnaires of the interviews are different according to the different case companies.

This paper uses a single case study method. Referring to Yin [21], the rationale for a single case can be one case "represents an extreme or unique case" or "the case is a revelatory case". In the paper, the case company highlights a special feature on the network to utilize enterprise-university cooperation in the internationalization process. It is supposed to give some indicates on the network theory and managerial implications of SMEs in the internationalization process.

The name of the case company is not disclosed in order to respect the confidentiality of the company.

CASE STUDY

The case company is a medium-sized Finnish company who provides electrical products and service for industrial application. It established a wholly-owned enterprise (WOE) in China in 1999. Chinese market entry was one important motivation of the case company. It is looking for stable growth opportunity of business development. The internationalization process to China was started by its first Chinese employee in the company. The starting point was R&D cooperation with a Chinese university through the personal network of the Chinese employee before the WOE was established. The case company had access to a specific competence that enabled the company to make the product in China. This was the main reason to cooperate with the Chinese university. The relationship with the Chinese university was a case-by-case cooperation on R&D activities. At the same time, the case company also had R&D cooperation with other Chinese universities and institutes in the beginning stage of internationalization.

The cooperation with the Chinese universities is in a both formal and informal relationship on the case by case base. Besides the cooperation on R&D activities, the case company utilized its network with universities to recruit employees. It was regarded as a good source of engineers, as the case company works with the universities in a long term to develop the engineers needed by the company. The university students took the internship opportunities provided by the case company and acquired the job positions later through internship in the

case company. On the other hand, some new employees were recruited through the recommendation by some of the employees who had studied in those universities.

Although it is not a major part of the customer base, some spin-off companies of the universities are the customers of the case company. The spin-off companies are start-up and developing companies. Some cooperation with those spin-off companies is on the condition of customer-supplier relationship.

DISCUSSION

Enterprise-university cooperation is not a new topic in the research. Geisler [23] studied the reasons for enterprise-university cooperative R&D based on the theory of resource interdependence and interaction. He stated the factors affecting the survival of enterprise-university R&D cooperation include: 1) relationship with focal university; 2) relationships with industry; 3) internal management; 4) research and technology strategies; and 5) individual attributes of the founders and managers [24].

Cooperating with university, especially on R&D activities, is acquainted by the SMEs in case of necessary when operating in their homeland. However, few SMEs transplant the same idea when facing resource disadvantage in their internationalization process to a foreign country. Confronting new business environment, resource constraint limits the business development in the activities such as human resource management and marketing network establishment besides R&D activities in the foreign market.

In this case, there are two main reasons for the Finnish SME to cooperate with the Chinese universities. One is to accesses to the supplementary competence. The other is Chinese market entry. The case company illustrates that its cooperation with the Chinese universities plays a role of resource supplementary in the internationalization process. The case company took advantage of the resources of the Chinese universities when some competence related to the R&D activities was not sufficient. The case company are wisely to cooperate on the R&D activities – the very beginning stage of product development in Chinese market. The activities support not only on the product development in a target market, but also for the new market learning in the process. The case company are actively working with a few universities in China. It enlarges the external resources that can be potentially utilized in their process of business development. The relationship with the Chinese universities is established in a both formal and informal way during the process of business development in China.

Human resource management (HRM) is a big challenge and one important factor for business success when a foreign company is operating in China ([25], [26]). The functions of human resource management such as recruitment, training and development, can be problems for foreign investment companies in China [27]. The case study shows that the case company utilizes the cooperation with the Chinese university to facilitate the recruitment and training. The process helps the case company to localize human resources with relevant expertise in a very effective way. At the same time, personal relationships of the Chinese employees are taken advantage of to recommend the new employees to the company. It is supposed a way to establish the loyalty of Chinese employees in order to reduce the turnover of personnel in a dynamic and rapid changing environment. Furthermore, it also helps the company to

overcome the problems of knowledge loss by retaining the employees with relevant knowledge [28].

Marketing activities are key to the successful business development in the internationalization process to a foreign country. It is important to reach the target customers and build marketing channels, although it is a tough task in the foreign market. The case company illustrates that the customer relationship is partly established with the spin-off companies of the Chinese universities. The case study provides an idea to fully exploit the cooperative relationship with universities in a foreign country. Although the spin-off companies are newly established companies and not a major part of the customer base of the case company, it is a business opportunity for the case company with those companies development in the future.

In this case, there are three factors to trigger the relationship with the Chinese universities. First is the motivation of Chinese market entry in the case company. Second is the personal relationship of the Chinese employee. Finally there is such a supplementary resource of the Chinese universities seeking by the case company. The case study illustrates that the strategy and internal resources of the case company help to establish and exploit the enterprise-university cooperation in the Chinese market. This kind of cooperation can potentially support several operations of the company instead of merely limited in R&D activities. The case study enlightens to explore more partners of the business networks besides suppliers and customers in the foreign market. Moreover, especially for SMEs with limited resources, it can be a competitive advantage for business development by fully exploiting the relationship to support more activities in the foreign market.

CONCLUSION AND RESEARCH LIMITATION

This study provides a real-life example of SMEs exploiting enterprise-university cooperation to boost the internationalization process in China. The reasons to utilize enterprise-university cooperation are to access to the competence and to enter the Chinese market. The Finnish SME realizes the enterprise-university cooperation through the social relationship of its internal resource, e.g. its Chinese employee. The Finnish SME exploits the enterprise-university cooperation on R&D activities, HRM practices and marketing channel establishment. The case study provides an idea for SME on how to develop their business in China by exploring more partners such as university in the business networks besides traditionally focusing on suppliers and customers. Moreover, exploiting the relationship with university can provide more assistance on the operations of the SME in China rather than merely on R&D activities.

It is a single case study with unique aspect and some revelatory implications, as few SME utilize enterprise-university cooperation in its internationalization process to a foreign market. Obviously, the case study illustrates a possible solution for SME when confronting resource disadvantages in the internationalization. The study partly contributes to the bilateral relationship management in the network development. It also provides an empirical study that how SMEs exploit the relationship to effectively utilize the advantages of their network which is little in the existing literature. The practices of the case company supply some

managerial implications for SMEs on R&D activities, HRM practices and marketing activities in the internationalization process to China.

The single case study is easily subject to some questions of generalization. The first research limitation is the replication logic. The case study can be questioned as a contingency instance. Can the case be duplicated in any other context such as by other firms in the Chinese market or in other target market in the process of internationalization? Second, since the case study shows that enterprise-university cooperation supports some operations of business development, what are the conditions to form the enterprise-university relationship in a foreign market? Besides social relationship, are there other channels for a foreign company systematically seeking enterprise-university cooperation to support the operations in a target market? These are questions can be further studied in the internationalization process of SMEs.

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A STUDY OF THE PRACTICE OF SUPPLY CHAIN MANAGEMENT OF MNCS' OVERSEAS SUBSIDIARIES

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ABSTRACT

This paper reported the supply chain activities of four MNCs. As overseas subsidiaries of MNCs, these manufacturers had to establish a wide supply chain relationship reaching from each of their suppliers to their international customers. The purpose of the study was to report how MNCs operate the supply chain of their subsidiaries and identify the issues in supply chain management that were significant for foreign-invested manufacturers. It was decided to conduct four case studies. Based on Sohal, Power and Terziovski (2002)'s framework, this paper interviewed with purchasing managers of subsidiaries of four MNCs, and attempted to grasp and systematically illustrate nine criteria that impact performance of SCM: backgrounds of the organizations, operational strategies of SCM, assessment of suppliers, categories of information systems, performance of the use of IS, benefits of integrating SCM, limitations of integrated SC information system, and customer partnership. All the companies were found to be involved to some extent in the use of the information system, as well as use of ERP and other enabling technologies. The evidence indicates that there were benefits from execution of supply chain management practices when they implemented supplier appraisal, customer partnership, ISO systems and others.

Keywords: Supply chain, Multinational Corporation, Supply chain management

INTRODUCTION

With increased competition and globalization of market reducing gap of qualities and performances among companies, academic and practical attentions have been shifted to how enterprises can operate more effectively and efficiently (Sarmah, Acharya and Goyal, 2006).

A Supply chain refers to "a network of organizations involved in the different processes and activities producing value in the form of products and services for the ultimate consumer"

(Albino, Carbonara and Giannoccaro, 2007:pp261). Supply chain management (SCM) is an integrated and process-oriented approach to the design, management, and control of the SC, with the aim to create value for the customer by improving customer services and lowering costs (Giannoccaro and Pontrandolfo, 1993). From the perspective of modern enterprise management, SCM is a new management approach to transform supplier relationship into partnership. The trend of major supplier relationship management is the transformation of supplier relationship: from arm's length relationships to strategic partnership in which firms in supply chain cooperate one another via risk sharing, exchange of production operation and financial information, investment of facilities and systems, and continuous improvement of performance and products (Albino, Carbonara and Giannoccaro, 2007)

Not every activity in a supply chain is perfectly operated. For example, in their study on global supply chains, Stratton and Warburton (2006) note there exists specific trade-off between low costs and quick responses. With more exacerbated competitions in global markets and higher customers' expectations, companies need to pay more attention to supply chain operations to make breakthroughs (Wang and Shu, 2007). As a result, it becomes an important issue on how to solve and discover SCM problems.

Most recent studies on SCM have drawn on mathematical models to settle the practical issues of SCM. Canakoglu and Bilgic (2007), for example, provide a mathematical solution for how many resources are to be put in produce development and technology to optimize the benefits of members in a supply chain, in the context of communication industry. Kurata and Liu (2007) draw on Markov model to infer the optimized sales plan a retailer in a SC can take. Tempelmeier (2006) and Jain (2007) both make use of mathematical models to compute the optimal allocation of production and inventory in a SC given different levels of customers demands. In terms of prior and recent research, quantitative methods are used on the SCM related issues such as production scheduling (Lin,Chang and Chou, 2007);demand forecast (Aburto and Weber, 2007); optimal planning of lead time (Choi, Bai, Geunes and Romeijn, 2007); production and inventory management (Boute, Disney, Lambrecht and Houdt, 2007 ; Schwartz, Wang and Rivera, 2006); and raw material cost management (Tsai, 2007)

By contrast, there have been scant case-based or interview-based studies of SCM. In the light of the fact that the problems and difficulties are not well solved through quantitative methods, the purpose of the study draws on qualitative method to understand the practical operations of SCM in the context of international business. It also attempts to systematically organize the problems and solutions for a reference for academicians and practitioners and to enrich

qualitative literature of SCM.

The forthcoming part consists of a review of SCM literature. In section three we illustrate the research method and the framework for interview. We demonstrate the analysis of data in section four, with a comparison list of four international corporations. Finally, we present the results of analysis and discussions for academic and practical implications and state conclusions in complete.

REVIEW OF LITERATURE

Issues and practice of SCM have flourished since 1990's when firms began to notice that effective and efficient supply chain management can produce direct and indirect benefits, such as lowered cost, improved performance of delivery and acquisition of technology. During late 80s and early 90s, economic environment compelled firms to be more competitive to address the challenges of globalized market. Firms are required to obtain upgraded production technology to be more competitive. Internal development is not the only way to produce these technologies, still connecting suppliers' capabilities with customers' demands is a more significant alternative. While connecting suppliers' capabilities, firms must change their attitudes toward suppliers by considering them as partners instead of enemies, and them as resources instead of costs. (Cousins and Menguc, 2006).

SCM comprises a host of indispensable business activities for the firms facing global competition. Successful SCM requires careful selection of suppliers, robust supplier relationship management, application of information technology, and internal/external integration of supply chain. A review of literature is followed to provide a basis for building an integrated and systematic framework for carrying out field interviews.

Supply chain management (SCM)

SCM is an integrated approach to manage information flows, raw material and service of firms to meet customers' demands. Traditionally managers promote profits by focusing on internal operations. However, SCM helps managers to integrate internal operations/decisions and external suppliers to gain competitiveness (Li and Wang, 2007) .

For the last two decades, academic attention on SCM has increased and important knowledge and theories have been developed. Widespread development in the field of SCM is evidenced by the increases in academic publications, conferences, professional programs and university

courses. Researchers have been persistent in amending or creating various technologies and techniques to help SCM operations, as well as promoting implementation performance of firms. Organizations in both the public and private sectors are recognizing the impacts of SCM on business performance (Cousins, Lawson and Squire,2006). The knowledge of SCM resides in such functional silos as purchasing, logistic management, information technology and marketing (Burgess, Singh and Koroglu, 2006). Hence the interviews embrace issues including strategy, operations, use of technology and supplier management for a comprehensive understanding of SCM in the international business context.

Selection of suppliers

Differentiation of suppliers is the degree of different characteristics that exist among the suppliers in the supply base, such as organizational cultures, operational practices, technical capabilities, and geographical separation. (Choi and Krause,2006). One of the most important issues is how a firm can select appropriate suppliers among variously differentiated supplier to improve its supply performance.

Supply performance is a dynamic and active continuity behavior that consists of the past, present and future of time horizons. An effective and efficient approach in supply performance assessment has been increasingly critical in the issues of supply chains. (Chang, Wang, and Wang, 2007). Hence prior research is reviewed to outline the criteria of supply performance assessment, and practitioners are interviewed for criteria of assessment they emphasize. A comparison of the criteria of assessment is presented in table 1.

As Table 1 shows, three criteria that are most favored in prior research are cost, quality and delivery performance. However, the importance of the three measures varies in terms of different industries, nature of operation and appraisers' preferences. For this reason, we attempt to understand the opinions of international business buyers on the three criteria and how ineligible and well-performed suppliers are treated respectively.

Authors	Criteria of supply performance assessment
Dickson(1966)	Quality, cost, delivery performance
Cusumano & Takeishi	Financial state, price, quality, delivery, technical capability, past business relations

(1991)	
Weber & Current(1993)	Price, delivery , quality
Chaudhry et al(1993).	quality、limitations of delivery capability, price feedback
Swift(1995)	Product, availability, dependability, experience, price
Choi & Hartley(1996)	Finance, consistency, relations, flexibility, technical capability、service、dependability、price
Jayaraman et al.(1999)	Quality, nature of product, lead time, warehousing capability
Lee et al.(2001)	Cost, quality, delivery, service
Muralidharan et al.(2001)	Quality, technological capability, delivery
Muralidharan et al.(2002)	Quality policy, price, technical expertise, finance, performance history, facility, flexibility, service
Prahinski & Benton(2004)	Quality, delivery, price, responsiveness to change requests , delivery performance, price, service support
Kreng & Wang(2005)	cost、quality、delivery、lead-time、on-time delivery
Pi & Low (2005)	Quality, in time delivery, price, service
Chang et al.(2007)	R &D, cost, quality, service, response

Table 1. The criteria of assessing suppliers in prior research

Use of information technology

Lai, Zhao and Wang (2006) demonstrate that information technology helps increasing Chinese firms' competitive advantages. The use of IT improves speed to delivery speed and reliability, customer relationship and order accuracy. Higher IT assures more efficient service quality. Above all, higher IT can lead to a higher cost advantage when it is beyond the "strategic necessity" level. In sum, prior research has confirmed that the proper use of IT substantially increases firms' competitive advantages and efficacy of SCM.

Information technology is also applied in the field of environmental protection, which is valued especially by the European Market (EM). Reverse logistic (RL) is one of the critical issues of environment protection. Effective RL management not only reduces costs of production, promote image of green brands, and shorten lead time, but also meet regulatory requirements so that the firms can sustain in advantageous conditions. Consequently, effective IT serves as an excellent controller over the uncertainty characterized by reverse logistics. Furthermore, some studies (Biehl、Prater and Realff, 2007 ; Lieckens and Vandaele, 2007) demonstrate IT-supported RL improves time, quantity and quaality of supply.

In addition, related firms' networks of production and delivery need supports of sound information technology to successfully coordinate just-in-time system (Naso, Surico, Turchiano and Kaymak, 2007). Ko and Evans (2007) draws on genetic algorithm (GA) to provide a solution for the deployment of third part logistics.

The development of science and technology allows for enterprises to promote productivity with better chance. Hence the survival of firms in the domestic and international markets depend to the greater extent on the use of scientific techniques in their decision-making processes (Dhahri and Chabchoub ,2007).

Prior research has confirmed good use of information technology is a one of the keys to build successful international businesses. Hence it is essential to explore use of IT by international businesses and their subsidiaries. The benefits and limitations of the use of IT is therefore a critical point in this study.

Integration of SCM

Research on the trends of SCM (e.g. Carr, 1999; Storey, Emberson, Godsell and Harrison, 2006) identifies that SCM has shifted from the antagonistic model to a collaborative model, and that supplier-evaluation tools have increased to facilitate more efficient and effective SCM. Hence it becomes more important to integrate SCM and nurture partnership with suppliers. Kim (2006) note that both transfunctional integration and external integration with suppliers and customers are required to achieve superior performance in cost, quality, flexibility and delivery performance (Kim, 2006).

Many firms recognize that good suppliers help firms focus their core competencies to reduce costs and product development time and to increase product quality. Tang (1999) identifies four different types of supplier relationships: vendor, preferred supplier, exclusive supplier and partner. These four types relationships differ from each other in terms of types of contracts, length of contracts, type of information exchange, pricing scheme, and delivery schedule (Tang,2006).

Good supply relationships bring positive benefits to firms. Managing supply relationships is a strategic task that contributes to competitiveness and profitability of the firms and the entire SC (Huemer, 2006). Supply relationship management covers many aspects such as the extent of production integration, information exchange and working conditions management of suppliers' employees (Locke and Romis, 2007).

Performance of production scheduling improves not only when SC is externally integrated, but even significantly when internal integration facilitates internal function teams connect with customers and suppliers to cultivate common visions.

Inappropriate SCM leads to negative impacts, direct and indirect. For example, firms in the vendor and retailing markets face different marginal costs and uncertainties; hence their strategic decisions tend to maximize profits instead of profits of the whole chain, causing problems of overpricing, ordering too little goods or serving too few customers (Lee and Rhee, 2007).

Relationship management of SC is thus concluded to be a key to the success of SCM. The present study also attempts to understand in depth how subsidiaries of international corporations play their roles as integrators of SCM and what benefits they obtain.

METHOD

Based on Sohal, Power and Terziovski (2002)'s framework, we interviewed with purchasing managers of subsidiaries of four multinational corporations. These subsidiaries are located either in Taiwan or in China. Through interviews we attempted to grasp and systematically illustrate nine criteria that impact performance of SCM: backgrounds of the organizations, operational strategies of SCM, assessment of suppliers, categories of information systems, performance of the use of IT, benefits of integrating SCM, limitations of integrated SC information system, and customer partnership.

We provide narratives of interviewees and make excerpts in section 4. We draw interview questions from literature review in section 2, which also sorts out some important and quantitatively unsettled issues, in an attempt to discover possible solution through interviews. We then compare the content of interviews by outlining a list of comparison and forward our suggestions in section 5 for practical and theoretical implications.

CASES

Background of organization

Company A is an American international corporation in IC industry, with numerous product categories ranging from electronics, components, and electronic chip. The suppliers consist of providers of raw material, production facility and factor consumer goods. The subsidiary in Taiwan, with 2,200 employees, provides IC packaging service to customers. The main raw materials include wafer, gold lines, copper lines, silica gel, die glue, packaging material, and

rinse solvent. The manufacturing process of IC is made up with two stages, with the first stage for wafer production and the second for packaging test. Wafers are ordered by American customers and manufactured by Taiwan Semiconductor Manufacturing Company, Ltd. (TSMC®) and United Microelectronic Corporation (UMC) to deliver to the Taiwan subsidiary for end-treatment, then sold to client firms.

Company B is a Korean international electronic corporation. With high expectations of Taiwan's potentials of development, Company B established its Taiwan International Purchasing Office (IPO) in 1991. The Taiwan IPO was later expanded to the Taiwan international purchasing center (IPC) as a result of increased sales and purchases. Presently, the Taiwan IPC is mainly responsible for purchasing electronic parts for the electronic business unit subordinated to the group. The purchasing process starts from orderings by IPCs to collaborated firms which provide electronic parts. Factories then assemble these parts into products. The business departments of the Taiwan subsidiary are responsible for purchasing raw materials. The Taiwan IPC purchase IC-related products, such as electronic IC, computer memories, connectors, DVI, PCB、panel boards, passive materials, initiative raw materials. Panel board is the main purchasing items and accounts for 50%-60% of the purchases.

Company B imposes strict control over subsidiaries. The chief members of the subsidiaries are Koreans. Every business unit has to implement the strategies made by headquarter. Headquarter examines top management on a regular basis ,as well as reviews employees at random to make sure employees execute business by standard operating procedures. A specialized unit of assessment is in charge of the implementation of the assessments. In addition, subsidiaries review performances of every underlying department monthly to determine reward and punishment.

Company C, established in 1998, is a Japanese company's subsidiary in China. There are approximately 1500 employees in Company C at present. Amplifiers are the major product of Company C. Since most senior managers of Company C are from Japan, they do not have easy access to the national culture and social environment of China. Consequently, some of the company's policies are not suitable for Chinese culture. In this situation, Taiwanese or Chinese managers who are familiar with Chinese culture and social environment could play crucial roles at the management level.

As a Japanese enterprise, the headquarters has implemented Japanese style management for

all the branches and all its subsidiaries. Japanese style management has many advantages and used to be popular all over the world. However, since not only effectiveness but also efficiency are required in the businesses of the 21st century, it is no longer considered a competitive tool. Instead, management teams composed of Chinese people and Taiwanese people are gradually taking charge of the management.

As mentioned previously, there are approximately 1500 employees in Company C. In other words, they need enough orders to keep the company running with so many employees. There are about one hundred items of parts and material for producing amplifiers, which are Company C's main products. Approximately ninety-five percent of these items used to be offered by suppliers in China, and five percent were imported from other countries.

Among suppliers in China, about two thirds were subsidiaries of Taiwanese companies, since they had the ability to provide high-quality parts and material. However, native Chinese suppliers are improving the quality of their products with the consulting and other kinds of assistance offered by Taiwanese business people. Right now, approximately one third of the suppliers are native Chinese companies. The top management of Company C believed that it will have more and more native Chinese suppliers in the future.

Company D's headquarters are in Taiwan, the China branch was established in 1995. It has 33 billion NT dollars revenue in 2005. There are ten thousand employees in China now, about one hundred of them are from Taiwan, and most of the Taiwanese employees are managers. Company D's major departments include the power product department, the board department, the finishing assembly department and so on. Each department is in charge of its own material.

Company D needs to develop new products even faster than it used to do because the life cycle of products has become shorter and old products can no longer make enough profit. Company D's Taiwan factories now only produce the LCD-TV for LG. Household electric appliances exported from China are sent to different countries as work-in-process. Then the works-in-process are assembled and sold there, since works-in-process are charged at lower tax rates.

The power product department and the finishing assembly department are some of the newly developed departments. The finishing assembly department now works most efficiently and has the largest operating revenue. About two-thirds of Company D's 33 billion NT dollars revenue in 2005 was generated in the finishing assembly department. The major products of

the finishing assembly department include DVD players、LCD-TVs、mobile phones、digital cameras and other digital related products. It includes three sub-departments: the DVD department、the LCD-TV department and the mobile phone department, which are all ODM plants. The finishing assembly department uses more than 3000 kinds of materials.

Implementation strategy of SCM

With respect to implementation strategy of SCM, Company A emphasizes its two-way interactions with suppliers by paying casual visits to suppliers or participating workshops held by suppliers. Most importantly, Company A possesses a strategy called WPL (worldwide, procurement, and logistics), which integrates purchasing and logistics into one single department. Each item of raw material has its own manager, who co-ordinates the procurement staffs of overseas subsidiaries, including bargaining in tandem with the demand of factories worldwide. Subsidiaries are responsible for purchasing raw materials only when they demand particular materials and have specification change of raw materials. Most purchases of subsidiaries are international procurements. Then headquarter proceed a overall bargaining and factories place their orders. Subsidiaries can recommend well-evaluated suppliers to headquarter for further reviews in order to be integrated into the supply chain. Hence SCM of Company A has both integration patterns of top-down and bottom-up.

For Company A, manufacturers are its clients. Company A provides components. Some clients even request raw material supplied by particular suppliers. Hence it is necessary to meet clients' demands as SC is concerned. Because clients may have problems in production once they cannot grasp the properties of raw materials. Some clients even ask for green certificated materials to meet governmental requirements and to promote their corporate images, and request papers of certifications that justify the process of manufacturing and contents of materials. In addition, Company A as well as clients examines the factories in Taiwan on the issues related to social responsibility. Clients also request some international certificates such as ISO, and TS 16949, which is related to automobiles and electronics. Specialized audit units from clients visit the factories for request and confirmation of the demanded certificates as well.

For company B, the present guidelines of strategy of the Taiwan IPC is abbreviated as 3S, standing for strategic sourcing, SCM process, and supplier partnership. As far as SCM

concerned, strategic sourcing demands prior considerations of total costs of purchases, suppliers' service attitude, product quality, and accurate date of delivery. Intangible costs are summed to reach a Win-win result. SCM process dictates development of automatic information systems such as GCC and Auto PO System, through which overseas factories directly place orders to IPCs and IPCs transfer the orders to suppliers. By means of the process, lead time is reduced and accuracy is improved. Supplier partnership requests numerous activities which interact with suppliers and an effective rewards and punishments system for maintenance and improvement of relationship with suppliers.

The employees of Company C think it too complicated to implement a SCM system, especially the information technology part, since it increases their workload. However, they like to have ready-to-use data. Company C adopted ISO/TS16949. This system enables it to involve every department. For example, there are rules that some of the information should be shared among suppliers, manufacturers and customers.

The original ISO system emphasizes the quality management field. However, financial functions are not involved. The new system includes almost all the functions of an organization. When applying the system, Company C found that their management philosophy, planning process, operating results and feedback are all included and examined. This is a method that forces every department to be involved.

Managers of Company D believe that outside consultants give little assistance in implementing new strategies since outsiders are not convincing to employees. Generally, the new strategy execution is handled by the leaders of the organization. Company D passed ISO 9000、ISO 14000 and QS 9000 so far.

Selection of suppliers

Company A select suppliers on three criteria: first of all, technically capable of supporting production. Second is cost. Cost is the common reason why suppliers are changed. Last but not the least, fine internal management system, especially quality and management systems.

For Company B, the Taiwan IPC selects the suppliers which can provide raw materials required by new projects. The structure of organization, financial status and owning of international certificates are three major criteria for choosing suppliers. Secondary criteria include cost, delivery efficiency and quality. Suppliers' quality should comply with the

requirements set by the Taiwan IPC. The Taiwan IPC orders components needed by business units from upstream suppliers, which produce and deliver the components to factories of business units for assembly. Headquarter of Company B sends engineers to suppliers for improving product quality required by the company.

When selecting the suppliers, Company C evaluates candidates' plants first. If the suppliers have complete quality control systems in their firms, Company C can forego the requirements for inspection when the parts arrive. This kind of supplier is Company C's first choice. Every time when Company C decides to make a transaction with a new supplier, it asks the new supplier for samples, so it might understand the quality level of the supplier.

Company C then considers the supplier's capacity. If the supplier has the capacity to offer the entire amount of designated parts, Company C will again consider it as the first best option, rather than choosing a supplier who can only provide a portion of the designated parts or material. Generally, Company C considers the above two criteria first, before negotiating the price and checking the supplier's old delivery records.

Company D's suppliers can be divided into two kinds: China-invested firms and non-China-invested firms; non-China-invested firms include Taiwanese firms, Hong Kong firms, Korean firms and so on. Since China-invested firms have disadvantages, such as unstable quality and poor payment terms, most of Company D's suppliers are non-China-invested firms.

Many of the key components and parts are imported from other countries. For some of the critical parts, Company D establishes strategic alliances with the suppliers in order to ensure stable supply. Sony is one of Company D's customers. Sony has its own criteria for supplier selection, such as production process requirements and environmental protection certificates. Consequently, Sony has a list of "green partners", which is a list of its qualified material and part suppliers. For Sony products, Company D will select suppliers from this list of "green partners".

Generally, "QCD" are the criteria used for supplier selection, but Company D put "cost" as its top priority. The professional supply chain related manager of Company D believed that in this competitive industry, a company without cost competitiveness will be knocked out easily. The second consideration is delivery. In other words, suppliers' delivery dates must meet the demand of production. Finally, the quality of material and parts needs to meet the company's requirements. Company D does not have its private brand. Most of its products are sold to large companies like WAL-MART. They also have a branch plant in Mexico manufacturing

LCD-TVs which are sold in the US. Company D's biggest markets are in the US and Europe. In particular, Company D mentioned that it is very difficult to make transactions with WAL-MART, as the price of the products must be very low. As a result, the products are not of very high quality.

Assessment of suppliers

Major criteria of assessment are CETRAQ (Cost , Environment , Technique , Response , Assurance , Quality) of Company A. Suppliers are assessed every six month. Suppliers scored less than 80 are asked to attend a review meeting. Scoring is made by units concerned and without visits to factories. Suppliers are notified to handle the problems raised anytime.

Company A chooses best international and regional suppliers on yearly basis. One or two international suppliers of each category and region are chosen, with a total of 10 respectively. Medals are sent to the chosen suppliers, which, in some regions, are invited to participate in awarding ceremonies and celebrations. Awarded suppliers feel cheerful because getting awards from company A, a respectable global corporation, is like getting quality certificates. Punishment is executed based on the contracts and there is no specific system of punishment.

For Company B, the Taiwan IPC does business reviews on suppliers every season and make assessments on operations of suppliers. Counsels may be given to the suppliers which have problems such as delayed delivery, ignorance of orders or poor service and space for improvement may be given for corrections. Suppliers which make serious mistakes are considered to change. Hence company B is regularly matching data provided by GCC system to search for more appropriate and capable suppliers. As an example, when the company desires to know about how the industry of medium-sized panel operates, whether the suppliers of materials are recommendable, or who are potential suppliers, the Taiwan IPC would classify the suppliers in terms of technology and backgrounds, search for information from internet or written publications, and evaluate the existing/potential suppliers in accordance with internal analysis. Executives are sent for a visit to the suppliers' factories to assess the operations.

For Company C, the supplier appraisal evaluation comprises several steps. Before evaluating the product, the very first step is evaluating the suppliers. Only the suppliers which obtain the approval of Company C's Technical and Quality Management Department will figure on the

list of qualified suppliers. Then Company C will generate a synthesized report of the quality inspection each month and find the "worst ten" and "best ten" suppliers. Company C will talk to the worst ten suppliers and try to help them improve. It may take a lot of time and effort to consult with them. With a continuous improvement program, however, the parts produced by the worst ten suppliers can reach a qualified rate of around 92%.

As far as the best ten suppliers are concerned, Company C will offer encouragement, for example in the form of better payment terms. Usually Company C will require the suppliers to offer 100% qualified parts and return the defectives. However, Company C will scrap defective parts from one of the "best ten suppliers" with no penalty. On the other hand, there will be some penalties or delaying payment for the "worst ten suppliers". This will force the suppliers to pay more attention to the quality of their products.

Company D's supplier appraisal requires its managers to go to the suppliers themselves. The professional supply chain related manager of Company D believed that they can understand the true situation, communicate sufficiently, and acquire more complete and real information by visiting the suppliers. Company D evaluates its suppliers once a year. If the suppliers do not pass the initial evaluation, it will give them the opportunity to make improvements within a certain time period. The suppliers will be eliminated if they fail to pass the second evaluation. The checking events include: quality, delivery dates, service and production conditions. Company D will increase the purchasing quantity as a reward to the good suppliers.

Categories of information systems

Company A uses SAP system, which possesses basic MRP functions such as order tracking, inventory, order confirmation, and electronic invoice. The company can transform SAP-based data into web-based, browsable and updatable information, which makes SAP unnecessary for the clients. The company introduced SAP system globally and simultaneously, and spent 4 years and over one hundred million dollar to finish the introduction task. Each operational page, form and specific requirement was constantly discussed for renewal. The system consultant firm responsible for introducing the system was then asked to modify and test the system, later to train staffs. Commissioners were sent by the system consultant firm to the company during the introduction period and a few service staffs were sent to headquarter after the introduction. The information unit of the company is still in existence but with only one supporting technician because staffs can operate the IT system and facilities without the assistance of the information unit.

For Company B, the Taiwan IPC utilizes ERP system installed in SAP to manage inventory, account receivables, account payables, invoice check and material ordering, etc. SAP was selected because its assured quality, and its modulable , flexible and addable functions. Other systems were also reviewed before the introduction but the SAP was decided. Hence ERP system of SAP has been used from headquarter, the overseas subsidiaries and the factories. In addition, headquarter can control subsidiaries' status of material, purchasing and inventory using the internet and the SAP system.

ERP is also served as a communication platform on which suppliers' information is conveyed. When a supplier delivers, records will be uploaded onto ERP system. On the other hand, suppliers can gain orders placed by the Taiwan IPC through EDI GLONET system of the company, and plan their working processes accordingly. Thus leas-time is reduced.

Company C uses Oracle's ERP system. It has the function of updating the data about quality management and saving it in a database regularly. It also may check material and parts provided. Company C's headquarters and all the subsidiaries use the same ERP system. However, Company C's suppliers do not use this system because of the high cost. It is a very large system, and normally, only about twenty percent of the system is actually used by Company C.

Since this system had been installed, Company C has spent a lot of human resources to adjust the system, because the original report form of the system was not suitable for the company. However, the system made the information available online internally and externally for Company C. When the suppliers do business with Company C, they use the Internet to contact each other. Since the suppliers do not have the same ERP system as Company C, they may receive information one way only. In other words, there is not a complete information sharing mechanism between the suppliers and Company C.

Company D used to employ an ERP system of a Taiwanese informational industry company. In 2006, Company D changed its computer system to TIP-TOP system. Generally, the decision about which system to use is made by the MIS department. Comparing the two systems, the professional supply chain related manager of Company D mentioned that each system had its own advantages. For example, the ERP system's return function is more effective. The computer system of Company D is connected to the headquarters in Taiwan.

Performance of IS

For Company A, information system facilitates the company to connect with suppliers and customers. The sales department is responsible for handling the client end. Products Distribution Center (PDC) directly contacts with most clients and has SAP system connecting with the company. The interface for clients or suppliers is simpler and is a WEB-based version which can be used without understanding of SAP system or particular equipments. Simple training is needed to operate the version.

The information system integrates accounting, financing and production, yet different part of the functions are used by different department. For example, accounting staffs are allowed to use only the order checking function, and production staffs to use only the payment confirmation function, rather than the PAYMENT function.

For Company B, the processing of SAP -based ERP is faster than Excel or Word of Microsoft Office program. Systematic processing allows proxies to grasp progress of operations when an authorized user is asking for a leave. The system facilitates quick responses to suppliers and clients.

For Company C, setting up a real-time system which can react instantly to every operational event is an impossible task. However, the implementation of ERP can improve the inventory. For Company C, it used to have an average inventory of six weeks and its managers couldn't shorten this duration, no matter how hard they tried. But with the implementation of the ERP system, their inventory has been reduced to three weeks. Company C invested a lot for employing and maintaining the ERP system. Moreover, much manpower was needed to update and review the data in order to keep it correct. If a mistake happened, the correcting process would be complicated.

The employment of the ERP system has brought many advantages for Company C. First of all, the headquarters can obtain the inventory data of its subsidiaries all over the world by a click of the mouse. It may only take one minute. Moreover, the management can access financial reports instantly. It also leads to better control of the budget of payables and receivables.

Company D's computer system provides great effectiveness with regard to controlling the material. Data has high accuracy and reports are made conveniently. The personnel are satisfied with the system so far.

The benefits of the integrated SC information system

The major benefit of introducing SAP system to company A is the sharing of information with respect to MRP, facilitating the headquarter to understand subsidiary's status of materials and production. Some segments of information is shared by suppliers and customers, thus information is more transparent and lead time and risk of shortage of materials are lessened.

For Company B, the Taiwan IPCs, an important effect of the integrated SC information system is that suppliers and the IPCs are allowed to provide precise information shortly and reduce lead time effectively. For the integration of supplier information, the Taiwan IPC adopts EDI GLONET system for communicating with suppliers. This is a system which facilitates suppliers to obtain orders placed by IPCs in a clear and quick way, and to work out production process and raw material swiftly. Administrative work is also simplified through the system in IPCs. Lead time is reduced and efficiency is improved in both suppliers and IPCs, thanks to EDI GLONE system.

For the integration of enterprise information, the Taiwan IPC uses SAP-based ERP system to plan internal resources such as inventory, account receivables, account payables, invoices and orders. The modulable ERP system allows for significant flexibility that information developers can customize and modify the operational system on the company's needs. In addition, headquarter is allowed to monitor the status of inventory, procurement and warehouse through the internet and ERP system. IPCs also use the ERP system to shorten administrative work.

In sum, the Tainan IPC uses EDI GLONET and SAP-based ERP system to integrate SC information systems, and it turns out that lead time is reduced, efficiency and competitiveness are improved, customers' needs are satisfied effectively and quickly.

The most important benefit of the information system Company C uses is that it can provide the precise data in a very short time. The data in the ERP system includes inventory data and cost data. Actually, the lead time was decreased after adopting this information system. In this industry, the firms have to improve themselves in the competitive environment. For example, customers used to ask for a lead time of two months, but now the lead time is three weeks. Therefore, Company C's suppliers also need to improve. They used to be required to deliver the material or parts in six weeks; now they need to deliver in about three weeks. In short, Company C needs the cooperation of suppliers and the assistance of technology such as the

ERP system to achieve the shortening of the lead time that customers require. It is impossible to fulfill customers' time requirements with human processing.

Company D uses a supply chain information system to control subsidiaries in different locations. The application of an information system would help integrate its supply chain management and increase the efficiency of material distribution.

The restrictions of the integrated SC information system

Because of the unequal qualities of the suppliers, it is sometimes necessary to instruct come suppliers to use the information system the Company A provides. When some suppliers cannot operate the system smoothly and immediately, the company has to employ human resources to assist them in using the system.

For Company B, one advantage of SAP-based ERP system is that it can provides information anytime and assures precise information. Yet it has restrictions as well. The ERP may cause enormous losses if it is not operated in accordance with the standard procedures. For example, if a staff forgets to input the information of an order, there will be no information of this order in the system till the order is violated, which would cause loss in revenues and even damage the corporate reputation. For this reason, the training has a significant influence on the integrated information system. Using this ERP system is costly (the system costs the Taiwan IPC one hundred million NT dollars yearly), which imposes considerable restrictions on cost control. Nevertheless, company B and its subsidiaries still continue to use the ERP system that is trustworthy for its quality. The Taiwan IPC is also demanded to use this system.

The ERP system of Company C may create great losses if there is not a careful double check. For example, if the employees forget to key in an order, there will be no information at all. And no one will notice this until the due date. This will result not only in a loss in revenue but also in reputation. To avoid such mistakes, a careful double checking procedure is necessary.

The Oracle ERP system which Company C uses has two other disadvantages. The first is its high price, and second is that the English interface is inconvenient for the employees in China. As the system is very expensive (Company C spent more than US$ 30 million), this caused a serious increase in cost. However, as the headquarters uses the Oracle system and believes that the system is globalized, it asked Company C to use this system so that it can be connected with the headquarters smoothly.

Company D considered that an integrated supply chain information system required a general

operational system for each of the subsidiaries. Databases should be shared by every subsidiary and have the ability to provide information correctly. Generally speaking, the information system needs to be transferred when the subsidiary is in a different country, therefore causing problems for supply chain information system integration.

SC partners Relationship management

Company A shares information with its suppliers, and discusses and plans perspective capacity with suppliers. Newly founded suppliers which are short of operating capital are funded and counseled by the company, on a premise that the suppliers are deemed to be well managed. The company designs in with clients respectively if necessary to get a win-win result.
In general, Company A seeks more than two competing suppliers for providing materials because of two reasons: the production is in great demand and the complementarity of the suppliers. The first guideline of company A is to develop long-term partnerships, which entails greater bargaining power for company A.

The clients of the Taiwan IPC of Company B are business units and factories of the Taiwan subsidiary. Taiwan IPC is responsible for purchasing raw materials and components needed by the clients. Hence the IPC serves such clients as overseas factories, third factories or headquarter. All clients follow production projects made by either by headquarter or internal organizations, and place orders to the IPC for raw materials and components, hence in time delivery is the first demand to meet. The IPC plays a role of bridge between clients and suppliers by keeping a close eye on deadline of delivery to prevent clients from losses due to delayed delivery and satisfying clients' needs.

In addition to developing good supplier relationship, the Taiwan IPC holds campaigns such as procurement forum and jogging contest etc, though which the IPC can maintain interactions with suppliers. The IPC takes face-to -face communication strategy to work out problems with the suppliers if any problems related to procurement are needed to be solved. If some suppliers cannot meet the technical requirements of the IPC, the IPC would seek for headquarter's assistance in sending engineers to help the suppliers improve their techniques.

Half of the products Company C made are for private brands, the other half are for OEM. Among the OEM products, half of them are produced for automobile manufacturers and half are for stereo manufacturers. One of their customers is SONY. It is one of it headquarters' strategies is to maintain a good relationship with their customers. Instead of making

amplifiers only, the headquarters also produces other products such as televisions, and other firms – actually their customers – cooperate with them by providing technical support.

As a matter of fact, their customers provide necessary manufacturing technology for them or work as their OEM plants. In other words, they act as suppliers and OEM plants at the same time. With this kind of cooperation, Company C and its headquarters can decrease their R&D expenses while at the same time making products of high quality and low manufacturing cost.

For the strategy alliance, Company D would discuss the future production plan with the suppliers to make the most appropriate plan in delivery, and the delivery dates are different for different products. The model of collaboration commerce is used, and monthly reviews as well as evaluating suppliers will maintain the competitiveness of the company. In order to ensure smooth operations, Company D shares its predicted production level with its suppliers. This will help suppliers to deliver their goods on time. Company D will hold meetings with their suppliers each month and discuss cooperation patterns such as collaboration commerce.

Since Company D correctly sets its strategy with its suppliers, its revenue doubles almost every two years. Concerning the supply chain management strategy, Company D sets different production plans to meet each customer's needs. In Company D's manufacturing plant, there are specific production lines for each of the important customers, and special manufacturing processes to meet each customer's product requirements. Company D believes that this it is a good way to enhance its competitiveness and to win more customers.

CONCLUSION

Table 2 is a brief based on the interviews. Comparisons of the four international companies are shown and narrated. The four companies are global manufacturers; therefore their supply chains are highly complex and need diverse materials. They all stress supplier relationship management, an indispensible practice in stabilizing immense production operation system, in their implementation strategies of supply chain. As the table shows, both A and B have more explicit implementation strategies and the headquarters tend to adopt centralized global purchase modes. However, C and D are China subsidiaries responsible for manufacturing, so they tend to purchase locally. The different operational modes among the companies influence SCM and information system applicability.

Regarding the selection of suppliers, company A, B and C emphasize more in internal operations, recognizing that excellent management and fundamental capabilities ensures excellent quality.

Cost is a second consideration. Moreover, different companies, even of the same industry, select suppliers on different criterion. For example, as electronics manufacturers, C ,as a branded company, emphasizes quality, however D, as a ODM, value cost-advantages suppliers provide.

Company A is intended to assess suppliers on rigid criterion. Company A spends less time in filed assessment, but it rewards well-performed suppliers. Company B takes the opposite approach to company A by adopting flexible criterion of assessment, visiting suppliers regularly, and assistant in improving suppliers' performance. Company C focuses on quality control by taking on monthly quality inspections, rewarding the excellently performed suppliers and counseling the poorly performed. Company D, an ODM, imposes strict regulations on price and on time delivery by means or purchase orders , but stresses less on level of quality. In addressing poorly-performed suppliers, Company B and C takes on counseling approach, while A and D are intended to take the tougher approach by imposing regulated sanctions, mostly purchase orders adjustment, and demanding deadlined improvement.

In the utilization of information system, both A and B have adopted SAP systems, while company C has used the Oracle-based ERP system. The ERP systems from SAP and Oracle are highly sophisticated and globally leading systems. Company D has adopted Taiwan's TIP-POINT MRP system, which is designed for managing material resource. Considerations on the adoption of an information system include not only functionality, but firm size, global strategic layout, internal institutionalization, and operational standardization. If a company fails to consider the entire criterion above, it is likely to have a ERP that can only exert its limited functionality. Company C's inadequate considerations has made it utilize only 20% of the functions of an Oracle system. Moreover, if an ERP system fails to share information with clients and suppliers, it will fail to provide great benefits on SCM. Successful SCM practice requires more than adoption of an sophisticated system, it requires comprehensive examinations of such factors as counseling suppliers, externally connected software and interfaces and data transformation capability. Furthermore, different businesse emphasizes different dimensions and gain different benefits from information systems. Company A emphasizes internal/external connection, thus its system allows only the counseled suppliers access. While the other three companies emphasize inventory management, inventory performance improvement and easiness- to-operate, they contrive their systems on various human factors.

Finally, supplier partnership management is the top SCM issue in these four companies. They counsel, assist and support the suppliers that they think deserve, as well as develop long term strategic alliance with important suppliers. Furthermore, All the companies have their information systems effectively connected with both customers and suppliers for refined and

fluent SCM, expect for company D, which has a internally-oriented, less sophisticated information system.

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Table 2. A comparison of the four international companies

	Company A	Company B	Company C	Company D
Background	● Taiwan Subsidiary of U.S.-based International company of. IC Industry ● Leader of global packaging test industry	● Taiwan Subsidiary of Korea-based International company of. IC Industry ● Leader in Korean electronics industry	● China Subsidiary of Japan-based International electronics maker ● With private brands ● ODM	● China subsidiary of Taiwan-based electronics manufacturer No private brands ● ODM
SCM implementation strategies	● WPL integrated strategy ● Global Centralized purchase ● Supplier relationship management ● ISO and TS16949 systems	● 3S strategy ● Global Centralized purchase ● Supplier relationship management	● ISO and TS16949 systems ● Local purchase	● ISO and QS9000 systems ● Local purchase
Selection of suppliers	● Quality management ● cost ● technology	● structure, finance, international accreditations ● cost ● delivery performance /quality	● Quality & Capacity first ● Cost ● Delivery	● Cost first ● Delivery ● Quality ● Sony：Green Partner list
Assessment	● Semi yearly visit ● ETRAQ norm ● Reward ● Regulated sanctions	● Seasonal visit ● Counseling the poorly-performed	● Monthly quality inspection ● Worst ten and best ten" method ● Counseling the poorly-performed	● Annually ● Real time appraisal ● Deadlined improvement demand
Categories of IT	● SAP	● SAP	● Oracle-based ERP	● TIP-TOP system
IT Performance	● Internal/externalconnections ● Transfunctional connections	● Shorter process time ● systematic ● Quick response to demands	● Reducing inventory ● Shortening lead time ● Linking headquarter on time	● Material controlling ● Linking headquarter on time
Benefits of IS integration	● Connection with headquarter ● MRP information sharing	● Connection with headquarter ● Shorter lead time	● Efficient data-based control ● Decreasing in lead time	● Materials controlling ● On time controlling
Limits of integrating IS across SC	● Counseling suppliers and customers is a must	● Man-made errors are undetectable ● High costs	● High cost ● Language transformation	● Database transformation ● System language
Supplier partnership management	● Sharing information ● Collaboration ● Joint planning/forecasting ● Supporting suppliers ● Long term partnership	● On-time delivery ● Suppliers activities ● Counseling Staffs	● Technology exchange ● Reducing cost by coordination	● Collaboration forecasting ● Producing strategy share

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MANAGERS DEVELOPMENET AND EDUCATION IN CULTURE CONTEXT

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ABSTRACT

The purpose of the paper is to present the national organisational culture of Polish businesses and to indicate how this knowledge can be used for management education and development. The article attempts to present the diagnosis of Polish organisational culture in the context of impact on managers development. The uniqueness of this approach is due to the multidimensional analysis of Polish organisational culture - existing, preferred and perceived by foreign respondents.

The paper will examine the context of management development in Poland and shows some of the ways in which cultural, economical and political environment has shaped the process.

The diagnose of managerial competencies and the modern approach to managerial development will be presented as the result of the research run by scientists in Polish companies. The main research undertaken by the author contains the following issues: aims, process, determination of training needs, responsibilities, methods and techniques of delivery identified in the Polish. The picture of the diagnose of management education and development in Poland will be discussed in a broader context emphasizing the role of organizational culture.

Keywords: Polish organisational culture, managers development

INTRODUCTION

Poland is undergoing dynamic environmental changes, such as becoming a European Union Member State and globalisation. What this means for Polish managers is that they have to learn faster than their western colleagues to cope with the complexity of this situation. The purpose of this paper is to present some issues concerning cultural impact on managers development and education with discussing their implications.

Hence, it is worth trying to answer the question concerning the process of managerial development in Poland and the recommendations related to its improvement. The market driven economy and increasing competition has challenged traditional governmental assumptions about the purpose, content and delivery of management development. The age of globalization and the economy based on knowledge makes managers face an increasing number of expectations. They 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.

There are various evidences presenting the research results with even more general conclusions concerning Central and Eastern European countries. Mangers development research based on the 1000 companies identify the following phenomena (Mabey and Finch – Lees, 2008: 5):

- the existence of a passive, even negative, attitude towards change, culturally embedded from a long experience of living in a static environment – this is limiting the managerial capabilities desperately needed to conceive, develop and implement appropriate strategic responses.
- The human resources function is preliminarily focused on staffing activities while neglecting those dealing with human resources development and management development.
- According to general managers, the greatest capabilities are concentrated at the highest level of management. This reflect an attitude that the hierarchy, power distance remains the key factor or that mangers are assessed acc0ording to their experience rather than against criteria of innovative behaviour, social and cultural competencies,.
- Managers have difficulty articulating their training needs and tend to follow what's on offer from training providers, who market their current product/service portfolio rather than investigate what their customers' needs really are.

Analyzing the problem it is worth trying to answer the question concerning the process of manager's competences development in Poland and the recommendations related to its improvement in culture context.

One of the key themes underlying the analysis of the issues discussed in this paper is cultural difference. There have been some attempts to separate cultural differences from other environmental differences in research (Saha, 1993; Easterby-Smith et al, 1995) but their overlap in most models for cross-cultural comparisons remains problematic. Hofstede (1996) states that systems and culture are part of the same circle; this would imply that there is no need to separate local environment from culture. However, this assumes that political and economic structures and systems in a country arise from a consensus - then these could be seen to represent an articulate part of national culture. Wilkinson (1996) warns against such 'structuralist' views on the grounds that it is rarely the views of the majority which have the necessary power to build systems. In order to understand culture it is, therefore, useful to separate environmental issues from cultural issues, or as Jankowicz (1995) puts it: the past 50 years from the past 500.

As culture represents or expresses values, behaviours and attitudes, it is important to understand cultural differences in order to understand which management methods will work. Since the requirements of European Union Membership and globalisation demand from Poland to move through transition and more companies become responsible to their stakeholders it will be necessary to make management effective in economic rather than political terms. Understanding the national culture of both management and the workforce will be needed in order to make this change sucessful.

ORGANISATIONAL CULTURE CONCEPTS

There are many manifestations of cultural differences. These are evident in national and regional differences in style, taste, family relations, government structures etc. There is also evidence of differences in working methods and business organisation from one country to

another: German co-determination, Japanese management methods etc. The following are a few examples of definitions and methods used to compare cultures.

According to Trompenaars (1993), "Every culture distinguishes itself from others by the specific solutions it chooses to certain problems" (p. 8). His system of comparing cultures centres around three categories: relationships with people, attitudes to time and attitudes to the environment. Relationships among people are then broken down into five orientations: universalism versus particularism; individualism versus collectivism; neutral or emotional; specific versus diffuse; achievement versus ascription. By considering the solutions to 'certain problems' Trompenaar seemingly overcomes the need to demonstrate the universality of his selected orientations or values. The orientations combine behaviour and attitudes: neutral/emotional refers to the way in which people communicate (behaviour) and the way in which people feel others should behave (attitude). Trompenaar's explanation for these differences is based primarily on pre-modern belief systems.

Hofstede (1991) defines culture as the software of the mind, that is the underlying values and assumptions which are shared by an identifiable group of people. Hofstede's method of analysing culture was derived from a survey of work values conducted at IBM between 1968 and 1973. The four dimensions concerned attitudes to authority, group membership, risk and competition versus co-operation. Later work led by Bond at the Chinese University of Hong Kong added a fifth dimension: Confucian dynamism (Bond et al, 1987). The basis of this model is that the dimensions can be measured and compared. The dimensions represent a system of values which are related to behaviour, management practices and methods of organising systems. Schein (1992) disagrees with these methods - he replaces values with 'basic assumptions' which are both taken for granted and non-negotiable (p16). Schein does not agree that cultural assumptions (or values) can be broken down and measured by a survey method.

Culture then is described as something - orientations (Trompenaars, 1993), values (Hofstede, 1980) or assumptions (Schein, 1992) - which is shared by a group of people. There are different groups which can be considered, such as national groups, occupational groups, industry groups and firms. This gives rise to different 'cultures' - that is national business culture, occupational culture and corporate culture. It is clear that people from different cultures do some things differently, for example, they may speak differently and/or treat one another differently. From the models described, it emerges that different management methods would prevail in different cultures.

Hostede's dimensions are probably the best known and most frequently used but Hofstede himself criticises many of the applications of his questionnaire. The model has a certain elegance - four or five dimensions which can be compared along straight line continuums, some of which have been shown to be related to preferences for different organisational systems as well as to economic development. However, the questionnaire is not designed for 'one-off' measures in a given country. Trompenaar's model is not as elegant as that of Hofstede's. Yet, the focus of this model is on different relationships which may be most important in understanding the transferability of different organisational structures and management methods. It was developed and applied to analyse the seven cultures of capitalism (Hampden- Turner, Trompenaars, 1998).

DESIGN AND METHODOLOGY

Following a review of literature, a research model of the national organisational culture was developed, based on 7 basic assumption categories and 18 sets of values.
The model was developed using the concepts of Kluckholn and Stodtbeck (1961), Schein (1992), Hofstede (1980, 1991), Trompenaars (1993), Hampden Turner and Trompenaars (1998), Adler (2001), Laurent (1983), Hall (1960), Hall and Hall (1991), Lewis (2000), Schneider and Barsoux (1999) and others. The author identified 7 basic assumptions and 18 values important for culture diagnosis:

- relation with the environment (uncertainty avoidance, external or internal control),
- human nature (basically good or evil, fixed or changeable),
- nature of human activity (active or passive, achievement or ascription),
- nature of truth and reality (truth in facts or in feelings, reality is material or spiritual, deduction or induction),
- human relations (task orientation or relationship, individualism or collectivism, power distance, masculinity or femininity, universalism or particularism),
- nature of time (mono or polichronic, short term or long term orientation),
- language (low or high context, neutral or emotional).

Process approach to managerial competencies development makes it possible to identify the stages concerning the development of managerial staff and their mutual relationships. The model involves four elements: goals, planning, implementation and evaluation (Sitko – Lutek, 2004)
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 competences declared by the managerial staff was evaluated, as well as the elements requiring further development 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.

The third element of the development model is implementation and it refers to specific aspects, such as forms and methods, both carried out and preferred within the development 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 managerial development, namely the organizational culture context

The survey was conducted (Sitko – Lutek, 2004) with the respect and impartiality accorded to academics, which in Poland may have increased the response rate (78%) and value of responses. The research used the questionnaire which was developed and tested in Poland. The purpose of the questionnaire was to determine the difference between current practice and managerial preferences in order to identify areas of conflict. Therefore all the questions asked for two responses: one to measure the current systems existing within the respondents' firms and the other one to measure the respondents' preferences. The questionnaire contains 44 questions diagnosing culture dimensions and 40 disgnosing managerial competency development. Each question was composed of two statements and the respondents were asked to select the one which was the most similar to the situation in their firm, and then the one which best described their preferred situation. Questions were asked on all of the dimensions in the model as well as an overall question concerning the meaning of business organisations. All the questions were based on making a choice between two statements (representing the two sides of each dimension).

Methodology of calculations:

1. The analysis of the interdependence of the categorised features was carried out by means of independent test χ^2 . It was displayed as: numerical distribution tables; test functional value $\chi^{2,}$ degrees of freedom for test function, probabilities for test functions used to compare with significance levels. In the methodology of calculations also different coefficients were provided , among others Cramer's V and Pearson contingency coefficient.
2. In order to analyze differences in the evaluation of situations depending on the respondents' preferences U test for fractions was applied.
3. In order to carry out statistical calculations the programme Statgraphics Plus v.5.1. was used.

The research model was subsequently used to diagnose the existing organisational culture, cultural preferences and perception of the Polish organisational culture by foreign respondents from Great Britain, Germany and the Ukraine. The objective of the foreign research was to objectivise beliefs regarding the organisational culture. A cultural gap was also defined, that is the difference between the preferred and existing culture. Next, organisational culture development avenues were pointed out. The author relied on an assumption that differences in existing patterns of values are determined by situational factors, and cultural preferences are universal in a given country. There are also differences between the evaluation of one's own culture and its perception by foreign respondents. This means that the perception of a culture may be conditioned by the existing culture.

The questionnaire has been used as the research method, to collect information on the organisations and respondents examined, and to diagnose the organisational culture.
The research sample was drawn specifically for the project, and the project covered organisations representing various industries: from traditional ones, such as extraction, railways and municipal utilities, to construction companies, and to those organisations which are most affected by market processes, such as banks, telecoms, or the medium-sized rapidly growing enterprises. Following pilot research and revision of the research vehicle, research proper was conducted on a sample of 30 enterprises, covering in total 750 managers of various levels and 443 respondents from three countries: 146 from Great Britain, 130 from Germany and 167 from the Ukraine.

FINDINGS AND DISCUSSION

Organizational culture diagnose

The research results on *organizational culture diagnose* are presented in table 1.

Table 1. Polish existing and prefered culture and its British, German and Ukrainian perception (%).

Dimensions	Existing	Preferred	British perception	German Perception	Ukrainian Perception
Uncertainty avoidance	High 71,46	High 76,36	High 73,97	Low 67,16	High 63,66
Locus of control	Internal 67,27	Internal 85,27	External 54,11	Internal 76,12	Internal 62,5
Good- evil human nature	Good 81,99	Good 95,49	Good 76,71	Good 83,58	Good 78,43
Fixed- changeable human nature	Changeable 82,85	Changeable 84,63	Changeable 80,56	Changeable 91,04	Changeable 58,06
Active – passive nature	**Passive 52,88**	**Active 68,01**	Passive 74,43	Passive 56,22	Active 50,39
Achievement – ascription	**Ascription 50,62**	**Achievement 92,78**	Ascription 93,15	Ascription 91,04	Achievement 72,90
Truth in facts – in feelings	Facts 84,17	Facts 92,24	Facts 87,67	Facts 65,15	Facts 75,82
Reality is material – spiritual	Material 94,15	Material 87,10	Spiritual 53,42	Material 86,57	Material 72,73
Experience – theory	Experience 80,25	Experience 87,31	Experience 75,9	Experience 89,55	Experience 70,32
Task orientation – relationships	**Task 59,53**	**Relation 51,67**	Relationships 54,42	Task orientation 70,15	Task orientation 62,96
Individualism – collectivism	Ccollectivism 57,16	Collectivism 71,04	Individualism 53,42	Individualism 62,39	Individualism 58,02
Power distance	**High 56,54**	**Low 65,3**	High 67,95	High 76,42	Low 51,78
Masculinity – femininity	**Masculinity 56,66**	**Femininity 54,5**	Masculinity 61,64	Masculinity 64,18	Masculinity 52,33
Universalism – particularism	Universalism 60,64	Universalism 69,95	Universalism 82,19	Universalism 51,49	Universalism 56,69
Monochronic – polychronic	**Poly 57,56**	**Mono 64,42**	Poly 53,08	Poly 64,55	Poly 51,45
Short – long term orientation	Long term	Long term	Long term	Long term	Long term
Low-high context	**High context 53,08**	**Low context 75,97**	High context 63,01	High context 78,36	High context 67,15
Neutral- emotional	Neutral 66,44	Neutral 70,71	Neutral 57,53	Neutral 52,24	Neutral 67,74

Source: Sitko, Lutek, 2004, p.170

The results indicate differences between the existing systems and managerial preferences:

- passive instead of active attitude;
- evaluation based on ascription rather than achievement;
- people instead of task orientation;
- femininity instead of masculinity;
- high instead of low power distance;
- polychronic instead of monochronic temporal attitude;
- high instead of low communication context.

Given the diagnosis of Polish organisational culture, it would be interesting to say to what degree the culture meets the European management model presented, featuring the ability to manage national diversity, social responsibility, internal negotiations, people focus, or reduced formalism of management systems. Among the standards and values identified in the Polish culture, hindrances to integration with the European culture may include: highly distanced authority, weaker task focus than people focus, or high avoidance of uncertainty, and the passive nature of the people in the organisation. Cultural preferences of respondent managers are to a significant degree in line with the values of the European culture and can represent a change indicator. One should note the special significance of the need to develop such values as personal commitment at all levels of the organisation, continuous development, building relations of trust which generate the social capital of modern organisations.

The perception of Polish organisational culture as evaluated by foreigners to a great extent confirms the existing cultural values. Yet, in all the three countries Polish organisational culture is seen as individualistic, while the diagnosis indicates collectivism. This may result from a certain historical stereotype of a Pole or from European cultural models. The opinion of the British, however, is indicative of a spiritual, religious model of Polish culture, which manifests itself, among others, in the perception of reality as spiritual, people focus and (zewnatrzsterownosc) . The Ukrainian respondents, who had similar experiences from the period of centralised economy, see Polish organisations as more advanced in the field of the values supporting the management of market enterprises, such as the status stemming from individual achievements not from (nadanie), the active nature of human actions or a smaller distance shown by the authorities. The Germans assess our organisations as characterised by low uncertainty avoidance, which means that they perceive our economy as entrepreneurial and open to change.

Out of the recommended directions of modelling organisational culture which result from the culture gap, the preferences of the managers surveyed , the following changes can be suggested:

- the departure from a traditional bureaucratic culture based on hierarchy and formal authority, in which the employees were expected to passively carry out orders and there was a large distance on the part of the authority, and which lacked open-mindedness as well as participation in the life of the organisation

- the democratisation of organisational values, which manifest themselves in the promotion of a greater significance of the human potential by means of the appreciation of people focus and feminity models, as well as fostering organisational trust conducive to generating social capital
- the transition from a passive attitude in human actions to an active one and, in consequence, encouraging employee initiative
- a change in the criteria of status evaluation from (nadanie) to individual achievements
- a monochromic instead of polychronic temporal attitude, which is connected with a necessity of better organization of managers' work as well as that of the personnel they are in charge of
- diminishing the communication context from high to low.

The results of the research also indicate similarities between Polish preferences and what is accepted as best practices.

Managers competency development

The diagnose of *managers education and development* shows the following conclusions:

1. The model of developing managerial competences 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, incidental, 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 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 development

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 system solutions in the organizations, concerning development* 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. 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 systemic 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 development are concentrated on the top level of the board of managers. Another significant aspect while appraising the role of direct 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 (Sitko – Lutek, 2004) reveal *a significantly varied attitude to developing managerial competences*. 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. Out of the recommended directions of modelling organisational culture which result from the culture gap, the preferences of the managers and the need for managerial competences development, the following changes can be suggested:

- the departure from a traditional bureaucratic culture based on hierarchy and formal authority, in which the employees were expected to passively carry out orders and there was a large distance on the part of the authority, and which lacked open-mindedness as well as participation in the life of the organisation
- the democratisation of organisational values, which manifest themselves in the promotion of a greater significance of the human potential by means of the appreciation of people focus and feminity models, as well as fostering organisational trust conducive to generating social capital
- the transition from a passive attitude in human actions to an active one and, in consequence, encouraging employee initiative
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- diminishing the communication context from high to low.

Organizational culture and managers development impact

Within cultural constraints of managers development the following interrelationships can be determined:

- While assessing the existing situation and their preferences, the respondents declare a will to experience some cultural change from its being task-oriented towards people-

oriented, which is related to their preferences concerning development leading to setting tasks oriented towards relations rather than competences. Another expectation regarding development and resulting from this cultural dimension concerns a transition from a teacher-oriented approach to a more central role of the trainee. To sum up, creating the culture of people's values means improving relationships, trust, mutual cooperation in the organization and increasing individual responsibility for managers' learning processes.

- The big distance of authority results in the fact that in the activities related to the area of development the teacher is taking the central position, so the trainer decides about the processes and their direction. The preferences declaring diminishing the distance of authority result from those concerning higher managerial independence and a better preparation to play their role due to being oriented to managerial purposes rather than the narrow functional ones.
- The cultural dimension of avoiding uncertainty means an approach to development understood as creating such conditions for learning which should minimize uncertainty, e.g. structuring development or the central role of the trainer, creating the environment for safe and stable learning. Regarding the preferences, it is worth noting that the respondents wish to work in the culture of avoiding uncertainty and acquiring improvement in a structured form. So there is no expectation regarding lowering the level of avoiding uncertainty, but rather suggestions referring to undertaking some actions which would limit protecting oneself from uncertainty.
- Cultural internal locus of control affects the central role of the trainee, whereas external locus of control influences their key role, which may mean that taking up independently the responsibility for one's own career in the organization will also lead to being active in the area of individual development.
- The cultural dimension of the passive nature of human activities is correlated with the central role of the trainer and the theoretical approach to learning within the area of managerial improvement, which may result from preferring such forms and methods of development that would require one's passive participation rather than active involvement. Regarding the preferences, the expectation to be offered an active cultural model is connected to intuitive learning styles as opposed to analytical ones.
- Cultural relationship was also pointed out both while analyzing the existing situation and the preferences regarding the bases for estimating reality and the truth based on facts rather than on emotions and correlated to the analytical style of learning.

The correlations of the values belonging to the Cognitive Styles Index with the cultural value of the criterion of assessing reality on the basis of facts as opposed to intuition (expressed both in reference to the existing situation and preferences) may suggest a very analytical attitude of the managers who concentrate on details, with a lower orientation towards taking advantage of opportunities due to intuitive assessment, which is characteristic of leaders. Among the studied managerial staff the most analytical learning styles were characteristic of the representatives of traditional branches. This means that they represent the profile of expert managers who concentrate on technical knowledge and emphasize the role of specialist skills rather than being leaders or creators of changes who would like to initiate new actions. This tendency may also support the relationship between intuitive learning styles and the active attitude to reality in reference to cultural preferences and learning. The group of studied managers representing a more intuitive approach is thus also more pro-active and expects similar behavior of their

employees. Hence a conclusion that on the one hand more actions are needed leading to a more intuitive learning style and to creating an active approach to the nature of human activities on the other.

- There is also a relationship between the attitude to poly- or monochromic time and structured or unstructured forms of development, concerning both the existing and preferred situations. The direction of this relationship means that the adherents of the monochromic approach more easily accept structured situations, whereas the supporters of the polychronic attitude prefer unstructured ones.
- The cultural orientation to a long period of time is related to choosing such methods that would require individual work after classes. This can be explained by the fact that development should be treated as a continuous process rather than a one-time event which is over after the training has been completed. Unfortunately, studies reveal that practical training activities of organizations are dominated by methods which do not require any individual work after classes, though the managerial staff do realize the meaning of continuing the learning process, which they expressed while assessing their preferred methods of development.

Summing up the discussion on the cultural constraints of managerial development, the analyzed interrelationships may be regarded as statistically significant differences among the selected dimensions of the existing national corporate culture with the selected aspects of planning and implementing the development and the relationships referring to cultural preferences and the chosen aspects of aims, planning and development implementation.

FINAL CONCLUSIONS

In Poland, the incredible amount of change in the macro-environment as well as in firms themselves means that managers are looking for new methods and new skills. The eagerness to import models from The West should be tempered by two different types of problems:

- misunderstanding or ignoring the importance of both the environmental differences resulting from the political differences of the past 50 years and from cultural differences;
- a lack of a critical evaluation of the Western systems and their future application.

The first of these two areas combines the environemntal and cultural differences between Poland and the developed countries from which numerous management theories are imported. The second area concerns the global environment and what is needed to be competitive in the future.

Polish firms need to be dynamic and flexible to cope with the transition and this must be reflected in their business culture. The existence of differences for effective management makes it difficult or even impossible for management development to be prescriptive. The value of any model or theory will lie in its application to the specific case. What is possible in each firm and industry, let alone what is effective, will be different, therefore, a prescriptive method will lead to disillusionment with the management development process as academic and irrelevant rather than useful.

Two further concerns must be added in the area of environmental differences. The first is the difference between various systems within the West; the second is the idealistic and inapplicable nature of much of management theory.

First, it is clear that different competitive environments and business environments exist throughout Western Europe. Hofstede (1996) compares the 'root' of management theories in different countries. In the USA it is the market, in France it is systems etc. Recent research by Calori, Steele and Yoneyama (1995) analysed interviews with managers throughout Western Europe and found that there were distinct differences separating European management from both Japanese and American practices. They also found that there were separate schools of management within Europe which started with categories of Anglo, Germanic and Latin and eventually separated into different groups by country. If there is no such thing as 'western' or capitalist best practice then the application of foreign management theories in Poland needs to be evaluated carefully.

The second concern is very important to a target group which is sometimes idealistic. Just as Polish consumers discovered very quickly that many Western brands offered the same quality for a much higher price, Polish manager may find that western theories are often unworkable in their 'textbook' form. Much of Western literature is written from a prescriptive view: what should happen rather than what does happen. While many theorists prescribe democratic and people-oriented management styles, management researchers often find that the opposite is the most effective. One example is Dunphy and Stace's (1993) finding in Australia that a directorial management style was most successful for change management. Another example is Kotter's (1979) finding that political rather than conceptual skills (from Katz, 1955) are most important as managers rise in the hierarchy. Much of the theory has been developed around normative views of how the market should work and is continually replaced because it cannot be validated through research. Polish managers and educators must be aware of the limitations of the material imported. Taking it at face value is likely to lead to disappointment, while evaluating it as new ideas to be tested and altered to fit the situation may lead to greater value.

The research and theory on cross-cultural comparisons is then limited to the acknowledgement that cultural differences exist. The models which have been created to evaluate the transferability or application of theory to a different culture can identify some areas in which problems may be expected but they cannot prescribe methods or techniques to be used in another culture. More intensive research which investigates how managers behave and what leads to effective management in different cultures may lead to working out more useful models. At the moment any cross-cultural application must be made with great care.

What are the implications of the changing global economy for Polish economic and management development? Perhaps, following western, confrontational, models is to follow the west into second place and miss the chance to follow those who will lead in a few decades time. Taking a wider view of management methods and economic organisation will assist the adoption of 'best practice'. Evaluating not only the cultural application but also the future value of models and methods is thus necessary.

Polish firms need to be dynamic and flexible to cope with the crisis and competition and this must be reflected in their business culture. The existence of differences for effective management makes it difficult or even impossible for management development to be prescriptive. The value of any model or theory will lie in its application to the specific case. What is possible in each firm and industry, let alone what is effective, will be different, therefore, a prescriptive method will lead to disillusionment with the management development process as academic and irrelevant rather than useful.

What are the implications of the changing global economy for Polish managerial competences development? Perhaps, following western, confrontational, models, best practices is to follow the west into second place and miss the chance to follow those who will lead in a few decades time. Taking a wider view of management methods and economic organisation will assist the adoption of 'best practice'. Evaluating not only the cultural application but also the future value of models and methods of competences development is thus necessary.

Summing up, there are also positive tendencies which 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

One of the weaknesses of the research may be that a limitation of the dimensions being applied. Two dimensions may not cover all the complexity of cultural differences and they do not seem to cover the additional complexity of environmental differences. However, the findings also provide valuable information regarding potential problem areas for the application of foreign management development methods and models.

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ROBUST SOLUTION FOR CORRELATED MULTIRESPONSE EXPERIMENTAL DESIGN

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ABSTRACT

For experimental design with multiple responses using response surface modeling, most research focuses on finding an optimal solution based on certain objective function but neglects how robust the solution is when input variables changes around the set values. In practice, robustness is more important than optimality to keep process outputs in control. The paper proposes a solution which considers both the optimality and the robustness. The procedure of the method and its validity is illustrated through an example.

Keywords: response surface modeling, multiresponse, robustness, desirability function

1. INTRODUCTION

Typically in the analysis of industrial data for product/process optimization, it is common to observe several responses and optimize these responses simultaneously. In some industrial enterprises, such as semiconductor manufacturing, 12 to 15 response variables are not unusual (Myer, et al., 2004). The objective of experimental design is to find optimal settings of input variables to yield optimal process out puts. When there are several responses in experimental design, the problem is often called the multiresponse experimental design problem which becomes more complicated with the increase of responses and factors. One of the objectives in multiresponse analysis is the determination of a set of input variables for optimizing several responses simultaneously, which is called multiresponse optimization.

Response surface methodology (RSM) is an important tool for optimization by using design of experiments in modern quality engineering. Box and Wilson(1951) first introduced the concept of RSM. Also see recent publications such as Khuri and Cornell (1996), Park (1996), Myers (1999), Myers and Montgomery (2002), Myers, Montgomery and Vining et al. (2004). As mentioned by Carlyle, Montgomery and Runger (2000), much of RSM was focused on finding optimal operating condition for the process variables which resulted in a maximum or minimum response.

There have been many different approaches provided in the literatures for the multiresponse optimization problems. A straightforward approach for optimizing multiple responses is to overlay contour plots for the responses. Lind, Goldin, and Hickman (1960) illustrated this approach. However, the graphical approach is limited to two or perhaps three dimensions. Khuri and Conlon (1981) proposed a generalized distance function approach that computes the generalized distance of the estimated responses to their respective optimum values.

Taguchi (1986), Pignatiello (1993), Vining (1998), and Ko, Kim, and Jun(2005) proposed several methods using the loss function approach in their literatures. Another useful approach to optimize multiple responses is desirability function approach proposed by Derringer and Suich (1980). Derringer (1994), Park and Park (1997)introduced some weighted desirability functions which take into account the property weights. Kim and Lin (2000) introduced a "maximin" approach of desirability function which is robust to the dependences between responses. The desirability function approach is simple, and easy to apply.

Compared with most of the recent works in multiresponse analysis only focusing on the optimization issue, little research has been done on how robust the optimum solution is. It is worth emphasizing that robustness is also an important concept in industrial optimization. Robustness means that the responses are insensitive to the fluctuations of the input variables (He, et al., 2009). The results are considered robust solutions if the responses are not affected much by small changes in the input variables.

In this paper, we consider the robustness issue when dealing with multiresponse optimization problem and present a robustness desirability function to solve the multiresponse robust optimization problems. Moreover, the "maximin" approach proposed by Kim and Lin(2000) is employed when the assumption of independence is violated. The next section provides a brief review of the recent works in multiresponse optimization. Then a robustness desirability function approach is given, and the "maximin" approach is used to achieve a better balance between all the responses. Finally an example is used for illustration of the proposed method.

2. LITERATURE REVIEW

There have been many creative approaches in statistics literature for multiresponse optimization problems, including desirability function approach, generalized distance function approach, and quality loss function approach.

Suppose each of the m responses is related to the k independent input variables by

$$y = f(x_1, x_2, \cdots, x_k) + \varepsilon$$

where f denotes the relationship between the response y and the input variables $\{x_1, x_2, \ldots, x_k\}$, and ε is a statistical error, having a normal distribution with mean zero and variance σ^2. Because the form of true response model f is unknown and perhaps very complicated, the following second-order model is usually appropriate,

$$y = \beta_0 + \sum_{i=1}^{k} \beta_i x_i + \sum_{i=1}^{k} \beta_{ii} x_i^2 + \sum_{i<j}^{k} \beta_{ij} x_i x_j + \varepsilon$$

The fitted second-order response surface model can be obtained by using the least squares method:

$$\hat{y} = \hat{\beta}_0 + \sum_{i=1}^{k} \hat{\beta}_i x_i + \sum_{i=1}^{k} \hat{\beta}_{ii} x_i^2 + \sum_{i<j}^{k} \hat{\beta}_{ij} x_i x_j$$

The next three subsections briefly review the three most popular approaches for multiresponse optimization respectively.

2.1 Desirability function approach

The desirability function approach is to first convert each response y_i to an individual desirability function d_i, where $0 \le d_i \le 1$. If the response y_i is at its goal or target, then $d_i = 1$, and if the response is outside an acceptable region, $d_i = 0$. The value of d_i increases as the desirability of corresponding response increases. Then the design variables are chosen to maximize the overall desirability

$$D = \left(d_1 d_2 \cdots d_m\right)^{1/m}$$

where there are m responses.

The correlations of responses are not considered in this approach, which may alter the structure of the overall desirability function and mislead the optimum operating conditions. Kim and Lin (2000) and Jeong and Kim(2003) introduced a "maximin" approach of desirability function which can be stated as $Max(\min(d_1(X),\ldots,d_m(X)))$. This "maximin" approach is robust to the potential dependencies among responses.

2.2 Generalized distance function approach

Khuri and Conlon (1981) proposed a method based on a generalized distance function, which computes the overall distance of the response functions to their respective optimum values. The generalized distance function in the m-dimensional Euclidean space is

$$\rho[\hat{\mathbf{y}}(\mathbf{x}),\boldsymbol{\theta}] = [(\hat{\mathbf{y}}(\mathbf{x}) - \boldsymbol{\theta})'\{\mathbf{var}[\hat{\mathbf{y}}(\mathbf{x})]\}^{-1}(\hat{\mathbf{y}}(\mathbf{x}) - \boldsymbol{\theta})]^{1/2}$$

where $\hat{\mathbf{y}}(\mathbf{x})$ is the $m \times 1$ vector of estimated responses at $\mathbf{x}$, $\mathbf{var}[\hat{\mathbf{y}}(\mathbf{x})]$ is the $m \times m$ variance-covariance matrix for $\hat{\mathbf{y}}$ at $\mathbf{x}$, $\boldsymbol{\theta}$ is the $m \times 1$ vector of target values or ideal optimum for the responses.

This method gives a measure of closeness to the target values or ideal optimum. The optimum value of $\mathbf{x}$ can be obtained by minimizing the distance $\hat{\rho}[\hat{\mathbf{y}}(\mathbf{x}),\boldsymbol{\theta}]$ over the experimental region.

2.3 Quality loss function approach

Taguchi(1986)proposed a method named quality loss function to measure a social cost on customer's monetary scale. Pignatiello(1993) extended Taguchi's univariate loss function to a general multiresponse loss function:

$$L(\mathbf{y(x)},\boldsymbol{\theta}) = (\mathbf{y(x)}-\boldsymbol{\theta})^T \mathbf{C}(\mathbf{y(x)}-\boldsymbol{\theta})$$

where $\mathbf{y(x)}$ is a $m\times 1$ vector of responses at $\mathbf{x}$, $\boldsymbol{\theta}$ is the $m\times 1$ vector of target values for the responses, and $\mathbf{C}$ is a $m\times m$ positive definite matrix of cost.

Vining (1998) proposed a new squared error loss approach which its definition of loss function by substituting $\hat{\mathbf{y}}\mathbf{(x)}$ for $\mathbf{y(x)}$,

$$L(\hat{\mathbf{y}}\mathbf{(x)},\boldsymbol{\theta}) = (\hat{\mathbf{y}}\mathbf{(x)}-\boldsymbol{\theta})^T \mathbf{C}(\hat{\mathbf{y}}\mathbf{(x)}-\boldsymbol{\theta})$$

where $\hat{\mathbf{y}}\mathbf{(x)}$ is the $m\times 1$ vector of predicted responses at $\mathbf{x}$.

Ko, Kim, and Jun (2005) proposed a new loss function combining the strengths of Pignatiello's and Vining's methods. Let $\mathbf{y}_{\mathbf{new}}\mathbf{(x)}$ denote the vector of future responses. The new loss function can be defined as

$$L(\mathbf{y}_{\mathbf{new}}\mathbf{(x)},\boldsymbol{\theta}) = (\mathbf{y}_{\mathbf{new}}\mathbf{(x)}-\boldsymbol{\theta})^T \mathbf{C}(\mathbf{y}_{\mathbf{new}}\mathbf{(x)}-\boldsymbol{\theta})$$

The quality loss function approach is distinguished by its consideration of the variance-covariance structure of the responses as well as the process economics.

3. ROBUSTNESS DESIRABILITY FUNCTION

3.1 The measure of robustness

Most of the recent work in the field of multiple response analysis has only focused on the optimization issue, and the robustness of responses is usually ignored. However, in practice input variables are hard to be fixed at one point without fluctuation. The input variables fluctuate in a small region, and it is desirable that the responses do not vary much in this small region of input variables. With the consideration of robustness for multiresponse optimization problems, in this section, a robustness desirability function to measure the robustness for multiple responses is presented.

In this paper, the changes of responses caused by the changes of input variables are used to measure the robustness of a point. If the responses are not affected much by the changes of input variables of this point, the point can be considered as a robust point. Suppose that there are k variables $\{x_1, x_2, \ldots, x_k\}$ and m responses $\{y_1, y_2, \ldots, y_m\}$. To any one point $(C_1, C_2, \cdots, C_k)$ in the feasible region, a small region around this point could be defined to describe the changes of input variables of this point, for the measurement of robustness. The ranges of responses in this defined small region are used to measure the changes of responses caused by the changes of input variables.

In this paper we define a small region around a point $(C_1, C_2, \cdots, C_k)$ to be the spherical region such as

$$\sum_{j=1}^{k} (x_j - C_j)^2 \le r^2$$

where $0 \le r \le \delta$, δ is a positive real number usually smaller than 0.3. If there are two input variables, it will be a circular region with radius *r*. Instead of the spherical region the cuboidal region may be used. In this paper the spherical region is used, since the most outside points in the region are equally spaced from the point of interest $(C_1, C_2, \cdots, C_k)$.

To a selected point $(C_1, C_2, \cdots, C_k)$ in a *k*-dimensional space, the estimated range of each response in the defined small region can be obtained, respectively:

$$R_i = (\max \hat{y}_i) - (\min \hat{y}_i), \quad i = 1,2,\cdots,m \qquad (1)$$

where $(\max \hat{y}_i)$ and $(\min \hat{y}_i)$ are the maximum and minimum estimated values in the defined region for response y_i, respectively. These two values can be obtained by

$$\begin{aligned} &\max(\min)\hat{y}_i \\ &\text{subject to} \\ &\sum_{j=1}^{k}(x_j - C_j)^2 \le r^2 \\ &\mathbf{x} \in X^k \end{aligned}$$

The constraint $\mathbf{x} \in X^k$ means that the solution vector $\mathbf{x}$ should be inside the experimental region X^k. Since the point $(C_1, C_2, \cdots, C_k)$ can be considered as one robust point when the responses are not affected much by the changes of input variables, if R_i is small, the point $(C_1, C_2, \cdots, C_k)$ is robust in the defined region for the response y_i. A robustness desirability function is proposed as follows.

3.2 The robustness desirability function approach

Suppose that L_i is the lower specification limit for the response y_i, U_i is the upper specification limit. We can use the estimated range R_i in the robustness desirability function. The robustness desirability function involves the transformation of each estimated range R_i to a robustness desirability value d_{ri}, where $0 \le d_{ri} \le 1$. If the range R_i equals to 0, then $d_{ri} = 1$; if the range R_i is larger than the value of "U_i-L_i", then $d_{ri} = 0$. The value of d_{ri} increases as the "robustness desirability" of corresponding response increases.

Let d_{ri} be the *i*th individual robustness desirability function. If the target T_i for the response y_i is a maximum value (**larger-the-better**), then

$$d_{ri} = \begin{cases} 0 & R_i \ge T_i - L_i \\ \left(1 - \dfrac{R_i}{T_i - L_i}\right)^s & 0 < R_i < T_i - L_i \\ 1 & R_i = 0 \end{cases} \qquad (2)$$

where *s* is an appropriate positive value for weight.

If the target for the response is a minimum value (**smaller-the-better**),

$$d_{ri} = \begin{cases} 0 & R_i \geq U_i - T_i \\ \left(1 - \dfrac{R_i}{U_i - T_i}\right)^s & 0 < R_i < U_i - T_i \\ 1 & R_i = 0 \end{cases} \qquad (3)$$

If the objective for y_i is to be as close as possible to the target (**nominal-is-best**), the individual robustness desirability function can be defined as,

$$d_{ri} = \begin{cases} 0 & R_i \geq U_i - L_i \\ \left(1 - \dfrac{R_i}{U_i - L_i}\right)^s & 0 < R_i < U_i - L_i \\ 1 & R_i = 0 \end{cases} \qquad (4)$$

When the weight $s = 1$, the robustness desirability function is linear. $s > 1$ means that more importance is placed on robustness, while $0 < s < 1$ means less. The individual robustness desirability function varies depending on different values of *s*.

3.3 The "maximin" robustness desirability

The dependences between responses which can appear in various forms are very difficult to detect in reality. The overall desirability function approach proposed by Derringer and Suich does not consider the correlations of responses, which may alter the structure of the overall desirability function and mislead the optimum operating conditions. In this paper, the "maximin" approach is used in the robustness desirability function approach with the consideration of the potential dependences between responses.

In section 3.2, we have proposed the individual robustness desirability function. With respect to all the responses within the experimental region, the input variables are chosen to maximize the minimum individual robustness desirability.

$$\text{Maximize } D_{robustness} = \min\left[\, d_{r1}\{\hat{y}_1(\mathbf{x})\}, d_{r2}\{\hat{y}_2(\mathbf{x})\}, \ldots, d_{rm}\{\hat{y}_m(\mathbf{x})\} \,\right] \qquad (5)$$

3.4 Overall desirability function

In this paper, the "maximin" approach is also used in the optimization desirability function approach proposed by Kim and Lin(2000) with the consideration of the potential dependences between responses.

$$D_{optimization} = \min\left(d_{o1}, d_{o2}, \cdots, d_{om}\right) \qquad (6)$$

The overall desirability function can be obtained by making appropriate tradeoffs between robustness and optimization for the multiple response problems. The **overall desirability function** can be defined as

$$D_{overall} = \left(D_{optimization}\right)^{w_1} \left(D_{robustness}\right)^{w_2} \qquad (7)$$

where $D_{optimization}$ is the overall optimization desirability, $D_{robustness}$ is the overall robustness desirability function, and w_1 and w_2 are the weights for optimization and robustness respectively, both of them are positive real numbers, and satisfy the equation $w_1 + w_2 = 1$. The robust optimal point can be obtained by maximizing the overall desirability.

4. ILLUSTRATED EXAMPLE

As an illustration, we consider an example from literature. Schmidt et al. (1979) investigated the effects of cysteine (x_1) and calcium chloride (x_2) on the textural and water-holding characteristics of dialyzed whey protein concentrates gel systems. The objective here is to find the robust optimum solution to simultaneously maximize hardness (y_1), cohesiveness (y_2), springiness (y_3), and compressible water (y_4). The design is a central composite design with five center points. The design, in original and coded form, and the multiresponse data are given in Table 1.

Table 1 Central composite design with two variables and four responses

Design (original)		Design (coded)		Responses			
X_1	X_2	x_1	x_2	y_1	y_2	y_3	y_4
8.0	6.5	-1	-1	2.48	0.55	1.95	0.22
34.0	6.5	1	-1	0.91	0.52	1.37	0.67
8.0	25.9	-1	1	0.71	0.67	1.74	0.57
34.0	25.9	1	1	0.41	0.36	1.2	0.69
2.6	16.2	-1.414	0	2.28	0.59	1.75	0.33
39.4	16.2	1.414	0	0.35	0.31	1.13	0.67
21.0	2.5	0	-1.414	2.14	0.54	1.68	0.42
21.0	29.9	0	1.414	0.78	0.51	1.51	0.57
21.0	16.2	0	0	1.5	0.66	1.8	0.44
21.0	16.2	0	0	1.66	0.66	1.79	0.5
21.0	16.2	0	0	1.48	0.66	1.79	0.5
21.0	16.2	0	0	1.41	0.66	1.77	0.43
21.0	16.2	0	0	1.58	0.66	1.73	0.47

The correlations and P-values of the responses are given in Table 2.

Table 2 The correlations and P-values of the responses

		y_1	y_2	y_3
y_2	Pearson correlation	0.507		
	P-value	0.077		
y_3	Pearson correlation	0.792	0.869	
	P-value	0.001	0.000	
y_4	Pearson correlation	-0.932	-0.508	-0.841
	P-value	0.000	0.076	0.000

So this example can be used as a correlated multiple responses case. Simultaneous consideration of several responses involves first building an appropriate response surface model for each response. The fitted full second-order response surface models for the four responses are given respectively as follows:

$$\hat{y}_1 = 1.526 - 0.575x_1 - 0.524x_2 - 0.171x_1^2 - 0.098x_2^2 + 0.318x_1x_2$$
$$\hat{y}_2 = 0.66 - 0.092x_1 - 0.01x_2 - 0.096x_1^2 - 0.058x_2^2 - 0.07x_1x_2$$
$$\hat{y}_3 = 1.776 - 0.25x_1 - 0.078x_2 - 0.156x_1^2 - 0.079x_2^2 + 0.01x_1x_2$$
$$\hat{y}_4 = 0.468 + 0.131x_1 + 0.073x_2 + 0.026x_1^2 + 0.024x_2^2 - 0.083x_1x_2$$

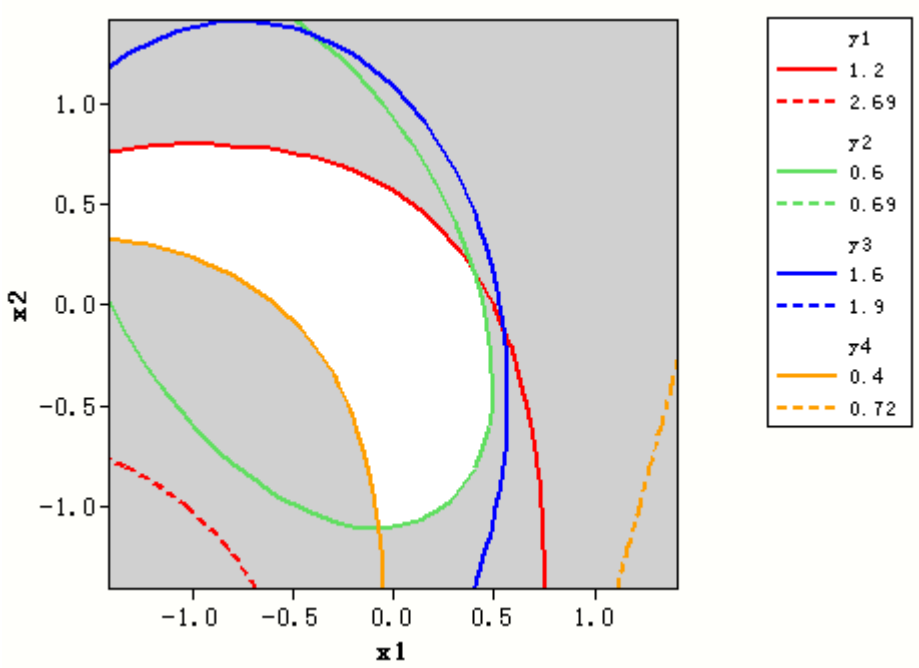
Since this experiment uses a spherical CCD, the experimental region is a circle of radius $\sqrt{2}$ centered at the origin. On the basis of the response surface models, the individual optimum value $\hat{\theta}_i$ for each response and their corresponding locations in the experimental region $X^k = \left\{ (x_1, x_2) \middle| \sum_{j=1}^{2} x_j^2 \le 2 \right\}$ are presented in Table 3.

Table 3 The individual maximum for each response and their corresponding location.

Response	maximum	Location of maximum
y_1	2.69	(-0.97, -1.05)
y_2	0.69	(-0.57, 0.26)
y_3	1.90	(-0.82, -0.54)
y_4	0.72	(1.39, -0.35)

We choose the maximum values as the targets for the responses. For the hardness response y_1, we set target T_1=2.69 and lower specification limit L_1=1.2. We choose T_2=0.69 as the target for the cohesiveness response y_2 and L_2=0.6 as the lower specification limit. For the springiness response y_3, we choose the target T_3=1.9 and the lower specification limit L_3=1.6. The target T_4=0.72 and the lower specification limit L_4=0.4 are chosen for the response compressible water. All the weights for individual optimization desirability and individual robustness desirability of each response are set to be “one”.

Figure 1 shows an overlaid contour plot for the four responses in Table 1. As the unshaded portion of Figure 1 shows, there are a number of combinations of two variables cysteine (x_1) and calcium chloride (x_2) that will result in a satisfactory process in the feasible operating region.



The results of applying "maximin" desirability function approach and the approach proposed in this paper are summarized in Table 4. We can conclude that the proposed "maximin" robustness desirability function approach gives more robust optimal result than the existing method when both robustness and optimization are under consideration.

Table 4 Comparison of results using different approaches when δ=0.05

	"maximin" desirability function	"maximin" robustness desirability function	
		w_1=0.5, w_2=0.5	w_1=0, w_2=1
x_1	-0.0123	-0.2333	-0.7597
x_2	0.0286	-0.2496	0.6689
$\hat{y}_1$	1.5179	1.4954	1.3082
$\hat{y}_2$	0.6608	0.6742	0.6774
$\hat{y}_3$	1.7768	1.8009	1.7833
$\hat{y}_4$	0.4685	0.4634	0.4852
r_1	0.1078	0.1045	0.0988
r_2	0.0103	0.0086	0.0041
r_3	0.0324	0.0290	0.0197
r_4	0.0200	0.0200	0.0201

As mentioned above, it is possible to choose different weights when both desirability and robustness are under consideration. So we should analyze and compare the results of different weights calculated by Equation (7). Because both w_1 and w_2 are positive real numbers, and $w_1 + w_2 = 1$, if we change the weight w_1 from 0 to 1, accordingly the weight w_2 is changed from 1 to 0. One can choose different values of weights w_1 and w_2 according to practical requirement. The results of the robust optimal solution X^*, the corresponding optimization

desirability $D^*_{optimization}$, robustness desirability $D^*_{robustness}$ and overall desirability $D^*_{overall}$ for different weights are shown in Table 5. As shown in Table 5, with the decrease of the weight w_1 for optimization, the value $D^*_{optimization}$ of the robust optimal solution X^* decreases, while the value $D^*_{robustness}$ increases. With the increase of the weight w_2, the robust optimal point becomes close to the robust point, and far from the optimal point.

Table 5 The robust optimal points with corresponding values of desirability for different weights.

w_1	w_2	X^*	$D^*_{optimization}$	$D^*_{robustness}$	$D^*_{overall}$
1	0	(-0.0123, 0.0286)	0.2133	0.8227	0.2133
0.9	0.1	(-0.0388, 0.0551)	0.2101	0.8262	0.2409
0.8	0.2	(-0.0621, 0.0937)	0.2075	0.8246	0.2735
0.7	0.3	(-0.0621, 0.0937)	0.2075	0.8246	0.3139
0.6	0.4	(-0.2333, 0.2496)	0.1981	0.8505	0.3548
0.5	0.5	(-0.2333, 0.2496)	0.1981	0.8505	0.4105
0.4	0.6	(-0.2333, 0.2496)	0.1981	0.8505	0.4749
0.3	0.7	(-0.2333, 0.2496)	0.1981	0.8505	0.5494
0.2	0.8	(-0.4648, 0.3893)	0.1869	0.8765	0.6434
0.1	0.9	(-0.6080, 0.4406)	0.1782	0.8952	0.7617
0	1	(-0.7597, 0.6689)	0.0726	0.8985	0.8985

5. CONCLUSIONS

In practice robustness of the solution can be more important than optimality because if the solution is not robust, the output responses may change significantly when process input variables change around their preset values, and thus the process may exhibit out of control. For multiresponse experimental design problems based on response surface methodology, the paper proposes a solution which considers both the optimality and the robustness. The procedure of the method and its validity is illustrated through an example.

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REPORTING ACCOUNTING FRAUDS OF CLIENTS

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ABSTRACT

This paper presents the need of reporting illegal acts and accounting frauds of clients. Illegal acts and illegal accounting have cost taxpayers, shareholders and investors billions of dollars. With the occurrence of recent high profile accounting frauds, the accounting profession has lost some of its credibility and confidence level among the public has declined considerably. Accounting profession is also affected by the change in economy, where intangible assets have significantly increased. In this research, an attempt is made to explain some of the regulations used by The Securities Exchange Commission (SEC) to curb illegal acts in the United States. Also included in this research are several cases where the companies have been found guilty of committing illegal acts to improve their financial statements. The study also addresses the need to understand the responsibilities of the auditors when detecting illegal acts and accounting frauds. The research, finally, gives suggestions that are likely to improve on the law to curb illegal acts in businesses. It is hoped that this research will broaden the reader's view on the illegal acts and their consequences by reviewing the new guidelines, assuming of key roles and enforcement actions against companies committing accounting fraud.

Keywords: Illegal, Fraud, Violation, Non-compliance, Irregularities.

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THE ROLE OF THE DIVINE PROPORTION AS A DECISION SUPPORT IN THE PLANNING OF CRANIOFACIAL SURGERY

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ABSTRACT

A number of researchers advocated the theory that craniofacial beauty is consistently manifested in various proportions measured against certain facial as well as anatomic landmarks. The purpose of this study was to investigate the changes in those proportions resulting from satisfactory cosmetic craniofacial surgery. The hypothesis of this study was that the measured proportions after the surgery would be closer to the divine proportion than those before the surgery. Twenty two subjects were included in the study sample. Two measured ratios in vertical direction and two measured ratios in horizontal direction based on front-view photos were used. A trend of moving toward the divine proportion was observed. Such trend was more pronounced in the horizontal direction. Consequently, the authors conclude that the divine proportion can serve as a useful reference upon which the surgery planning of a craniofacial surgery can be based.

Keywords: divine proportion, gold standard, features, craniofacial surgery, surgery planning, decision support

INTRODUCTION

The global market of the cosmetic industry was estimated to be more than $30 billion by the Aesthetic Buyer's Guide in year 2006. According to the American Society of Plastic Surgeons, 11.8 million cosmetic procedures were performed in the United States alone. It would be nice if the procedure outcome can be quantitatively evaluated by an agreed-upon objective measure. In so doing, disputes between surgeons and patients are likely to be reduced to a large extent by referring to such a gold standard. Furthermore, the existence of such a gold standard permits a meaningful assessment of the required effort to correct the deformation so that the patient won't have an unrealistic expectation of the final result.
Many people, however, argued that cosmetic surgery deals with beauty which is very subject in that factors such as race, culture play very important roles, and therefore no universal gold standard can be established. The saying – beauty is in the eyes of the beholder – has been

repetitively quoted to support their argument. Despite the prominence of such a school of thought, a number of theories have been proposed over the years regarding the ideal human anatomic model which transcends the racial difference and ultimately results in perfect physiological function as well as highest esthetics. One theory which has gained much publicity is the so called divine proportion. It draws on the very interesting property which was called "extreme and mean ratio" by the famous mathematician, Euclid, who first discovered it. Specifically, a line can be cut into two pieces so that the ratio of the total length to that of the longer segment is equal to the ratio of the length of the longer segment to that of the shorter on if and only if the ratio is 1.618. Such a mathematical elegance was first linked to the human beauty when Ricketts [7,8]claimed that he found many measurements regarding the craniofacial structure are compliant with such a divine proportion (aka φ). He went on to advocate the adoption of such idealized model as the guide for the pre-surgery planning to maximize craniofacial beauty. Such a monumental publication received mixed responses in the community of orthodontics -- some were supportive and others were rejective.

Ever since then, a number of studies centered on the so called divine proportion have been conducted and reported.[1,2,3,5,6] Among others, Baker[1] and Edler[4] focused on the changes of measured ratios between pre-surgery and post-surgery. Most of the researches relied on a panel of judges to generate the beauty scores of subjects.

Materials and Methods

2 male subjects and 20 female subjects were included in this investigation. According to the statistics report published by the American Society of Plastic Surgeons, 1.1 million male cosmetic procedures and 10.7 million female cosmetic procedures were performed in year 2007. The male to female ratio of 1:10 within this study sample closely matches the ratio of performed cosmetic procedures performed on different genders.

These twenty two subjects were randomly selected from the photo galleries posted by cosmetic surgery clinics in the Internet. In order to minimize the effect caused by age variation, we have confined the subjects to relatively young subjects.
For each subject, two before-procedure photos – one front-view photo and one side-view photo – and two after-procedure photos – one front-view photo and one side-view photo—are available. However, only front-view photos were used in the computation of various ratios, while side-view photos were for reference purpose only because those side-view landmarks proposed by advocates of divine proportion are associated with anatomic structures which cannot be precisely determined from photos. Front-view photos with head in straight up position, with glasses removed and eyes at the same level as the camera were used in the study. All photos were in color.

A total of four ratios were computed. Two were measured in the vertical direction whereas the other two were measured in the horizontal direction. They are listed below:
(1) R1: the ratio of NC to EN
(2) R2: the ratio of EM to MC
(3) R3: the ratio of Mouth-width to nose-width
(4) R4: the ratio of LR to the Mouth-width,

where NC = the vertical distance between the based of the nose and the chin
EN = the vertical distance between the based of the nose and the pupil of the eye
EM = the vertical distance between the pupil of the eye and the mouth
MC= the vertical distance between the mouth and the chin
LR = the horizontal distance between the leftmost end of the left eye and the rightmost end of the right eye

Hypothesis test

The after-surgery ratios would be closer to the divine ratio (1.618) than its corresponding before-surgery ratios.

Apparently not all cosmetic procedures produced satisfactory outcomes. But only great results with which both the surgeons and patients were highly satisfied would be posted on the Internet for the very purpose of promoting business. Consequently, the four ratios posted in Internet would move closer to 1.618 if such a value is indeed the gold standard that reflects perfect beauty.

Results

The computed ratios of R1, R2, R3 and R4 for the twenty two subjects are listed in table 1, table 2, table 3 and table 4 respectively. The top row and the second row show the before-procedure ratios and after-procedure ratios respectively. The third row shows the polarity of movement, with +1 indicating movement toward the alleged divine ratio, and -1 otherwise. In considering the limitation of measurement accuracy, any difference less than 0.03 in magnitude is regarded as insignificant and therefore counted as neither moving-toward nor moving-away. They are left blank in the tables.

The statistics of moving direction for the four ratios are summarized in Table 5. The ratios of Moving-Toward 1.618 cases to Moving-Away cases are listed in the last row. It can be seen that the Moving-Toward cases dominate in the vertical direction by a margin of at least 50%, and in the horizontal direction by a margin of 200%. In other words, a stronger tendency of moving closer to the so called divine proportion of 1.618 was observed in horizontal features than in vertical features.

The four ratios (R1, R2, R3 and R4) for each subject can be considered as a four-dimensional feature vector, [r1 r2 r3 r4] associated with said subject. It is interesting to calculate the cumulative effect by adding up individual net effect, assuming that each feature component has equal contribution. Table 6 shows the cumulative effect for each subject by summing together individual net effects. Bear in mind that the net effect takes on values of +1, 0 or -1 depending on how the procedure affects a particular ratio under investigation. A positive sum indicates an overall moving toward the divine number, with the magnitude of this sum reflecting the strength of this tendency. Likewise, a negative sum indicates an overall moving away from the divine number, with a strength manifested in the magnitude. It resulted in 13 cases of overall moving toward the divine proportion versus 4 cases of overall moving away. The case of cumulative effect of -2 which was relatively strong, was further examined. It was discovered that particular subject has a very significant profile improvement in her nose

silhouette, which apparently outweighed the effects of degradation stemming from the four features measured in this study. Such an outlier can be explained because side-view features were not considered in this study.

Table 1 Results of Computed R1

Subject	1	2	3	4	5	6	7	8
BP	1.536	1.766	2.048	1.565	1.388	1.725	1.531	1.656
AP	1.612	1.640	2.181	1.543	1.359	1.928	1.583	1.765
Net Effect	1	1	-1			-1	1	-1

Subject	9	10	11	12	13	14	15	16
BP	1.753	2.051	1.617	1.811	1.602	1.857	1.674	1.782
AP	1.602	1.977	1.720	1.758	1.515	1.777	1.754	2.026
Net Effect	1	1	-1	1	-1	1	-1	-1

Subject	17	18	19	20	21	22		
BP	1.380	2.028	1.666	1.209	1.434	1.410		
AP	1.557	1.878	1.612	1.331	1.419	1.388		
Net Effect	1	1	1	1				

Table 2 Results of Computed R2

Subject	1	2	3	4	5	6	7	8
BP	1.589	1.456	1.424	1.681	1.694	1.755	1.698	1.634
AP	1.560	1.488	1.386	1.565	1.818	1.585	1.628	1.504
Net Effect		1		1	-1	1	1	-1

Subject	9	10	11	12	13	14	15	16
BP	1.465	1.404	1.382	1.663	1.552	1.564	1.268	1.646
AP	1.602	1.325	1.398	1.670	1.567	1.523	1.287	1.527
Net Effect	1	-1				-1		-1

Subject	17	18	19	20	21	22		
BP	1.770	1.560	1.476	1.931	1.678	1.799		
AP	1.644	1.506	1.537	1.793	1.667	1.760		
Net Effect	1	-1	1	1		1		

Table 3 Results of Computed R3

Subject	1	2	3	4	5	6	7	8
BP	1.516	1.317	1.413	1.280	1.511	1.430	1.380	1.332
AP	1.592	1.389	1.572	1.253	1.640	1.425	1.340	1.340
Net Effect	1	1	1		1			

Subject	9	10	11	12	13	14	15	16
BP	1.505	1.394	1.412	1.208	1.261	1.372	1.546	1.181
AP	1.486	1.402	1.475	1.373	1.392	1.455	1.548	1.175
Net Effect			1	1	1	1		

Subject	17	18	19	20	21	22		
BP	1.410	1.456	1.617	1.666	1.356	1.564		
AP	1.435	1.443	1.453	1.319	1.419	1.514		
Net Effect			-1	-1	1	-1		

Table 4 Results of Computed R4

Subject	1	2	3	4	5	6	7	8
BP	1.768	1.915	1.664	2.202	1.865	1.697	1.824	2.158
AP	1.671	1.860	1.661	2.346	1.883	1.813	1.812	2.022
Net Effect	1	1		-1		-1		1

Subject	9	10	11	12	13	14	15	16
BP	1.778	1.868	1.918	1.913	1.785	1.622	1.727	1.867
AP	1.798	1.697	1.878	1.710	1.782	1.614	1.640	1.890
Net Effect		1	1	1			1	

Subject	17	18	19	20	21	22		
BP	1.970	1.978	1.940	1.536	1.879	1.884		
AP	1.894	2.034	1.934	1.702	1.759	1.720		
Net Effect	1	-1			1	1		

Table 5 Summary of Moving Direction

Category	R1	R2	R3	R4
Move Toward	11	9	9	9
Move Away	7	6	3	3
MT / MA	158%	150%	300%	300%

Table 6 Cumulative Effect of Four Ratios

Subject	1	2	3	4	5	6	7	8
Cumulative Effect	3	4				-1	2	-1

Subject	9	10	11	12	13	14	15	16
Cumulative Effect	2	1	1	3		1		-2

Subject	17	18	19	20	21	22		
Cumulative Effect	3	-1	1	1	2	1		

CONCLUSION

It has been shown that there is an overall trend of moving toward the divine proportion as a result of cosmetic surgery. Therefore, the authors conclude that the divine proportion can be used as a useful guide when a craniofacial surgery is planned.

However, this study has limitations. First of all, the side-view information has been ignored. It is possible that features extracted from side-view silhouettes be equally or even more important in the evaluation of beauty. Secondly, it is likely that the four features utilized in this study may not be equally important. What we have done by summing them up to create the "Cumulative Effect" shown in Table 6 is merely a first order approximation of their overall effect. The next objective of this study is to find out the optimal weights for each of the four features that faithfully reflect their relative importance in affecting the overall beauty score of a subject under investigation.

One remark worth noting is that a net tendency of moving toward the so called divine ratio as a result of satisfactory cosmetic surgery has been observed. Such an observation cannot be interpreted as a proof that the divine ratio is the ultimate sought-after goal (or equivalently, the gold standard) for craniofacial surgery. What we can claim is that the divine ratio serves as a useful reference for the purpose of surgery planning, with the understanding that the divine ratio may not be exactly the gold standard that we are looking for, if such a universal gold standard indeed exists.

ACKNOWLEDGEMENT

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APPLICATION TSP-TOUR WITH A PERFORMANCE INDICATOR FOR HOTEL'S WEBSITES AGENT

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ABSTRACT

Application calculation of tour from actual origin-destination trip of tourist hotel combine attractions on the travel salesman problem, measured performance by the ability index of the tourist hotel from website provides reservations and information. Actual route's calculation by Google Map and choose the shortest way to make the O-D Trip. This research is application from finding tour by Storm 2000 that shows the travel of tourists to travel in PATTAYA based on location. 31 Attractions listed in Tourism Authority of Thailand come from a selection of all attractions within 30 kilometers from Pattaya Maung be calculated with hotel standard in the three indicators. The first evaluation measured the ability to travel go 31 major tourist attractions of all hotels in PATTAYA. Sort of indicators by The Best Travelling Salesman's Tour of Hotel divide by Standards of Hotel Classification. The second evaluation measured the ability of all hotels within the framework or star hotel standard. Sort of indicators by Standards of Hotel Classification divide by Price Rate. At the last evaluation measured the ability of all hotels within the framework combined with the measurement of travel. Sort of indicators by Best Travelling Salesman's Tour of Hotel divide by Price Rate. The results of the first between the range of 19.06 to 47.17 and the best place are Hotel114. The second between the range of 0.02 to 0.46 and the best places are Hotel4. The third between the range of 0.01 to 0.16 and the best place are Hotel117

Keyword: Travelling salesman problem, Performance measurement, Pattaya, Website, Google map

1. INTRODUCTION

Mostly measured assessment of the hotel can offer various conveniences by the hotel standard. Stars representing the hotel amenities, but attractions distances cannot indicate whether or how to use the term which the hotel is services convenient don't indicate on travel. Tourist visits such places in the PATTAYA city. Tourist hotels around the city of PATTAYA are located both near and far from attractions. Attractions is available many data from Tourism Authority of Thailand (TAT), which displays attractions in CHON BURI, PATTAYA MUNG, including the making of the attractions to choose which are outside the city but also in Pattaya, Chonburi Province. Rating for the selection of attractions from evaluating hotels near tourist attraction, visitors to help them choose what hotel to explore the website information directly at the service of organized package Hotels in Bangkok such as web sites. Hotelthailand, Agonda etc. these provide facilities in the Special Class hotel maps and various Tourists choose to stay in, but do not have any data to measure the distance

shown in service near the attractions in the decision to stay. Therefore, the information of distance to stay with the facilities available in the hotel has decided to focus on select-service hotels.

2. DATA COLLECTION AND PRELIMINARY ANALYSIS

2.1 Data Collection

2.1.1 *Web Services Information*

Generally the data stay in hotels each hotel shown on the website, it contains information that is limited due to the business in e-commerce. Set of time frame will need to show information clearly. Fast as a click of the user make the information displayed in addition to the information necessary preliminary, there are services in the Review of the customers is an important part of today because of society on mail with a link to each other. In the case of hotel service not impressed and may affect the reviews of customers and decisions. The location of the hotel most of the data associated with the services of Google Map.

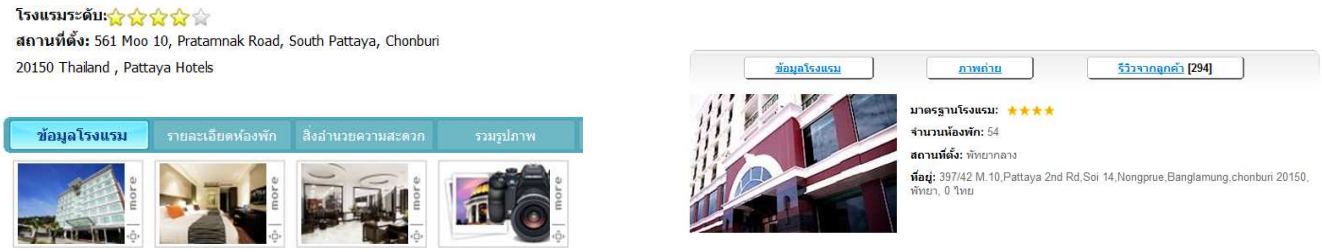


Figure 1 Information of Service Web Agency

2.1.2 Information attractions in Thailand

Services attractions in Thailand to search for information from the website services Tourism Authority of Thailand (TAT), which shows that attractions and significant events in each province in Thailand for distance can be calculated from Google Map service to find the path of travel by car and walk.

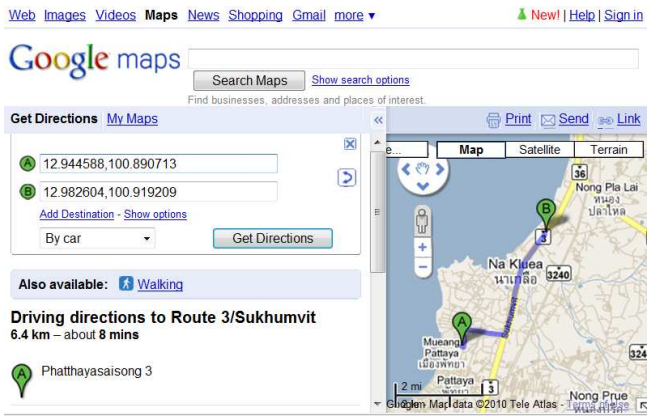
Figure 2 Service attractions of Tourism Authority of Thailand Website

2.1.2.1 Geographic coordinate's Location to find attractions and hotel by Google Map

The OD-Trip information generated from location of hotel far from the tourist attractions with a Google map application and the actual term used to calculate data to solve tour. The travelling by the car and chooses a distance of the nearest distance in case of multiple routes of travel.

		พิกัดภูมิศาสตร์
1	บ้านสุขาวดี	12.982604,100.919209
2	ปราสาทเวทมนต์ ทักซิโด้	12.947516,100.888996
3	เพอคูล่าฟาร์ม	12.604156,100.958862
4	ไร่องุ่นซิลเวอร์เลค	12.938314,100.890198
5	อเนกกุศลศาลา (วิหารเซียน)	12.802427,100.955429
6	หาดดงตาล	12.900919,100.86462
7	หาดเตยงาม	12.669817,100.861359
8	พัทยาคาร์ท สปีดเวย์	12.938984,100.889511
9	ทิฟฟานี่ โชว์	12.949231,100.888567
10	อัลคาซาร์ คาบาเรต์	12.943835,100.888653
11	สนามแข่งรถพีระอินเตอร์เนชั่นแนลเซอร์กิต	12.921667,101.010447
12	สนามแข่งรถเล็ก เค อาร์ โกคาร์ท กรังปรีซ์	12.949231,100.888567
13	ศูนย์ฝึก-สอนลิงพัทยา	12.882429,100.898094
14	หาดจอมเทียน	12.88176,100.882473
15	หาดวงพระจันทร์	12.972024,100.887022
16	สวนกล้วยไม้ศิริพร	12.932793,100.906506
17	โฟมปาร์ตี้ โรงแรมฮาร์ดร็อกพัทยา	12.935261,100.881743
18	แฟร์เท็กซ์ สปอร์ต คลับ แอนด์ รีสอร์ท	12.935303,100.896463
19	เดอะสอร์สชูพ้อยท์	12.920412,100.899982
20	เลคแลนด์ วอเตอร์เคเบิ้ลสกี	12.904852,100.882902
21	โรงภาพยนตร์ทะลมิติ	12.930284,100.877838

a. Geographic coordinates



b. Route of travel

Figure 3 Selecting the location and route of travel by Google map

Choosing attractions from the website of Tourism Authority of Thailand 42 place's PATTAYA of the selected tourist attractions within around 30 kilometers show 31 yellow colors below.

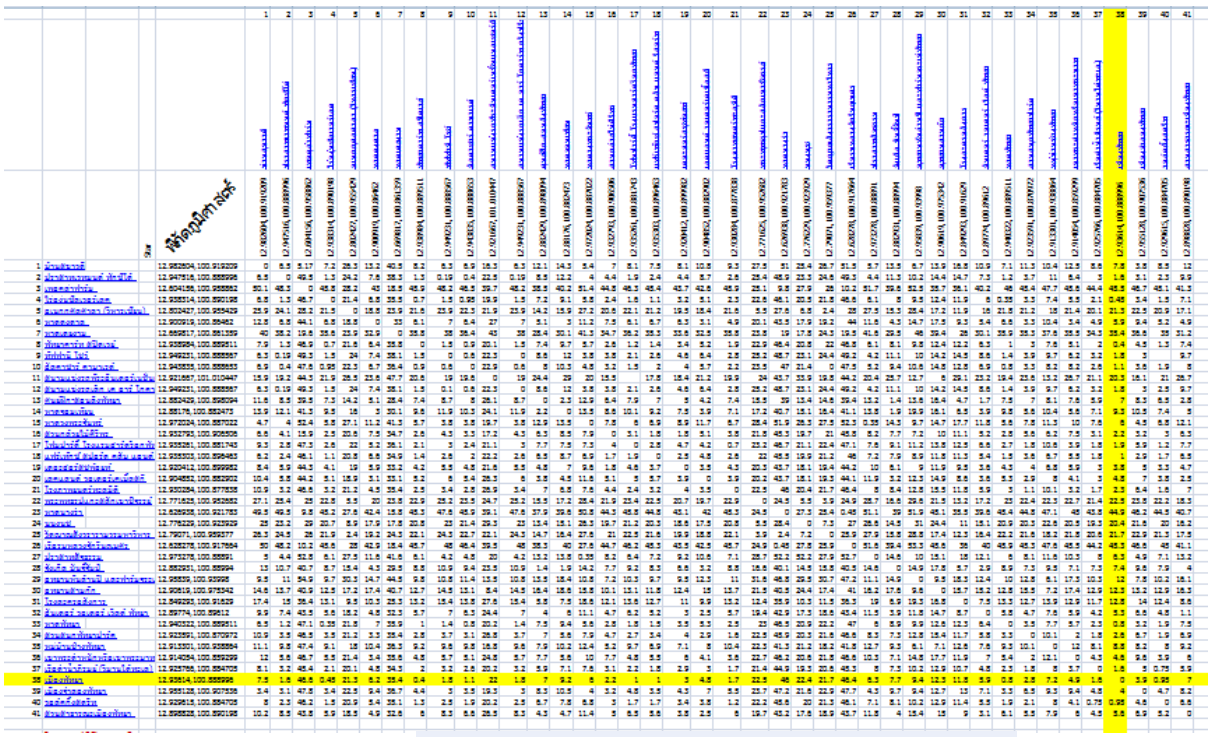


Figure 4 Selection of attractions to be reference for finding the tour.

Hotel accommodation selected from the web agency providing Reservation Hotel in PATTAYA has all hotels in the mostly Star Rating 2 Stars and 3 Stars. Finding the path to travel the shortest between the hotel and Attractions to create OD-Trip table of the hotel with 31 attractions for each OD-Trip All hotels in table to calculate the Tour of the hotel

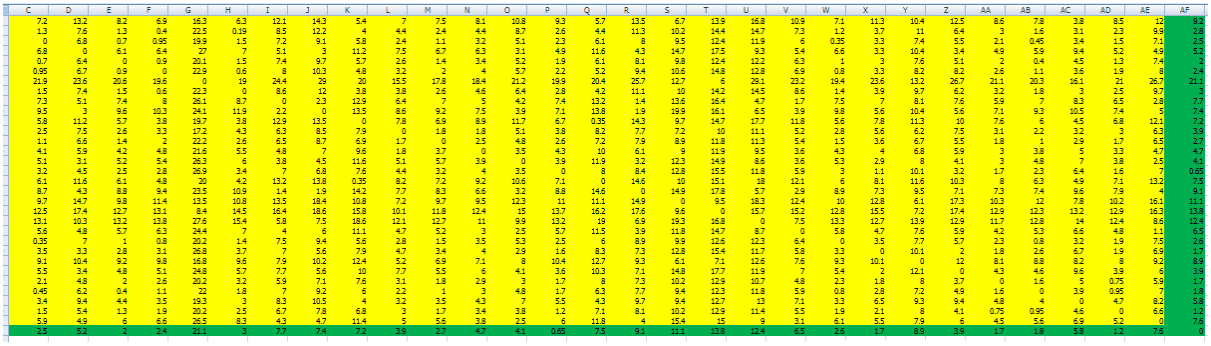


Figure 5 Origin-Destination Trip between hotel (Green) and Attractions (Yellow).

2.2 Preliminary Analysis

Data shown in the hotels website agent show basic information on each hotel emphasizes amenities and prices for accommodation, tourism to use these E-commerce systems in the decision. Location of the hotel may not be suitable to the characteristics of tourism activities to do during the rest although the price might be cheap but the location may be located remotely. E-commerce system open for tourists around the world to choose Hotels, but it cannot aware that suitable attractions with tourism activities and no indicators to tell which of the locations away from the accommodation, although clearly of Service Web Agency is linked to map data to the Google Map service. The principle of a tour to travel on the issue of travel salesperson problem make the tour suitable for travel and the principle of this application to the application location of hotel joined with attractions that are making the tour. Set of calculations can be used to demonstrate that there is close to attractions or not.

3. METHODOLOGY

Evaluation of the tourism hotel starts from due the tourist attractions to use reference with hotel in tour calculation by selection from websites for the Tourism Authority of Thailand. The location and distance around 30 kms of PATTAYA MUNG use to choose attractions include the location of each hotel to find Origin-Destination Trip by Google Map. OD-Trip each hotel calculated Tour by program Storm 2000 and evaluates by three performance key index.

3.1 Tour of travelling salesman problem

3.1.1 Strom 2000

Using Applet program to calculate in travelling salesman function, Storm 2000 used in calculation not much 50 node. In the case of research have 32 nodes from 31 attractions with 1 hotel

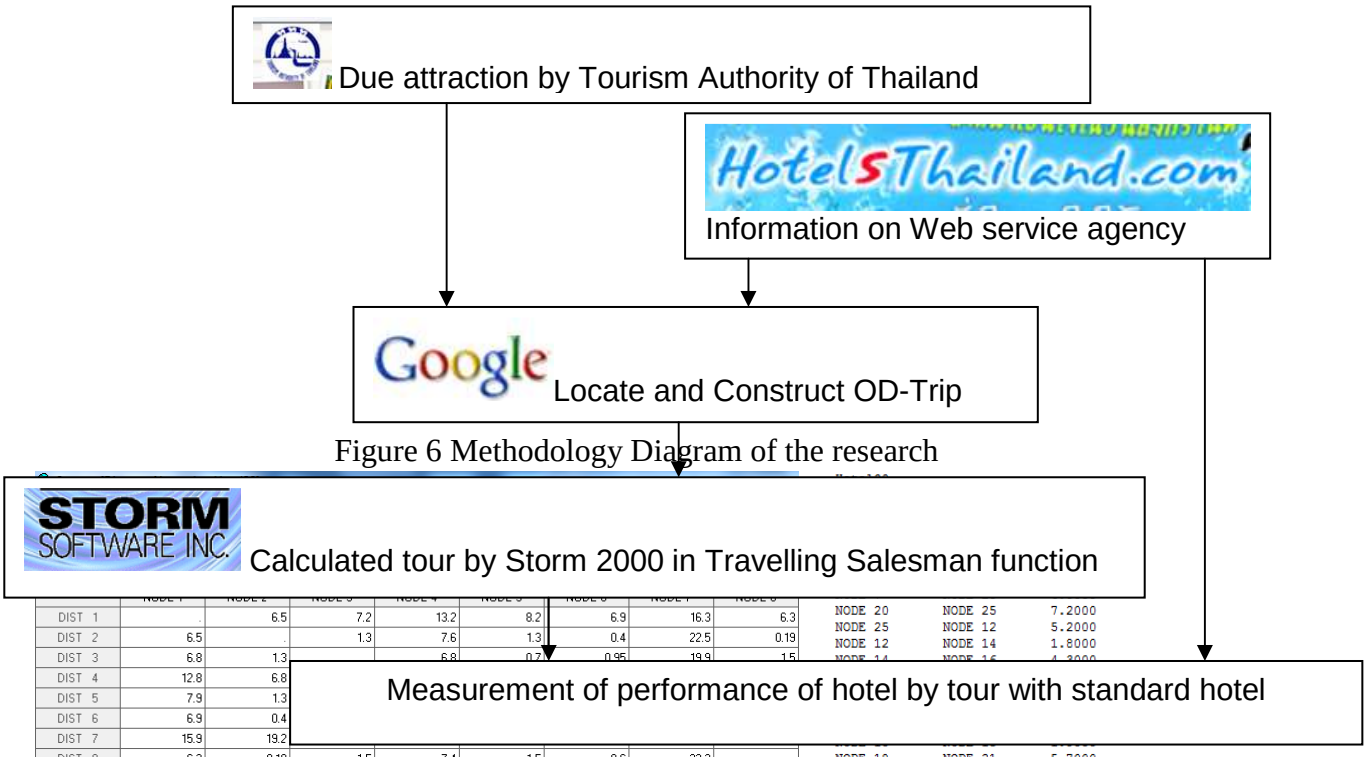


Figure 6 Methodology Diagram of the research

DIST 1		6.5	7.2	13.2	8.2	6.9	16.3	6.3
DIST 2	6.5		1.3	7.6	1.3	0.4	22.5	0.19
DIST 3	6.8	1.3						
DIST 4	12.8	6.8						
DIST 5	7.9	1.3						
DIST 6	6.9	0.4						
DIST 7	15.9	19.2						
DIST 8	6.3	0.19	1.5	7.4	1.5	0.6	22.3	
DIST 9	11.6	8.5	7.3	5.1	7.4	8	26.1	8.7
DIST 10	13.9	12.1	9.5	3	9.6	10.3	24.1	11.9
DIST 11	4.7	4	5.8	11.2	5.7	3.8	19.7	3.8
DIST 12	6.6	4.1	2.5	7.5	2.6	3.3	17.2	4.3
DIST 13	6.2	2.4	1.1	6.6	1.4	2	22.2	2.6
DIST 14	8.4	5.9	4.1	5.9	4.2	4.8	21.6	5.5
DIST 15	10.4	5.8	5.1	3.1	5.2	5.4	26.3	6
DIST 16	10.9	3.2	3.2	4.5	2.5	2.8	26.9	3.4
DIST 17	5	4.4	6.1	11.6	6.1	4.8	20	4.2
DIST 18	13	10.7	8.7	4.3	8.8	9.4	23.5	10.9
DIST 19	9.5	11	9.7	14.7	9.8	11.4	13.5	10.8
DIST 20	14.6	13.7	12.5	17.4	12.7	13.1	8.4	14.5
DIST 21	17.4	15	13.1	10.3	13.2	13.8	27.6	15.4
DIST 22	9.9	7.4	5.6	4.8	5.7	6.3	24.4	7
DIST 23	6.5	1.2	0.35	7	1	0.8	20.2	1.4
DIST 24	10.9	3.5	3.5	3.3	2.8	3.1	26.8	3.7
DIST 25	11.1	9.8	9.1	10.4	9.2	9.8	16.8	9.6

a. Asymmetric data calculated by Storm 2000

```
NODE 20      NODE 25      7.2000
NODE 25      NODE 12      5.2000
NODE 12      NODE 14      1.8000
NODE 18      NODE 21      5.7000
NODE 21       NODE 9      5.8000
NODE 9       NODE 22      1.7000
NODE 22      NODE 31      1.1000
NODE 31      NODE 15      2.5000
NODE 15      NODE 27      3.0000
NODE 27      NODE 30      0.7500
NODE 30       NODE 5      1.3000
NODE 5        NODE 6      0.9000
NODE 6        NODE 2      0.4000
NODE 2        NODE 8      0.1900
NODE 8       NODE 32      0.5500
NODE 32      NODE 23      0.9000
NODE 23       NODE 3      0.3500
NODE 3       NODE 28      0.4500
NODE 28      NODE 13      1.0000
NODE 13      NODE 29      2.9000
NODE 29      NODE 17      4.3000
NODE 17      NODE 11      0.3500
NODE 11       NODE 1      4.7000

Length of tour = 94.9400
```

b. Result of storm 2000

Figure 7 Using Storm 2000 calculated tour of hotels

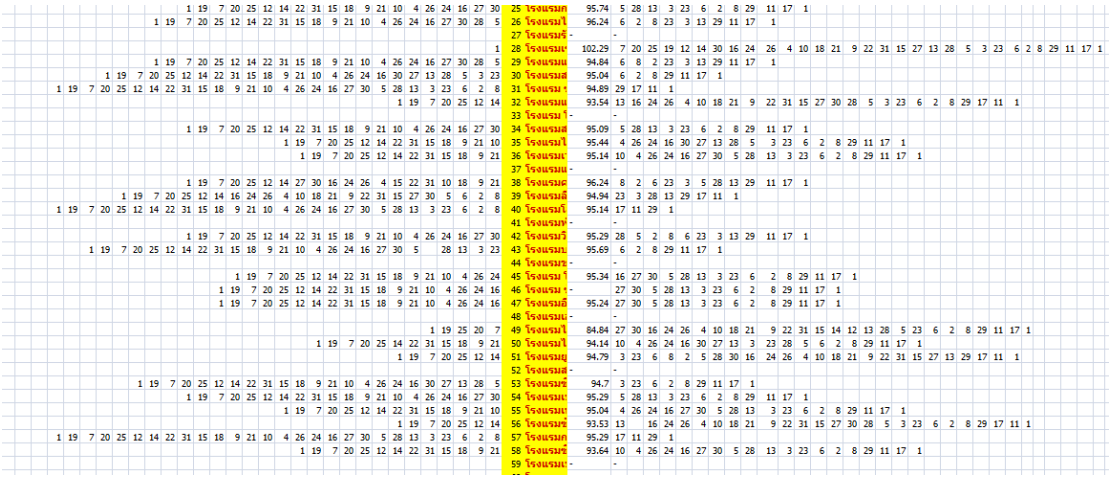


Figure 8 Sort of tour by fig hotels in the same column

3.2 Performance measurement of hotels

Relation of Hotels Performance Measurement provided for the Tour based on the attractions, frameworks and price rate show below hierarchy diagram

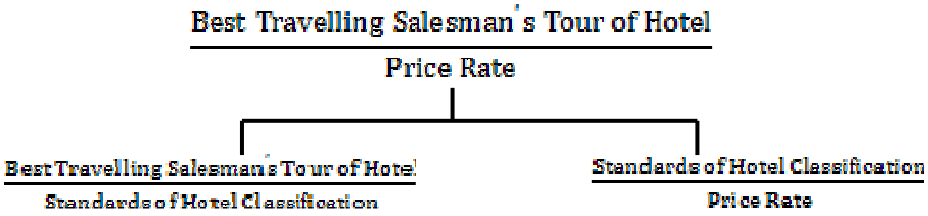


Figure 9 Hierarchy of Hotels Performance Measurement

3.2.1 Performance measurement between travelling on the attractions with frameworks

Performance Measurement of hotels provided the sort of hotels from the Tour based on the attractions, compared with frameworks.

$$\frac{\text{Best Travelling Salesman's Tour of Hotel}}{\text{Standards of Hotel Classification}}$$

The performance index value is indirectly variation of valuable

3.2.2 Performance measurement between frameworks with price rate

Performance Measurement of hotels provided the sort of hotels from standards of hotel classification, compared with price rate of hotel.

$$\frac{\text{Standards of Hotel Classification}}{\text{Price Rate}}$$

The performance index value is directly variation of valuable

3.2.3 Performance measurement between travelling on the attractions with price rate

Performance Measurement of hotels provided the sort of hotels from the Tour based on the attractions, compared with rate of hotel.

$$\frac{\text{Best Travelling Salesman's Tour of Hotel}}{\text{Price Rate}}$$

The performance index value is indirectly variation of valuable

4. RESULT

Table 1 Result of performance measurement's hotels

	Hotel No.	Star	Tour	Bath	Tour/Star	Stat/Bath	Tour/Bath
12.928192,100.88552	Hotel2	2.5	94.79	600	37.92	0.42	0.16
12.93225,100.883417	Hoel4	3	95.54	650	31.85	0.46	0.15
12.919806,100.885402	Hotel6	3	95.84	755	31.95	0.4	0.13
12.929134,100.883996	Hotel7	2	94.34	770	47.17	0.26	0.12
12.926687,100.876293	Hotel9	3	95.14	826	31.71	0.36	0.12
12.938984,100.901184	Hotel10	3	94.69	826	31.56	0.36	0.11
12.948269,100.897408	Hotel11	3	95.04	900	31.68	0.33	0.11
12.935596,100.8917	Hotel14	3	94.74	920	31.58	0.33	0.1
12.899121,100.870178	Hotel16	3.5	95.29	944	27.23	0.37	0.1
12.948603,100.891657	Hotel17	3	94.79	944	31.6	0.32	0.1
12.955128,100.899553	Hotel18	3	94.89	950	31.63	0.32	0.1
12.954082,100.890026	Hotel19	3	94.69	1000	31.56	0.3	0.09
12.930848,100.889189	Hotel21	3	95.24	1035	31.75	0.29	0.09
12.898389,100.869384	Hotel22	3	95.04	1062	31.68	0.28	0.09
12.934738,100.881701	Hotel24	3	95.39	1062	31.8	0.28	0.09
12.935345,100.883374	Hotel25	3	95.74	1082	31.91	0.28	0.09
12.944567,100.887859	Hotel26	3	96.24	1100	32.08	0.27	0.09

	Hotel No.	Star	Tour	Bath	Tour/Star	Stat/Bath	Tour/Bath
13.014175,100.928736	Hotel28	3	102.29	1100	34.1	0.27	0.09
12.93982,100.887623	Hotel29	3	94.84	1105	31.61	0.27	0.09
12.944588,100.890713	Hotel30	3	95.04	1121	31.68	0.27	0.08
12.951447,100.886722	Hotel31	3	94.89	1121	31.63	0.27	0.08
12.934717,100.896463	Hotel32	4	93.54	1150	23.39	0.35	0.08
12.931392,100.884018	Hotel34	3	95.09	1150	31.7	0.26	0.08
12.897217,100.872817	Hotel35	2.5	95.44	1150	38.18	0.22	0.08
12.885859,100.882559	Hotel36	3	95.14	1156	31.71	0.26	0.08
12.947453,100.886035	Hotel38	3	96.24	1180	32.08	0.25	0.08
12.946899,100.891796	Hotel39	3	94.94	1180	31.65	0.25	0.08
12.955713,100.886958	Hotel40	3	95.14	1180	31.71	0.25	0.08
12.930869,100.889339	Hotel42	3	95.29	1180	31.76	0.25	0.08
12.945069,100.885048	Hotel43	3	95.69	1200	31.9	0.25	0.08
12.921793,100.87522	Hotel45	3	95.34	1200	31.78	0.25	0.08
12.93112,100.88052	Hotel47	3	95.24	1593	31.75	0.19	0.06
12.931288,100.889511	Hotel49	2.5	84.84	1274	33.94	0.2	0.07
12.861176,100.896034	Hotel50	3	94.14	1274	31.38	0.24	0.07
12.935805,100.891743	Hotel51	3	94.79	1286	31.6	0.23	0.07
12.937436,100.890069	Hotel53	3.5	94.7	1299	27.06	0.27	0.07
12.935815,100.886486	Hotel54	3.5	95.29	1300	27.23	0.27	0.07
12.897615,100.869942	Hotel55	3	95.04	1323	31.68	0.23	0.07
12.934885,100.896463	Hotel56	3	93.53	1357	31.18	0.22	0.07
12.951751,100.885981	Hotel57	3.5	95.29	1357	27.23	0.26	0.07
12.872137,100.889254	Hotel58	3.5	93.64	1413	26.75	0.25	0.07
12.93112,100.880456	Hotel61	3	95.24	1416	31.75	0.21	0.07
12.923424,100.877881	Hotel62	3	95.49	1416	31.83	0.21	0.07
12.942246,100.888524	Hotel64	3	94.8	1416	31.6	0.21	0.07
12.946251,100.885252	Hotel65	3.5	95.69	1440	27.34	0.24	0.07
12.935794,100.883492	Hotel66	3	95.89	1500	31.96	0.2	0.06
12.95151,100.884211	Hotel67	3	95.49	1500	31.83	0.2	0.06
12.95024,100.884506	Hotel68	4	96.14	1500	24.04	0.27	0.06
12.92058,100.869598	Hotel69	3	95.89	1500	31.96	0.2	0.06
12.959645,100.889125	Hotel70	3.5	94.84	1500	27.1	0.23	0.06
12.956634,100.891914	Hotel71	3	94.84	1534	31.61	0.2	0.06
12.912883,100.899725	Hotel72	4	95.74	1534	23.94	0.26	0.06
12.93455,100.889297	Hotel73	3.5	95.04	1590	27.15	0.22	0.06

	Hotel No.	Star	Tour	Bath	Tour/Star	Stat/Bath	Tour/Bath
12.949691,100.889168	Hotel74	3.5	94.53	1593	27.01	0.22	0.06
12.89339,100.873117	Hotel75	3	94.84	2360	31.61	0.13	0.04
12.932166,100.879941	Hotel76	3	94.74	1653	31.58	0.18	0.06
12.941807,100.885885	Hotel77	3	95.34	1652	31.78	0.18	0.06
12.925197,100.884522	Hotel78	4	94.91	1699	23.73	0.24	0.06
12.934644,100.888106	Hotel79	4	94.74	1705	23.69	0.23	0.06
12.931089,100.88052	Hotel80	3	95.19	1711	31.73	0.18	0.06
12.914891,100.858226	Hotel81	4	94.95	2254	23.74	0.18	0.04
12.920161,100.899982	Hotel82	4	94.78	1770	23.7	0.23	0.05
12.930252,100.878364	Hotel83	3	94.27	1800	31.42	0.17	0.05
12.949482,100.895154	Hotel84	3.5	94.84	1800	27.1	0.19	0.05
12.93043,100.881368	Hotel85	3	94.99	1800	31.66	0.17	0.05
12.951447,100.883921	Hotel86	3	96.19	1805	32.06	0.17	0.05
12.930158,100.883417	Hotel87	3	94.89	1805	31.63	0.17	0.05
12.946721,100.886056	Hotel88	3	95.59	1864	31.86	0.16	0.05
12.915121,100.901227	Hotel89	4	95.64	1888	23.91	0.21	0.05
12.95701,100.914102	Hotel92	4	96.19	2000	24.05	0.2	0.05
12.949314,100.89642	Hotel93	4	94.94	2006	23.74	0.2	0.05
12.935491,100.885155	Hotel95	3	95.24	2200	31.75	0.14	0.04
12.944337,100.886877	Hotel96	4	96.04	2450	24.01	0.16	0.04
12.944092,100.889854	Hotel97	4	94.84	2490	23.71	0.16	0.04
12.915226,100.901098	Hotel98	4	95.19	2500	23.8	0.16	0.04
12.934571,100.888116	Hotel99	4	94.74	2508	23.69	0.16	0.04
12.970602,100.895176	Hotel100	4	94.94	2530	23.74	0.16	0.04
12.973864,100.892762	Hotel101	4	96.04	2596	24.01	0.15	0.04
12.935272,100.885187	Hotel102	4	95.24	2600	23.81	0.15	0.04
12.95381,100.884147	Hotel103	3.5	96.39	2758	27.54	0.13	0.03
12.949377,100.886582	Hotel104	4.5	96.44	2890	21.43	0.16	0.03
12.923299, 100.868440	Hotel105	4	95.84	2900	23.96	0.14	0.03
12.951165,100.886818	Hotel106	4	94.89	2900	23.72	0.14	0.03
12.929322,100.880241	Hotel107	4	94.74	3295	23.69	0.12	0.03
12.828121,100.910325	Hotel108	4	100.64	3500	25.16	0.11	0.03
12.838122,100.912042	Hotel109	4	97.44	3540	24.36	0.11	0.03
12.880086,100.882902	Hotel111	3	93.76	4366	31.25	0.07	0.02
12.898953,100.872517	Hotel112	4	95.44	4932	23.86	0.08	0.02
12.950245,100.884511	Hotel114	5	95.29	5061	19.06	0.1	0.02

	Hotel No.	Star	Tour	Bath	Tour/Star	Stat/Bath	Tour/Bath
12.920412,100.900154	Hotel115	3	94.671	5900	31.56	0.05	0.02
12.958631,100.885434	Hotel117	4	95.64	7360	23.91	0.05	0.01

5. CONCLUSION

Result of performance measurement 31 Attractions with any hotel within 30 kilometers in Pattaya Maung. The first evaluation measured the ability to travel go 31 major tourist attractions of all hotels in PATTAYA. Sort of indicators by The Best Travelling Salesman's Tour of Hotel divide by Standards of Hotel Classification. The second evaluation measured the ability of all hotels within the framework or star hotel standard. Sort of indicators by Standards of Hotel Classification divide by Price Rate. At the last evaluation measured the ability of all hotels within the framework combined with the measurement of travel. Sort of indicators by Best Travelling Salesman's Tour of Hotel divide by Price Rate. The results of the first between the range of 19.06 to 47.17 and the best place are Hotel114. The second between the range of 0.02 to 0.46 and the best places are Hotel4. The third between the range of 0.01 to 0.16 and the best place are Hotel117

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COMPLEXITY IN AN ORDER HANDLING PROCESS – A CASE STUDY IN HIGH TECH BUSINESS

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ABSTRACT

Order handling is one of the central processes in operative customer deliveries. It involves several intra-organizational units for efficient order execution having remarkable impact internal other parts of order-delivery process as well as suppliers and customers. Due to its central role and repetitive nature, inefficiencies in customer order handling process may have far-ranging intra- and extra-organizational influences and related costs may quickly grow considerably. In a complex business environment where high tech companies are acting the real root causes of order handling problems are difficult to study. This study provides an exact example of these problems take place in order handling in high tech business. Also a worst case scenario of the order handling is presented. The most common mistakes causing delays in order handling are product configuration mistakes, orders with wrong or lacking information, lack of product data in information systems, communication problems over organizations, unclear roles and responsibilities, and lack of resources. These problems are closely related to the challenges of logistical and technical product complexity, as well as organizational complexity and technical process challenges. The majority of the problems is not able to solve only in order handling function but requires wider organizational examination to be tackled.

Key words: order handling process, order fulfillment, complexity, large companies, organizational learning.

INTRODUCTION

Typically in high tech business product development is capable of designing technically complex products responding divergent customer requirements. Increasing challenges, however, appear in streamlining efficient order-delivery to customers. Challenges increase when the scale of business and product variety increases, even the basic operations, like order handling, becomes challenging (Forza and Salvador, 2002). Order handling is a central part of any organization delivering products to the customers. It involves several intra-organizational units, has impact on all the central organizational functions, and has direct

influence on suppliers and customers (Croxton, 2003). Thus, it is critical that order handling process is efficient and well-functioning. Due to its central role of order handling process and repetitive nature, inefficiencies may have far-ranging intra- and extra-organizational influence and related costs may quickly grow considerably. Even more far ranging problems take place, when errors occur and the time from order to delivery gets longer. Thus well functioning order fulfillment process is not only affecting customer satisfaction but can easily free up capital when company can pocket the gains from customers quickly (Croxton, 2003).

Complexity in products usually creates complexity to processes. However, when several organizational units or even several companies are connected in value chain, problems seem to be evident. Complex deliveries are typically not volume products rather they refer to project deliveries even with repetitive mode. Complexity and project mode in delivery creates or more like causes possibility to uniqueness of delivery and further uniqueness in operations. This, further, seems to allow process to have all kinds of "hassling" in order-delivery process with negative impact on profitability. Our case company seems to have this kind of phenomena in practice. Basically company has well defined processes and advanced product data management practices connected to enterprise resource planning. However unnecessary "hassling" takes place and mistakes occur, not to mention negative cost effects of these. It seems that complexity originating from product structure creates a lot of challenges for downstream phases in process.

Our case company is operating in complex, global environment where company is encountering all the challenges listed above. To improve their operative efficiency order handling process is in a key role. To tackle this challenge following research questions are raised:

RQ1.1 What kind of problems may take place in order handling process in the high technology company?
RQ1.2 Which of them and how they originates from the product complexity?

We know very little about complexity inside product and its influences further to order-delivery, not to mention problems that becomes due to constant changes on features and content of deliveries. Our literature review presents different perspectives of complexity in order-delivery and especially in order handling process. Keeping that in mind we have studied the case company qualitatively attempting to learn causes of product complexity to order-handling. We have studied our case company like Yin (1994) proposes. By qualitative case study we can better understand the nature of complex order handling process and provide new knowledge about this environment and the confronting challenges.

COMPLEXITY IN ORDER HANDLING PROCESS

Order fulfillment process is the interface where the customer is integrated into the selling company. Order fulfillment process includes all the steps needed to translate the customer requirements until the delivery of goods and invoicing them (Chung et al., 2007; Kallio et al., 2000). Sales negotiations, order receiving, order handling, product supply and invoicing are the operative tasks of order fulfillment (Croxton, 2003; Kallio et al., 2000). Order fulfillment also includes a strategic aspect to plan the required logistic network and organization of

operations (Croxton, 2003). Developing the order fulfillment process enables companies not only to cut operative costs but also accelerate the incoming cash flow.

The major operative work of order fulfillment is conducting the order efficiently. The order handling consists of the basic tasks; entering order, processing order, filling order, and after delivery to create the invoice (see Croxton, 2003). However, even simple tasks will come more challenging when the scale of business is wide and product variation is high (Forza and Salvador, 2002). Current business environment is creating the complexity for operations that global companies cannot get rid off. However, understanding complexity makes possible to work with it (Vesterby, 2008).

To recognize the different aspects of complexity on order fulfillment, and especially order handling, the classification of complexity by Khurana (1999) is utilized since the classification is made for production system analysis. According to Khurana (1999) complexity can be categorized for *logistical, technological, organizational, and environmental (business context) complexity* where the technological complexity can be studied from process or product points of view.

Logistical complexity

Logistical complexity is based on the high number of transactions or types of products (Khurana, 1999). Especially in high tech business this type of complexity is multiplying fast due to widening product portfolios (Anderson et al., 2006; Hoole, 2006). Current product portfolios in high tech industry include the high number of deliverables and single product variation together with high production volume (Choe et al., 1997; Kotha and Orne, 1989). The request to widen the amount of deliverables is due to divergent customers' needs where a company tries to answer by offering a large scale of product variants and customization (Vesterby, 2008; Lamothe et al., 2006; Kratochvíl and Carson, 2005). However, the divergent customer needs are also leading the high variation in operations (Anderson et al., 2006). Especially from the operational point of view, the potential implications of product portfolio complexity are not fully understood or recognized (Closs et al., 2008).

The high number of transactions and types of products has exponentially increasing the amount of product data in order handling process. The whole supply chain performance is today heavily dependent on how this data is handled on information systems (Huang et al. 2003, 2005; Johansson and Medbo, 2004). The roots of data explosion lay in the volume and diversity of product data, and complexity of single product information (Jin et al., 2007) but also the increasing number of product changes (version updates).

Technological complexity

Khurana (1999) reviews technical complexity from product and process points of view. Both aspects have significant implications for order-delivery process in high tech business where the complex nature of products is more than other business affecting the realization of operative processes too.

Product complexity is consequence of the number of components and parts, the number of interconnections and interfaces of these components and parts, and the number of the performed functions of an end product is presenting (see Vesterby, 2008; Closs et al., 2008; Crnkovic et al., 2003). Complexity increases since more often the customized components, embedded software, and client specific integrations are used (Kratochvíl and Carson, 2005) causing challenge for order handling since customized order usually require adaptation in processing. End product customization is often made by customer specific software or service components and since these modules are not usually as controlled defined as physical goods, the order fulfilment gets more complicated.

Technical process complexity discusses the capability to separate process tasks without affecting the total process performance (Khurana, 1999). Not only one department but several departments in organization would be concerned with the ordering process even though special order handling / fulfilling teams exists in the large companies. The stakeholders of order handling process consist of sales, customer, production/supply, logistics, and finance (see Croxton, 2003). In order handling, the sales requirements have to be matched with the company's internal operations and it have often been very problematic in practice. Technically the order fulfillment process is supported by many information systems such as ERP (enterprise resource planning), CRM (customer relationship management), and product configuration tools not even talk about the tools that feed the original information to these tools (like PDM – product data management).

Organizational complexity

Organizational complexity pertains to defined organizational structures, forms, and procedures (Khurana, 1999). Organizing order fulfillment and order handling requires a lot of communication with all the stakeholders' teams (Welker and Vries, 2005) and the function based integration has to be smooth. Thus defining the roles and responsibilities is a key to ensure smooth process completion. Also organizing operations on multi-site, having multi-cultural personnel is creating the special challenge to manage when local regulations and cultural perceptions are part of everyday work.

Environmental complexity

Environmental complexity is caused by the external operational issues. Large, global companies can face several requirements set by operation countries causing for example localization pressures (Khurana, 1999). Local rules, regulations, and laws make the international business more challenging task to organize. For operative process examination, this aspect of complexity is not that relevant to study more detailed.

CASE STUDY

The empirical case was conducted in one large, globally acting telecommunication company. The product portfolio is large and following the current business trend by offering to customers total solutions which combine physical products with services. The different aspects of complexity in the case order handling process are high. Cost pressures are demanding and operations have to be developed to improve their performance. Especially the

slow response to customer requests is harmful for the business. To improve the case company's operative efficiency order handling process is seen to be in the key role.

This case study defines the current state of the case company order handling process, analyzing the root causes of inadequate order handling performance, and discuss on overall complexity on order handling process (research process in Figure 1). 12 in-depth interviews were conducted with representatives from several organizational units involved in the order handling process. The interviews followed a semi-structured interview format consisted of four question guides; the interviewee's background information, questions concerning the current order handling phases, defining order handling problem areas, and improvement suggestions.. Interviews were conducted in an informal manner, allowing the interviewees to express their own perceptions freely and explain the process and practices. This enabled the researchers to obtain multiple views to the reality of the process and enriched the observations made. All interviews were recorded, transcribed and analyzed.

Figure 1. Research process.

The data has been analyzed in two ways. The individual interviews were analyzed and encoded under themes. Thereafter, all interviews were analyzed together as a whole to identify the major problems as well as draw the worst case scenario.

The results validation was made within interviewees. Every interviewee was able to comment on the correctness and validity of interview transcribed. At the end, a seminar was held to discuss the end results to validate the results.

The order handling process model of the case company

The basic order handling process in the case company is defined in Figure 2. The order handling process starts with an order negotiating between sales and customer representative. Sales (S-ORG 0) will define configurations and sends the order to the sub-organizational unit 1 (S-ORG 1) which handles orders with a requested lead time. S-ORG 1 receives and validates an order, where after the order is placed in the ERP system. This order handling process intends to be largely automated. Thus, an order should get scheduled and confirmed within minutes and should be quickly visible to all involved organizations, including product supply. In exceptional cases where order handling is not automated, the sub-organizational unit 2 (S-ORG 2) helps S-ORG 1 on scheduling and order confirmation. After order confirmation, the product is delivered to the customer as confirmed.

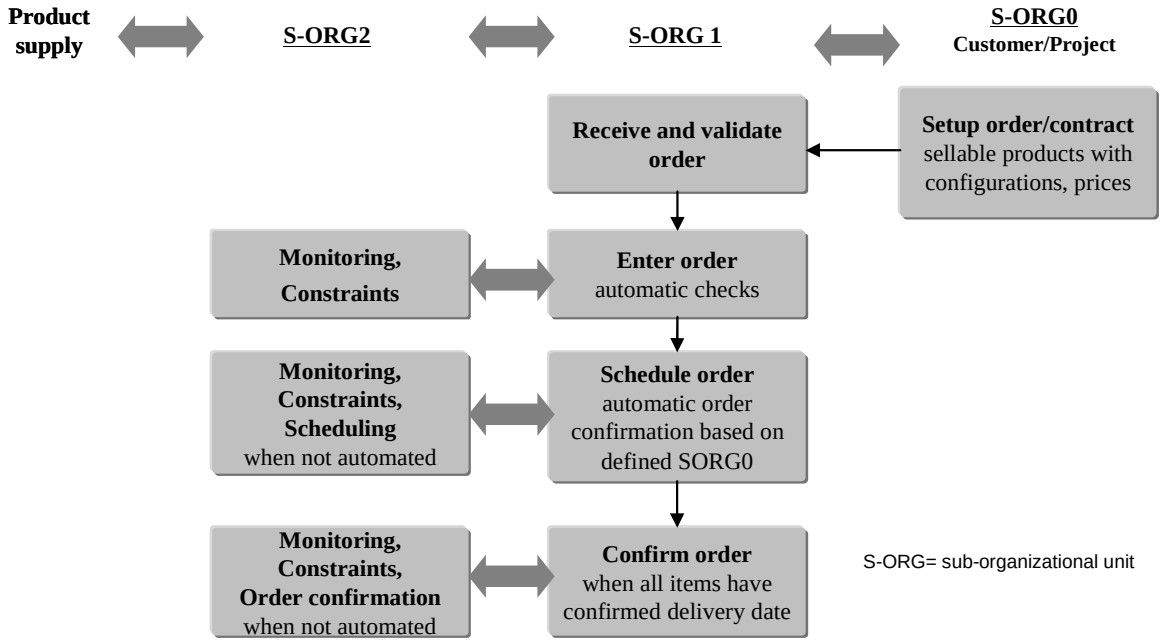


Figure 2 The case company "ideal" process model for order handling.

The product supply process (see Figure 3) is closely interconnected with the order handling process. For customer communication and order handling purposes, the link to the product supply is required to get the order confirmed. The final product deliveries to the end customers are delivered from the distribution center in this case study. Also other delivery methods exist but those are excluded from this study.

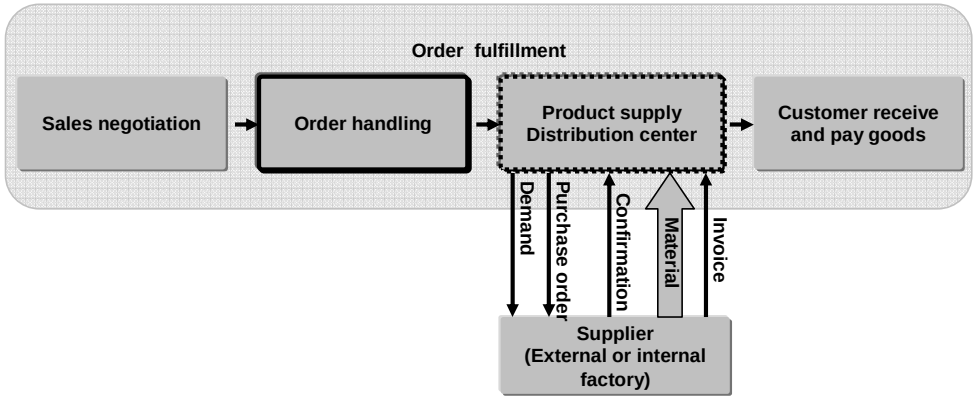


Figure 3. Interconnectedness of order handling and product supply process in the case organization.

In the case company, it was noticed that some problems occur in the defined order handling process. However, the root causes of deviations from the original order handling process were unclear. To track the problems, one type of product (called a case product) was used to identify the problems in the process. The case product is a complex system product. In practice, customers' orders consist very seldom only this one case product item but are the combination of different products and services. This case study wittingly simplifies the

overall order handling process in the case company serving the research aims in the best ways – to observe the order handling execution and recognize the current problems.

RESULTS

Actual order handling process

The empirical study indicated that the actual order handling process comprises a long chain of tasks (see Figure 4) and is more complicated than the ideal one. Actual order handling process involves several organizations and teams directly and indirectly requiring input of many other organizations not presented in the ideal order handling process. Team roles, responsibility areas, and communication channels are not as explicit as presented in the ideal process but featured several country and sales area specific differences. In an ideal order handling process customer order management and purchase order management are represented as separate processes, where as in real-life those processes are interwoven and dependent on one another in some existence.

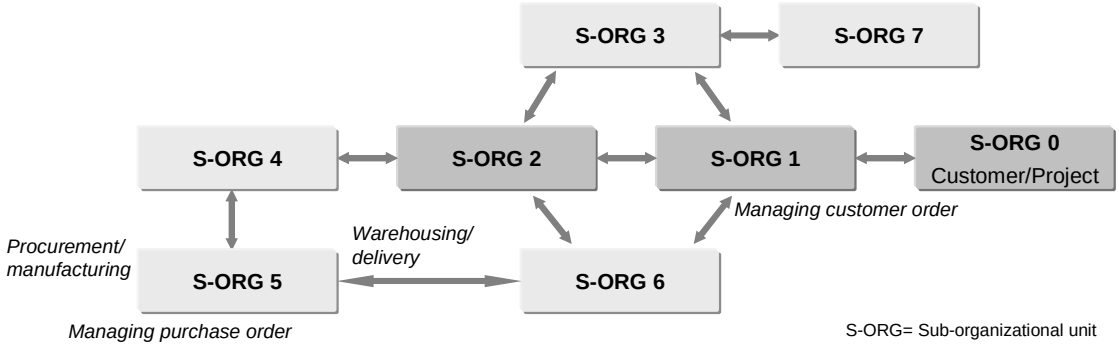


Figure 4. The actual order handling process.

In global environment, time differences between the numerous teams located across the globe are settling extra challenge especially for timeliness communication. The actual duration for order handling can range from some 10 minutes to several weeks. If order handling mistakes occur, order handling process can quickly take several days. Order mistake or problem identification, transferring information concerning order mistakes from one team to another, and transferring requests to correct even simple order mistakes all the way to sales, takes at least one day due to time differences if S-ORG 2 and S-ORG 4 is required to participate in the process. However, it was difficult for interviewees to estimate the occurrence of deviations compared with the ideal order handling process since several variables are affecting to the process; numerous country and market/sales area specific differences, product and product combination based differences, and periodical differences causing their own affects.

Sub-organizational specific challenges

S-ORG 0

Many of the problems occurring in order handling process are originated from the beginning of the process, where sales agree the customer order (S-ORG 0). One of the most common problems occurring in order handling is that sales places wrong type, faulty orders. Vastness and complexity of the current product portfolio accentuate the importance of great sales competence. Mastering numerous sales items and configurations is a challenging task. Moreover, sales has to master several customer specific configurations. According to several interviewees, faulty orders are often being placed purely due to lack of competence and know how.

The amount of manual, human errors done in sales could be significantly decreased by using a Configurator tool which contains up to date configurations. However, some person placing orders do not use the Configurator tool but prefer using old Excel-files, often passed down elder colleagues containing dated product codes, old products and configurations which increase the possibility of having an order wrong and causing significant delay for order handling. Moreover, there are currently several different types of delivery models available for different products and this information is reported to be lacked by other organizations.

Added to the vast number of product items to be mastered, sales also has to master several tools when handling different types of products. In addition to the Configurators, they also need to use a Forecasting tool and have some knowledge on ERP systems where the actual orders are handled. All in all, the great number of tools, products and different delivery models available together accentuate the need for high sales competence.

As an expression of organizational complexity, order handling process is largely dependent on the order forecast data received from the customers. The empirical material strongly indicated that lack of forecasting and inaccurate forecasts cause significant problems for order handling, particularly, for purchase order management, for S-ORG 4, 5, and 6. The interdependency of product supply and customer order confirmation seems to be unclear and not taken seriously.

Sales is criticized to communicate too little with the major order handling team S-ORG 1. Especially, in the case of the order mistake correcting was often pointed out to take too long on S-ORG 0. Another typical problem mentioned in the interview data related to sales was putting forward risk and trial orders without required authorization. Occasionally sales pressured S-ORG 1 and 2 to confirm risk and trial orders without required authorization. Confirmed risk and trial orders were also reported to cancel occasionally which in turn requires several teams' input.

Several differences between sales teams' performance were reported. Thus, not all problems can be related to all sales teams, or to all sales individuals.

S-ORG 1

Through out the empirical research, the roles of S-ORG 1 and S-ORG 2 was raised into discussion. Other teams perceived it quite challenging to define what the responsibility domains of S-ORG 1 and S-ORG 2 are, and which team to contact in which type of matters. Also inside these teams, it is not always clear who is doing and what due to the vaguely outlined responsibility areas. Particularly, responsibility over tasks such as monitoring and communicating order verifications were occasionally discussed by teams.

Overall, the tasks and responsibility domains of S-ORG 1 and S-ORG 2 are not accurate. S-ORG 1 and S-ORG 2 tasks have several market specific differences. In the ideal process, S-ORG 2 tasks merely cover monitoring and constraints, whereas in practice S-ORG 2 tasks are a lot more comprehensive covering several of the tasks described in the ideal process taking by S-ORG 1. On the other hand, some of those tasks of the ideal process under S-ORG 1 ranging from receiving to scheduling and confirming and order are conducted by S-ORG 2 and S-ORG 4.

Interviewees highlighted that big differences between S-ORG 1 teams exist. Some teams work well and efficiently, whereas other team's performance leaves room for improvement. Several interviewees had noted that S-ORG 1 often forms a bottle neck to order handling process. Many argued that occasionally orders lay at S-ORG 1 for days or at the worst even weeks prior to getting inserted into the systems or forwarded to S-ORG 2. Thus, when entering orders late into the system S-ORG 1 has to insert short lead times in order to match the delivery time originally required by customers. Some interviewees highlighted that even cases where the asked order delivery date was in the past have emerged. Thus, delays is S-ORG 1 cause pressure to the following units, especially to S-ORG 2, 4, and 5 that have to act rapidly in order to make up the lost order handling time and to keep up with the required delivery schedule. Furthermore, the likelihood of manual mistakes increases when acting in a hurry. The problem also lies partly with the systems. Order templates are created by sales and then transferred to S-ORG 1 where templates are handled again prior to sending them to S-ORG 2. In S-ORG 2 order templates arrive typically via email and are inserted into the ERP system manually. Each order typically consists of several order rows and thus, the possibility of making manual mistakes is high in all units handling orders.

Several reasons for the underperformance of S-ORG 1 had been noted. Several S-ORG 1 teams suffer from high people turn over, lack of resources and poor initial training. The number of rental workforce and trainees is high in some S-ORG 1 teams. Some interviewees enunciated their increasing worry of decreasing level of competence. Currently, the initial work orientation seems to be light which increases the amount of mistakes. Also the amount of manual work on S-ORG 1 is resource demanding and slows down order handling process. In addition, S-ORG 1 teams typically do not have sufficient performance measurement criteria and thus, do not have clear implications for underperformance and respectively no incentives motivating rapid actions.

Another concern highlighted by the empirical material was the lack of communication from S-ORG 1 towards S-ORG 2 and the rest of the teams. S-ORG 1 was criticized of holding back information concerning orders, particularly large orders surpassing frames. Earlier

communication on such orders could have improved the capability to respond to demand. Moreover, S-ORG 2 personnel occasionally had difficulties in getting answers from S-ORG 1 on various order related questions, such as missing order details. However, the problem is partly related to sales, which is not sharing information with S-ORG 1 to a sufficient amount.

S-ORG 2

Similar to S-ORG 1, also S-ORG 2 teams around the globe had been noted by the interviewees to have differences in terms of performance. S-ORG 2 Finland was praised for its efficient operation. S-ORG 2 Finland follow 24-hour performance measurement criteria for order handling and thus, over 90% of all incoming orders are inserted into the ERP system within 24 hours. In occasions when the order handling time period is surpassed, reason codes are registered and team's performance rating is affected. S-ORG 2 work tasks include a lot of manual work and inserting orders into the system within 24 hour time limit is often a challenging task. Several interviewees reported that S-ORG 1 slow input often causes pressure to S-ORG 2, which is working under tight performance criteria. Particularly, if orders are put into the system heavily late, S-ORG 2 has very little time to handle massive amount of orders. Moreover, difficulty of getting missing order details from S-ORG 1 and difficulty of getting order mistakes corrected by S-ORG 1 often requires intensive communication by S-ORG 2, frequent requests and thus, wastes S-ORG 2's working hours. However, in many other S-ORG 2 teams such performance criterion as in Finland does not exist. Similar to S-ORG 1, S-ORG 2 often forms a bottle neck to order handling (e.g. North America). In addition, several indicated that S-ORG 2 teams typically suffer from lack of resources and from lack of possibilities to assist other S-ORG 2 teams in peak times

S-ORG 2 order handling efficiency is limited by the current tools. Both order handling systems in used have room for improvement. Currently, order handling involves a lot of manual work and the systems allow for many manual mistakes.

S-ORG 3

S-ORG 3 is a relatively new team and its role and contact channels are not well known for all personnel working at S-ORG 1, S-ORG 2 or sales according to the interview data. Despite the importance of S-ORG 3 team in training and in assisting with order related problems, this organization has remained unknown for some workers and thus, occasionally order handling problem solving has been delayed due to not knowing who to contact. This problem has been tackled by organizing training and communication.

S-ORG 3 usually receives inquires concerning order problems and mistakes via email which does not support order prioritization and allows for time distances to prolong the process. As known, the number of emails is usually too high and it is impossible to identify which orders should be treated prior to others. Thus, important orders might get delayed. Some criticism towards S-ORG 3 was presented as getting answers occasionally takes some time. Similar to many other teams, S-ORG 3 has limited amount of resources and since S-ORG 3 is a global team time distances often cause delays.

S-ORG 3 has also faced some system related problems. They usually do not have enough user rights in ERP on orders and have no possibility of testing whether the correct mistake or all order mistakes were found when they are studying the problem in orders. Extra delay is caused if S-ORG 3 personnel have to ask assistance from other teams in order to get orders tested. The vast amount of products, configurations, codes and sales items, frequent changes in product portfolios, having to have up to date knowledge on the ramp up and ramp down products also requires high competence from S-ORG 3 personnel.

S-ORG 7

S-ORG 7 is indirectly involved in operative order handling. They are contacted when necessary product codes are not open for ordering. However, since S-ORG 7 is typically contacted via the route S-ORG 1 to S-ORG 2 onwards S-ORG 3 and respectively since information concerning opened codes travels back the same route to S-ORG 1, where orders are finally corrected, code related order problem solving usually takes a long time. Particularly, since S-ORG 2, S-ORG 3, and S-ORG 7 are often located on different time zones, code related order correcting takes easily days which is problematic with in the case product which lead time is short.

Occasionally, product item codes are not opened to all necessary products, to all distribution centers at once, which cause delays for order handling. According to the interview data, this is a problem particularly with the ramp up and ramp down products, and with product changes. S-ORG 7 is responsible for having the product related information correct in ERP, which is a heavy task with the current high number of different items, but at the same time it is a crucial task in terms of order handling –any code mistake can cause significant delay for order handling.

Other teams involved on customer order process: S-ORG 4, S-ORG 5, and S-ORG 6

Although, S-ORG 4, S-ORG 5 and S-ORG 6, are not directly involved in operational order handling their role for order handling is important and difficulties in any of three team's operation can have severe effects on order confirmations and fulfillment.

S-ORG 4 is the link between product supply and order handling. They should provide the information from the customer side quickly to product supply, especially to the S-ORG 5. In particular, lacks on forecasting are troublesome to S-ORG 5 who is working towards suppliers, own factories and hubs.

The lacking forecast information causes significant amount of extra work for buyers. Forecasts are handled by many people in several systems and thus, the information does not necessarily remain unchanged, nor does it travel to the end of the chain in a sufficient time frame. The biggest problem at the current moment in relation to creating forecast reports is the relatively recently launched tool which is unreliable and slow. Thus, S-ORG 6 and S-ORG 5 workers create the reports still manually. Drafting manual reports cause high amount of manual work, creates several possibilities for manual mistakes and delays purchase order management which has direct effects on sales order confirmations. Lack of order forecasts, placing orders different to forecasts and against agreed lead times makes everyday work

challenging and causes extra work such as shifting and adapting frames and purchase orders to both S-ORG 4 and 5.

Also late placed customer orders are troublesome to S-ORG 5. Often unofficial information concerning orders, particularly large ones, travels quicker to S-ORG 5 than the actual orders are being placed in ERP. Thus, S-ORG 5 must negotiate with suppliers and factories on arbitrary bases and often purchase orders have to be changed as the actual orders with full configurations have been placed in the systems. The actual configurations often differ from those presumed by buyers which cause unnecessary and repeated work.

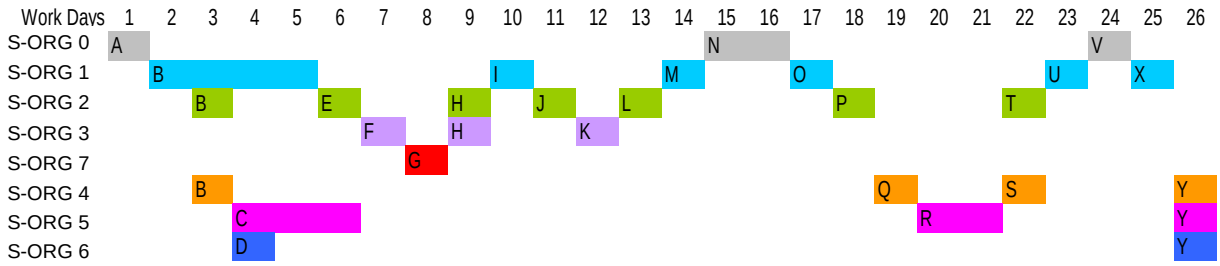
Order handling process also contains some overlapping, unnecessary and similar work. All of the organizations S-ORG 4, S-ORG 5, and S-ORG 6 monitor and control orders, as well as create similar type of reports. Likewise, S-ORG 4 monitors and controls the same issues as S-ORG 2 and S-ORG 1. Monitoring and running different types of reports consumes significant amount of work hours. In some occasions, teams have asked others for order related data on the purpose of creating similar reports that have already been created in other teams. Thus, it seems clear that resources are spent on conducting similar tasks.

Worst case scenario

Based on the current status process mapping, the worst case scenario for order handling can be defined based on the estimations given by the interviewees. The worst case scenario contains merely three actual order handling problems: (1) the order is not forecasted, (2) product item codes for the order or other product information is not available in systems and (3) the order contains a configuration mistake. All in all, in the worst case the process takes 26 work days and ends up with order cancellation by the unsatisfied customer. As can be quickly seen from the worst case scenario, the biggest lack time is caused by S-ORG 1 which is not putting the order forward fast enough, but takes 5 days. Another, order handling deficiency is the amount of time wasted in correcting two simple order mistakes; item codes and configuration. Their identification and correction takes altogether 13 days. In addition, the extra work caused by non-forecasted order for S-ORG 4, 5, and 6 is all together 12 work days.

Handling the worst case order requires the input of eight teams, instead of just two (S-ORG 1 and 0) presented in the ideal order handling process. Thus, the worst case order handling illustrates very quickly that several possibilities for improvement in order handling exist even though not all or even the majority of the orders are similar as the worst case orders.

Figure 5 illustrates and clarifies the worst case scenario in more detail. The input of different teams is represented with different colors. The timeline represents work days (and does not include e.g. holidays, or weekends). Thus, the actual duration for order handling is inevitably longer than 26 days. The worst case scenario does not consider the extra work and delay caused for suppliers, factories, distribution centers, customer or other stakeholders.



A) Sales negotiates a large order with the customer. Makes configuration with old Excel files and puts the order forward to S-ORG 1.
B) S-ORG 1 receives the order, and do not have time to put order into the system immediately. Unofficial information about the order delivered to S-ORG 2, 4 and 5.
C) S-ORG 5 gets information on the large order. Since the order is not forecasted, S-ORG 5 contacts to S-ORG 6 and starts planning the order delivery with suppliers/distribution centers/own factories.
D) S-ORG 6 contacts to S-ORG 2 concerning the unofficial order information. S-ORG 5 plans manually the possible order delivery since planning tool is not using in S-ORG 6.
E) S-ORG 1 puts the actual order in ERP. S-ORG 2 contacts to S-ORG 3 since ERP is not verifying the order on some reason.
F) E-mail inquiry to S-ORG 3 gets forwarded to S-ORG 7. Ordered items codes are not open in ERP on wanted distribution center.
G) S-ORG 7 opens the item code under wanted distribution center.
H)S-ORG 3 answers to S-ORG 2. Item codes are now available. S-ORG answers to S-ORG 1.
I) S-ORG 1 tries again, but the order does not get verified.
J) S-ORG 2 notices that order contains possible configuration mistake and contacts S-ORG 3 again.
K) S-ORG 3 replies what is wrong with the configuration to S-ORG 2.
L) S-ORG 2 forwards the message to S-ORG 1.
M) S-ORG 1 asks S-ORG 0 to correct the order.
N) S-ORG 0 renegotiates the order, corrects the configuration and sends the order to S-ORG 1.
O) S-ORG 1 places the order.
P) S-ORG 2 monitors. Order is not get verification for the requested date. S-ORG 2 contacts to S-ORG 4.
Q) S-ORG 4 notices that there are no forecasts for the order and contacts to S-ORG 5 to in order to find out the best possible delivery date.
R) S-ORG 5 notices that the unofficial order information was different that the actual order. S-ORG 5 has to renegotiate the supply delivery. S-ORG 5 replies to S-ORG 4 the best possible delivery date.
S) S-ORG 4 informs to S-ORG 2 the delivery time.
T) S-ORG 2 informs to S-ORG 1 the delivery time.
U) S-ORG 1 informs to S-ORG 0 the delivery time.
V) S-ORG 0 replies to S-ORG 1 that the order has to be cancelled since the next possible delivery was not soon enough for the customer who requested the shorter lead time.
X) S-ORG 1 cancels the order in ERP.
Y) Order is cancelled from all other systems and files.

Figure 5. A worst case scenario to order handling.

The worst case scenario based on the expectation that S-ORG 2 is working according to their target – responding within 24 hours. However, in several market areas this is not always the actual situation (since the performance measurement is used only in one S-ORG 2 team) and S-ORG 2 can delay the process even more in some market areas than described in Figure 5.

COMPLEXITY IN ORDER HANDLING PROCESS

All problems occurring at the process according to the interview data were listed and mapped. Similarities and differences were pointed out. *Major problems found in order handling process are; incorrect orders (missing data in order), high number of configuration mistakes, manual data transfer between tools, inadequate product data in information systems (missing data in the case of ramp up or ramp down products), slow communication in case of incorrect orders, lack of resources, poor competence to understand the process entity (related tasks and deliverables), and unclear roles and responsibilities.*

The majority of the root causes for faced problems are originating the overall complexity – logistical, technological, or organizational complexity and are discussed the next. In addition to these challenges, the lack of resources was often reported being a reason for delays in the process. It is an independent factor that has to discuss as an own entity in the case company. It is very common challenge, which consequences should be aware. In case of order handling, continuous hurry increased the number of manual mistakes. Hurry and pressure are also reasons for high people turn over decreasing the level of competent and experienced personnel.

Logistical and technical product complexity

Logistical complexity is high in the case company. The current product portfolio is experienced to be complex including the vast number of current products, sales items and configurations together with several product variants, customer specific solutions and optional products delivered via many different delivery modes. Also the company merges occurred earlier is affecting the width of product portfolio and creates some extra challenge for product management. To handle all these increases the need for high competence, product knowledge and experience among personnel. Especially for sales, that should be able to provide to the customers appropriate product solution but they should also know how the order should be build that dump mistakes (incorrect configurations, groupings, delivery modes etc.) do not delay the order fulfillment and the final delivery.

“First time correct order” is the ideal situation defined for order handling. The actual task of inserting orders into the systems is not a difficult task but the vast and complicated product portfolio makes it a challenging target for the personnel handling orders.

As pointed out in interviews, configuration mistakes are one of the most common order handling mistakes. These mistakes are not identified early enough in order handling: most often the reorganization of a configuration mistake is made by S-ORG 3 instead of S-ORG 1 or 2, since configuration mistake identification craves experience and specific know how. Thus correcting the configuration mistake is time consuming due to the long chain of communication between S-ORG 0 and S-ORG 3 and causing thus several days of delay.

The complexity of the product portfolio creates challenges for those in S-ORG 4, 5, and 6 that have to master the vast number of product items and their details: data maintenance is laborious since the vast amount of items and transactions. Especially the problem occurs when handling products on ramp up and ramp down phases. Due to the vast product portfolio

there are countless items that have to be continuously updated into all information systems. Products face more changes during the lifecycle than ever and product is versioning fast. To maintain all this information together with version compatibility requirements is laborious. Order handling is occasionally delayed since product item codes are not open in systems like should, and thus are not available for ordering even though those are able to be produced and sold or versioning compatibility do not work which causes that order confirmations are not created without manual work. Data lacks of this kind are causing several days of delays to correct since the order handling personnel do not have authority or responsibility to do these tasks. Another typical problem is that ramp up products are offered for customers too early on or that ramp down products are offered to customers. Despite the continuous communication concerning ramp up and ramp down products, many find it challenging to keep up with the numerous products' life cycle stage and all the information systems up to date.

Technical process complexity – Challenges of information systems

In large companies operative processes are highly dependent on information systems. To manage the high number of deliverables, transactional data, and customer information requires reliable systems and tools. In the case company several tools and systems are utilized to perform order handling process. The number of tools and the deficiencies related to tools are a problem for many teams. The major tools are ERP (where orders and deliveries are handled), an older order handling tool utilized in some market areas to insert the orders, product Configurators for sales, a customer order forecasting tool, and a planning tool which combines all the customer forecasts (but this tool is not currently working as designed). Major challenge is that data between the tools is being transferred and handled by many manually causing lot of non value added work. In each step of the chain of order handling there is a possibility of copying original information wrong or inserting faulty data.

The operative order handling is currently conducted in an ERP system. The major ERP system is reported to be robust but inflexible. Some basic functionalities of the ERP are slowing order handling (Table 1).

Table 1. Tool related factors that are slowing order handling process.

ERP functionalities	
	Do not enable copying orders even.
	Do not prevent manual mistakes: • a little pre-filled order details • system do not guide to fill important fields on the order.
	Order confirmation done without some basic level information such as delivery address.
	Slow capacity for required high speed of order handling.
	"Change mode" with no automatic log out period (others cannot handle the order since the former user has not changed the mode and thus requires personal contact).
Integration between ERP and older tool	
	Manual order transfer from the old tool to ERP by S-ORG 2 (delay 1-2 days).
	If confirmed ERP order is changed, the data is not automatically transferred for old order handling

tool and has to correct manually.

In case of mistakes in one of the tools is causing lot of additional, manual correction work.

For sales, the existence of several Configuration tools due to mergers and acquisitions is causing challenges. The main problem is that not all sales personnel know which of the Configurators to use to a particular product. There is the preferred Configuration tool which would be the only solution in the future but in the change situation it found to be frustrating and challenging to learn the use thus personnel often prefer using old Excel files that typically contain dated codes, old products and configurations increasing the probability of order handling mistakes.

The logistical and technical complexity of a product is increasing the number of product data handled. The earlier represented lacks on product data represent that high amount of data is difficult to handle in several systems. To improve the data accuracy people creating some piece of data should understand its meaning to other users – in case of order handling process people should know why the basics of product data should be in place or why product orders should contains all the required information in the first place. To increase this knowledge would decrease the lacks of data.

Even the order handling tasks are commonly quite simple the process includes more complicated tasks that are difficult to separate from total process. The importance of forecasting is not apparent through the order handling process and thus the customer forecasts are often inadequate level. The correct forecasting is the key to ensure order confirmation and on time deliveries. Forecasting tools are currently very unfavorable and require a lot of manual work to count the summary demand forecasts. Since the information about total demand and product supply cannot combine, the response of customer request takes time.

Organizational complexity

Actual order handling process involves several tasks, teams and organizations from various locations. Since the actual process is not following the defined order handling process roles and responsibility areas of different teams involved in order handling are not evident to all. In ideal order handling process, teams S-ORG 1 and 2 have clear responsibility areas which seem to be inaccurate in practice. Thus, the current organizational structure of order handling is putting a lot of pressure towards S-ORG 2 even it should be only for supporting team.

Also the reorganization of large companies' organizational structure is very common. In the case company, several changes to the order handling process and to different teams' roles, responsibility domains and names have been introduced recently. High personnel turnover together frequent organization changed complicates to recognize the next player on the process. There are also currently several country and market area specific differences in team roles which is confusing to many. Especially the key order handling organizations', S-ORG 1 and S-ORG 2, roles differ greatly between market areas and are also the most challenging for the other teams to comprehend.

Since the organizational structure is complex and not all responsibilities are clear overlapping work exists. The roles of S-ORG 1 and 2 are somehow blurred in practice leading to

overlapping work in some existence. Moreover, the whole chain of teams is doing a lot of order monitoring, controlling and reporting. S-ORG 1, 2, 4, 5, and 6 monitor customer order delivery development and run and create somewhat reports with the same content.

In global company time distances and the vast number of people involved decelerate the process, especially, when problems, such as order mistakes or scheduling changes, occur. Multi-site location also sets challenges for communication which is mainly done via emails between the teams like is the current business practice. However, in order handling process it causes often lose of information; for example order prioritizing is not visible enough and can leads incorrect order prioritization decision. E-mail contacts also slow the order correcting process since emails are not very structured way of handling information and email selection based on personal choosing.

The case company is outsourcing many of the tasks performed on order handling process according to the current business trend. The teams are thus unequal since some teams consisting of workers employed by the master company and others are rent work force where the turn over is high. High people turn over is causing the decrease of competence (knowledge on products, delivery modes etc.) causing delays on order handling. Moreover, several expressed their worry on people having more and more specified, narrow scoped competence and thus, losing the overall view at the whole process. Every team involved in order handling must possess certain task specific know how and all units must have at least basic knowledge on products, product portfolio, delivery models and the terminology, systems and tools being used. As an example, in the worst case basic delivery concepts (e.g. ex works) are understood differently between teams causing confusions and even order delays. Other teams also argue that S-ORG 0 and 1 are not following the required product lead times when placing the order which easily end up on order delivery delay.

Interesting differences of measuring performance through order handling process exists. For example, one particular S-ORG 2 team follows 24-hour order handling criterion when other S-ORG 2 teams are not measured against the same criteria. What is more important S-ORG 1 does not have any these kinds of performance criteria. Thus, teams are not motivated to handle orders as quickly as possible which is often witnessed as several days late inserted orders, missed lead times, and disappointed customers. Furthermore, S-ORG 1 role as bottle neck creates further pressure to the following teams handling orders that have to attempt to catch up the lost time.

Complexity caused by merger and acquisitions

Merger and acquisitions (M&A) faced some years ago are still affecting order handling process. The affects on M&A can be seen both in case of logistical, product and organizational complexity. On a single product item level it causes that company has to manage products with product models of different kind and the rules of configuration both handled differently in information systems (diverse rules of change management or configuration as an example). This is causing a special challenge for sales where several Configuration tools exist. Also in case of incorrect orders the help is not necessary asked for the team dedicated to the particular problem but the former colleagues used to work earlier.

Also some challenge occurs since the tools of former organizations have not still fully integrated and several parallel tools can exist.

DISCUSSION

Order handling and overall organizational performance

The case company has relatively sophisticated order-delivery process and often assessed as world class processes. High tech business is facing huge challenges of cost reductions not only from products but organizing the operations. Order handling process was defined to be one of the challenging processes for the company and this study is identifying the problem areas on it. Some of the development areas defined is straightforward related to the special process in scope but many problems are connected to different type of product complexity when solutions are not that simple requiring also reviewing business decisions.

Order handling process is one of the centric processes on order-delivery. It has direct impacts on product supply process as well as customer relations. With well smoothing order handling company can affect on its financial performance with reducing investments (e.g. warehouse costs), and hastening monetary inflow (close orders and invoice faster) (Croxton, 2003). If order feeding for information systems takes time or is incorrect, the visibility for product supply is unreliable and strengthens the demand distortion (e.g. Lee et al., 1997; McCulle and Towill, 2002) on product supply chain. Also the poor communication on order cancellations causes problems in product supply and if cancellation occurs very late will cause unnecessary increasing of inventory. In the case company, there are several product versions in a product which are compatible. Especially on maintenance business version management is crucial and if not working properly it can leads needless product purchases of the latest version and lead the increasing inventory in the case of earlier versions. Compatibility tables have to be accurate to direct orders first available version to get order confirmation and to avoid manual rework on the customer orders later.

Demand forecasting is not actual part of order handling process but important part of efficient order fulfillment expressing the organizational complexity to separate tasks. In practice, high tech companies are usually poorly handling their demand forecasting causing a lot of problems to the product supply teams and especially subcontractors affecting the competitive capabilities of the whole supply chain. Poor forecasting is ruining the product supply and thus affecting the order fulfillment.

The majority of customer communication is done through order handling. One major problem faced in the case company is that the customer is getting too late the information of challenging order: either the company cannot fulfill the order without project delivery or delivery takes longer on some reason. The information of the status of order fulfillment and the options should be provided for the customer soonest but currently it can take even a month. It definitely leads to poor customer satisfaction and can even cause order cancellation in the future by lost customer loyalty. Also long communication chain will lead to overrun the targeted lead times, which is one month maximum depending on the deliverable. This also ruins the internal targets of on time deliveries which are set on procurement and warehouse personnel.

Challenge of logistical and technological product complexity

Problems arisen from different aspects of product complexity are not a special process related. Like in this case, order handling disciplines is not able to reduce the complexity of single products or the consequences or product proliferation. Many of the challenges of the order handling process derivates from different aspects of product complexity even though the studied case product was experienced to be a simple one. These aspects of product complexity should be taken into consideration when making product related decisions on product development and product management.

Besides, the personnel of order handling team is not responsible to create the capability to sell and order a product item. These capabilities need to be built during product development project. Product development program should ensure that they provide the required product information so that product is able to be sold, delivered and produced also in supporting information systems (mainly in ERP and Configurator). Developing ways for decreasing the number of available configurations and the number of optional non-forecasted products would decrease order handling and delivery availability problems. However, few of the companies are willing to do that since they are not internalized the consequences of complexity.

Reducing organizational and technological process complexity in the case company

In large, globally acting company organizational structure can affect broadly on operational performance. When working on multi-site environment, time difference is one notable factor in case the order is not fulfilled automatically. Communication is coming more challenging and delays occur. Emails are thus the most used way of communication which, however, can lead the information lack as occurred in the sample case. Email communication is not supporting fast problem solving.

Also the number of several teams that should focus on special tasks on process is narrowing the competence and increasing the need for communication. Thus it is important to think how the different roles and responsibilities should be divided to ensure the competence and reduce the need for communication over organizations. In this case, some teams could be justified to combine so that the team also could handle other than just the basic order cases. However, the teams of data management, or product supply should still remains as separate entities since they are not the actual order handling teams but supporting teams.

This case also showed that the awareness of the overall order-delivery process and understanding the consequences of own work for the overall performance would affect positively to make things right on the first time: if the sales person know that lacks on order will delay the whole delivery (s)he would be more willing to provide this information at the first hand. Also the case company is missing the unified performance measures to support the overall process and not only own organizational units targets. The organizational unit specific targets are leading only sub-optimization of the process and can in some cases be also conflicting with the objectives of other organizational units.

In case of order handling, information systems are on the notable role in large companies. In this case, tool development would certainly rationalize order handling but more important is that tools are developed so that those are supporting defined process tasks: prevent ordering items that do not occur, prevent ordering incorrect configurations, and prevent placing order with lacking details as an example. For sales, the role of Configuration tool is crucial and in the case of wide product portfolio it should exist in the first place.

CONCLUSION

The original aim of our research is to help the case company in developing their order handling practices. Even though their current order-delivery processes are often assessed to be excellent overall - complexity is raising problems that are challenging to tackle. It is notable that this study is made for outlining the problems occurring in the order handling process. The majority of the orders in our case company are running well but too often problems take place.

The nature of order handling is earlier studied more on general level. This study is providing an example of the exact problems occurring in high tech order handling process. Several problems of order handling process can be defined: incorrect orders (missing data in the order), high number of configuration mistakes, manual data transfer between tools, inadequate product data in information systems (missing data in case of ramp up or ramp down products), slow communication in case of incorrect orders, lack of resources, poor competence to understand the process entity (related tasks and wide product portfolio), and unclear roles and responsibilities among others. (RQ 1)

Many of these problems are caused by the complexity that globally acting, large high tech companies are currently facing also in general sense. Logistical and technical product complexity is causing gap on personnel competence which leads on simple order handling mistakes (such as ordering wrong items, incorrect configurations, missing data in information systems). Also the complex structure of organizations is blurring the roles and responsibilities even the process owner is described in quality systems. Today's trend to utilize outsourcing is making the order-delivery networks even more complex. Technical process complexity is emphasized on order handling process as the role of information systems is immense where system integration is one major challenge to rationalize operations. As a whole, in the case company major problems and complexity in order-delivery can be traced down on complexity in products. (RQ2)

Companies are driving for costs savings and one place for those is obtaining efficiency on operational processes. This study shows an example which could be a possible place for improvements of large high tech company's order handling process. This qualitative study would need quantitative information alongside to settle priorities for development according to actual incidence. However, this information was not available currently in the case company. This research did not consider the influences of order handling on customers or on other stakeholders such as suppliers or distribution. Especially, the influences of poor order handling should be studied with a much wider perspective in order to obtain the full cost view to order handling process in the future.

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SIMULATIN MODELING TO DETERMINE THE OPTIMAL SEQUENCING OF AGVS FOR AN AUTOMOTIVE ASSEMBLY LINE

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ABSTRACT

Transportation under automation vehicles is now popular in numerous industries because of their accurate working. AGV is one alternatives of these automate transportation systems. A serious problem caused by this system is a vehicle collision problem that increases the cycle time. This research studies transportation by AGV in an automotive industry. A Simulation model uses ARENA to simulate the work system in the assembly line of this industry by grouping the launch of AGV and using priority rule to define the optimal sequence. Three performance measures are average cycle time, work in process, and AGV utilization. This model can be applied to a factory that has similar operation systems and also be used as a decision making tool. The best rule that give the minimum average cycle time is launch the same group of AGV in the same time by sorting Smallest data balance First. From this, the average cycle time decrease by 23.64% from old system.

Keywords: AGV sequencing, priority rule, simulation

INTRODUCTION

The Assembly lines of the automotive industry need an automate transportation system to lighten load of workman. Due to its accurate working, AGV has been used to carry automotive parts between storage stations. Furthermore, the carrying of AGV can save the hiring cost and protect automotive parts from cracking and damaging.

The routing of AGV is significant because the cycle time depends on the distance that AGV route to destination station. The group of launching AGV and the priority rule can show the optimal AGV launching. This research proposes the simulation modeling to simulate the working system in automotive industry.

This industry faces the problem that the cycle time of some AGV not meets the objective by 24.50 minutes that reason of the AGVs traffic congestion problem so that cause increasing the average cycle time.

Literature Review

Sinreich and Tanchoco (1991) used a branch and bound model to minimize total vehicle travel distance (loaded plus empty). Other approaches to AGV system design for a JIT environment where performance measures emphasize lower inventories use analytical modeling of a multi-vehicle system.

Mahadevan and Narendran (1990) identified and analyzed several issues related to the design and operational control of AGVs when multi-vehicle systems were used. These issues are: (1) the number of vehicles required; (2) vehicle dispatching rule; (3) the traffic flow pattern; (4) the layout of the AGV tracks; and (5) decisions regarding provision of control zones. Their result indicates that the single-vehicle loop configuration performs better than the multi-vehicle systems in terms of certain performance measures.

Sharp and Liu (1990) examined a design issue with respect to adding shortcuts and off-line spurs to fixed-path, closed-loop AGV systems. They concluded that the savings in travel time and waiting time due to congestion was significant enough to justify the costs of building shortcuts and off-line spurs.

Yoo et al. (2005) addressed a routing method using a graph-theoretic approach for deadlock avoidance for an AGV system.

A System in Automotive Assembly Line

The assembly line industry is assembling the car by getting the automotive parts from supplier and assembles to customer order. The automotive parts were classified by type and stored in each station. The transportation of automotive parts is used by AGV and workman together. In this case the AGV routing was considered and there are 23 destination stations to deliver the automotive parts. The work procedure shown in Figure 1, The route of AGV shown in Figure 2. The workload, loading point, distance and destination of each AGV are also shown in Table 1

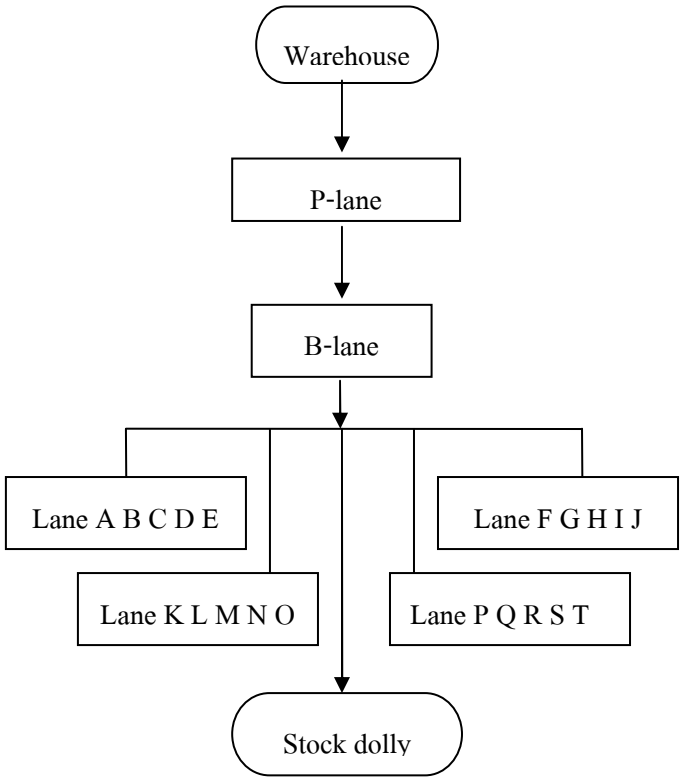


Figure 1 The work procedure

The work procedure can be describe as follows

1. The warehouse get the automotive parts from the supplier
2. P-lane sorts the parts to 18 lines in convenient for AGV to carry parts to B-lane
3. Grouping the parts by address (A to T) to distinguish the parts
4. AGV must carries parts from B-lane to destination station (load carriage shown in Figure 2) and sequence of launching AGV just classify into 4 group by the zoning of destination like this
   - Group 1 - A B C D E
   - Group 2 - F G H I J
   - Group 3 - K L M N O
   - Group 4 - P Q R S T
5. In each launch group, There are 4 AGVs, The sequence of inner group are First Come First Serve rule, and the interval of each group is 1.5 minutes (In one day AGV carried the parts around 18 cycles and the average cycle time is shown in Figure 3)

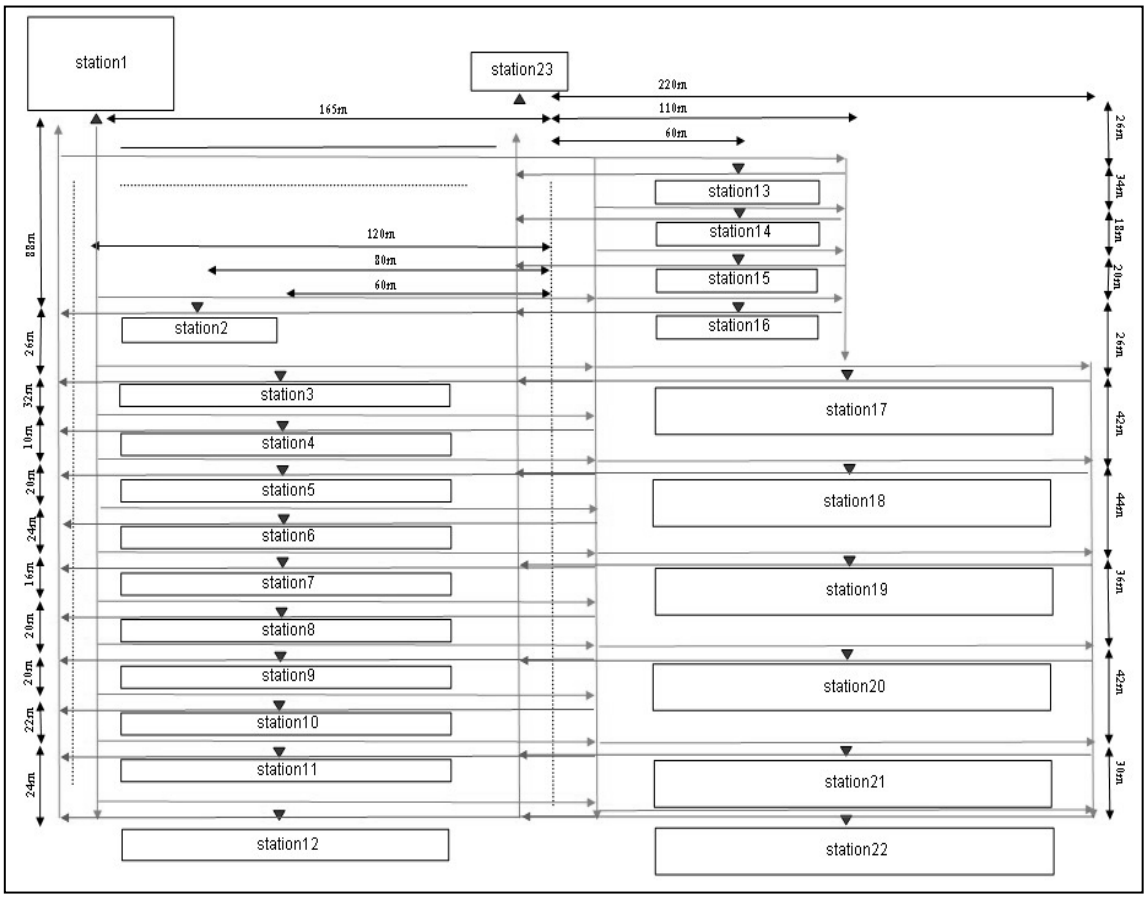


Figure 2 Transportation routes of AGVs

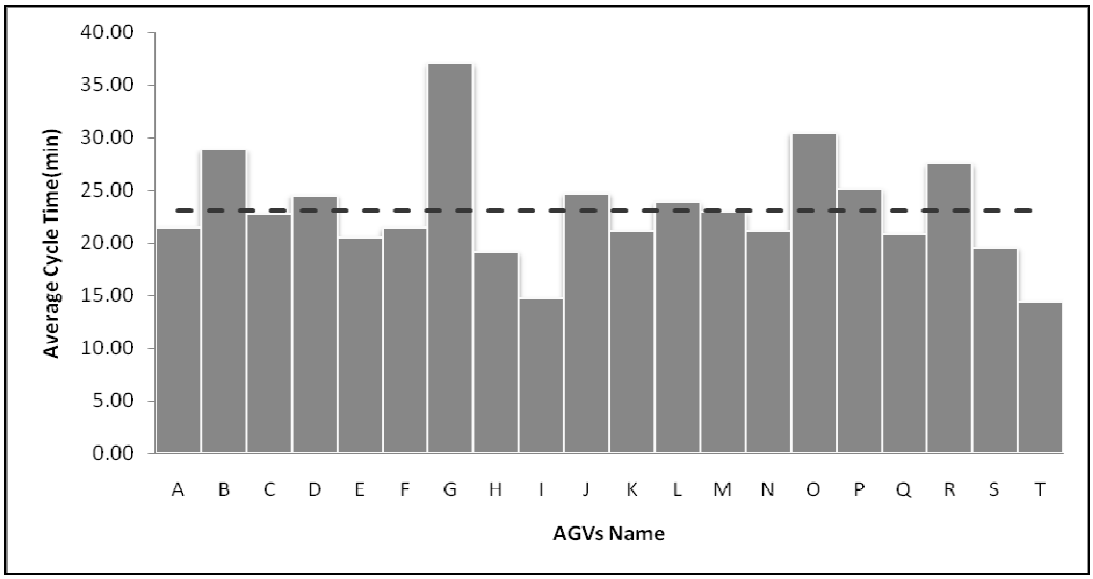


Figure 3 Average cycle time of each AGV from the old system

Table 1 Sequence of destination station, box of workload/sequence station, distance between station and Total distance of each AGV

AGV name	Sequence of destination station			Box of workload per sequence station			Distance between station(m)			Total distance(m)
A	2	12		145	425		128	294		1027
B	19	22	23	144	120	8	426	396	262	1249
C	17	18		902	54		368	246		955
D	18	19	20	204	232	38	394	252	246	1629
E	17	18		517	82		368	246		1081
F	17	18		472	266		368	246		933
G	17			301			368			933
H	13	15	16	24	296	289	230	212	140	901
I	14	15		476	487		240	138		749
J	16	17		80	305		278	160		1053
K	2	3	4	183	437	110	128	166	152	885
L	4	5		441	192		206	130		905
M	7	8	9	305	222	156	260	136	140	1065
N	9			504			296			825
O	8	10	11	172	167	96	276	160	142	847
P	11	12		400	172		338	154		1197
Q	10	20	21	540	12	3	316	196	246	1349
R	6	7		379	80		236	144		993
S	5	6		110	429		216	140		945
T	17			117			368			933

METHODOLOGY

The Group of Launching AGV

1. Group AGVs as the following

1.1 Balance distance and workload by calculate from
Data balance = **(S*v) + WL + SD**

Notation

S as total distance that AGV use in transportation (m)
v as AGV velocity (m/min)
WL as Workload (box)

SD as Standard deviation of transportation time

e.g. if AGV have total distance 1027 m, velocity 30 m/min, load carriage 289 boxes and SD 9.46 so data balance = 31108.46 then the four AGV with have nearest data balance were selected into same group.

1.2 Cycle time of each AGV was obtained from historical data

2. Set sequence of AGVs in each group by Priority Rule for Dispatching Jobs as

2.1 Largest Data balance First (LDF): this paper use LDF rule to select sequence of the launch AGV in each group which has longest data balance by sorting data from 1.1 descendingly and divide into 4 groups.
2.2 Longest Processing Time (LPT): this paper use LPT rule to select sequence of the launch AGV in each group which has longest processing time by sorting data from 1.2 descendingly and divide into 4 groups.
2.3 Smallest Data balance First (SDF): this paper use SDF rule to select sequence of the launch of AGV in each group which has longest data balance by sorting data from 1.1 asendingly and divide into 4 groups.
2.4 Shortest Processing Time (SPT): this paper use SPT rule to select sequence of the launch AGV in each group which has shortest processing time by sorting data from 1.2 descendingly and divide into 4 groups.

3. Launch AGV by Divided group
3.1 Launch the same group in the different time
3.2 Launch the same group in the same time

Simulation Model in Automotive Industry

Learning about transportation routing and work procedure of this industry and obtain data to use ARENA12 to simulate the transportation of AGV in 1 day (18cycles/day). The priority rules were tested using this model. The data were compare to select the optimal rule.

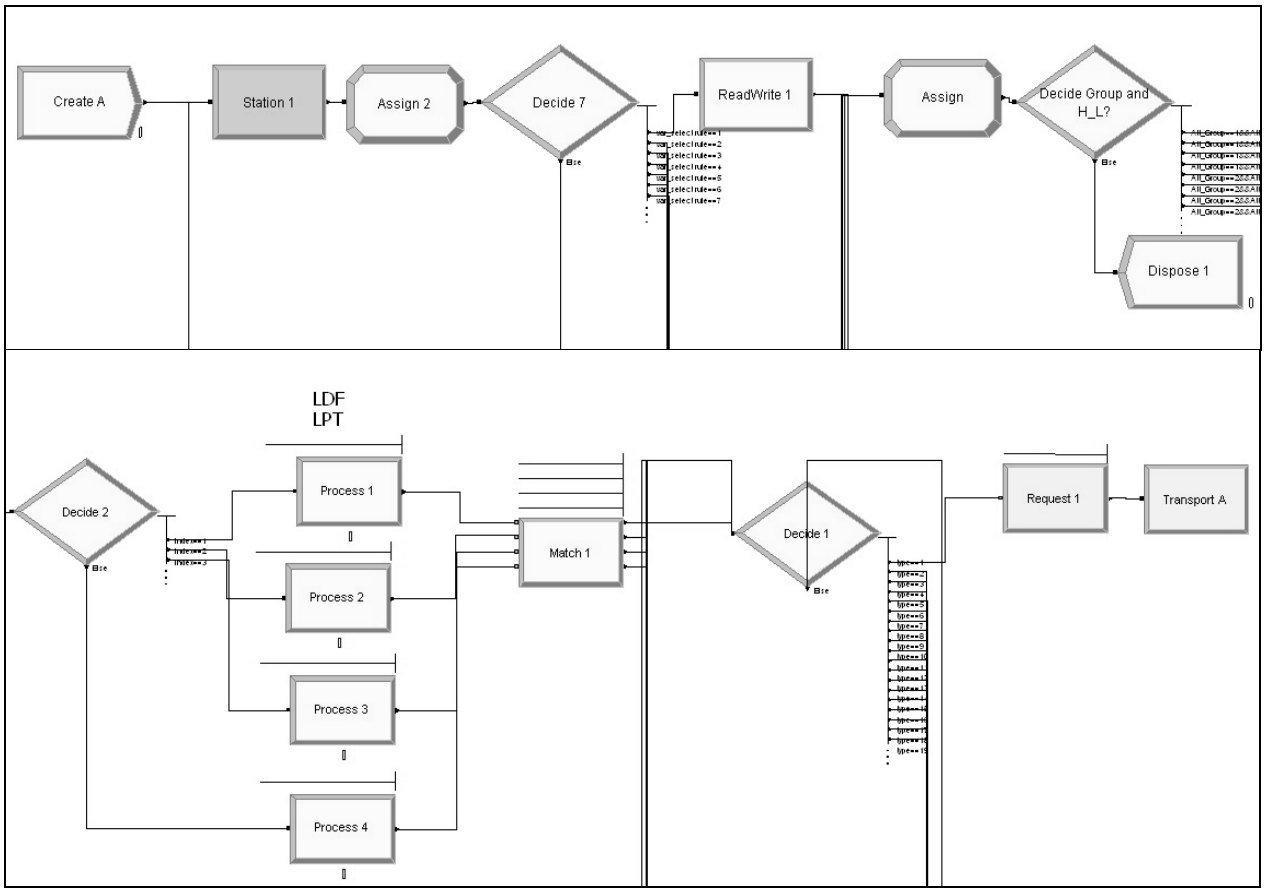


Figure 4 Simulation model for launching AGV by priority rule and reserving AGV

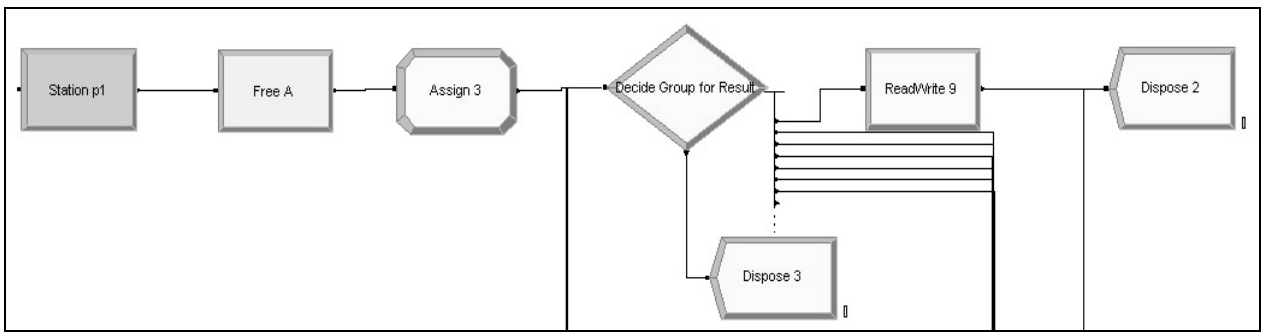


Figure 5 Simulation model for leave the AGV and report data

Figure 4 is an ARENA model that simulates the route of AGVs which has 23 destination stations and 20 AGVs. The system process starts from each AGV that carrying automotive parts arrives to the create module for transporting to destination that defines visitation by sequence spreadsheet module. The match module will group the four of AGVs for each group. After that request module and transport module will reserve the AGV for carrying the automotive parts. Given that the loading time in each station is 1 minute per each station.

The routes of AGV are specified by the network link spreadsheet module and the network module. Distance module will specify the distance that AGV must be transported.

Figure 5 is ARENA model that simulate the leave of AGVs and report data to the Excel file.

Simulation Model with Visual Basic Code in ARENA

The Visual Basic code in ARENA is applied to build a user interface. The program represents the criterion of launching AGV and dispatching rules. Based on the simulation model in Figure 4-5, the ARENA12 with Visual Basic code is written. The user form of rule selection is shown in Figure 6.

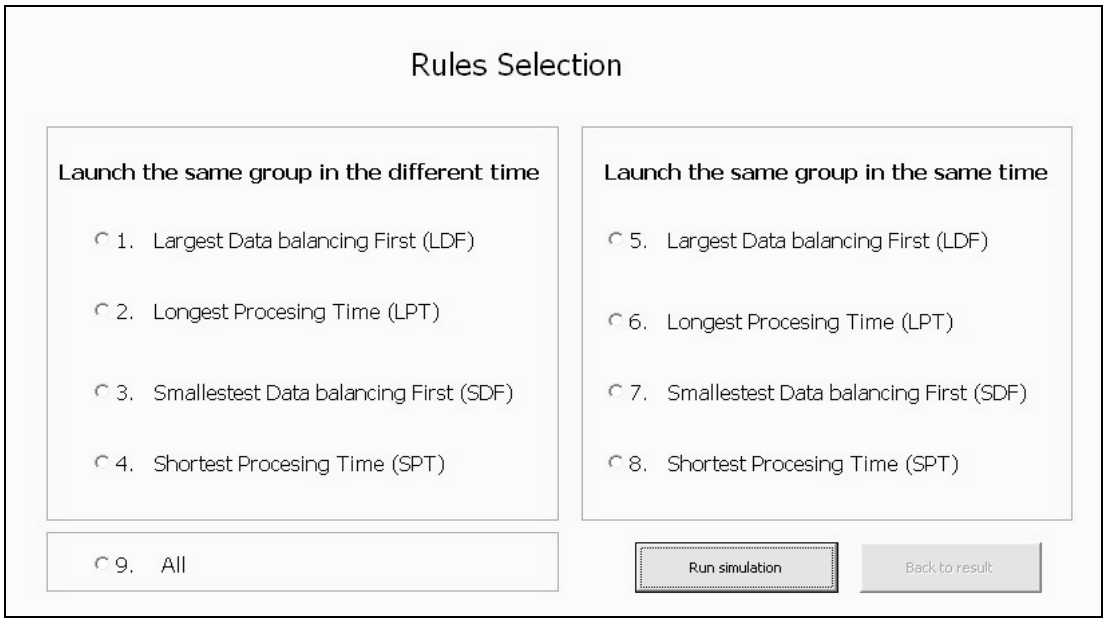
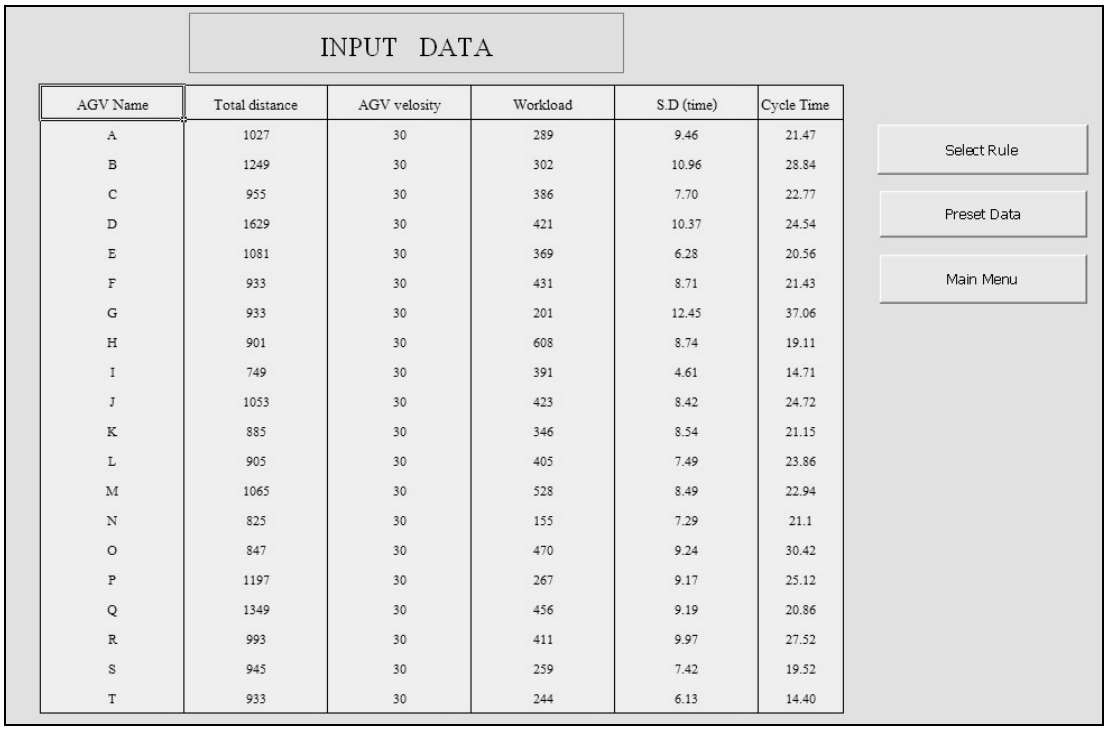


Figure 6 The user form of rule selection



AGV Name	Total distance	AGV velosity	Workload	S.D (time)	Cycle Time
A	1027	30	289	9.46	21.47
B	1249	30	302	10.96	28.84
C	955	30	386	7.70	22.77
D	1629	30	421	10.37	24.54
E	1081	30	369	6.28	20.56
F	933	30	431	8.71	21.43
G	933	30	201	12.45	37.06
H	901	30	608	8.74	19.11
I	749	30	391	4.61	14.71
J	1053	30	423	8.42	24.72
K	885	30	346	8.54	21.15
L	905	30	405	7.49	23.86
M	1065	30	528	8.49	22.94
N	825	30	155	7.29	21.1
O	847	30	470	9.24	30.42
P	1197	30	267	9.17	25.12
Q	1349	30	456	9.19	20.86
R	993	30	411	9.97	27.52
S	945	30	259	7.42	19.52
T	933	30	244	6.13	14.40

Figure 7 The user form of input data

The ARENA12 is generating every possible rule and then selecting the best way that give minimum average cycle time, based on the input data shown in Figure 7. The results show the appropriate rule selection shown in Table 2-4 and user form of result shown in Figure 8-9.

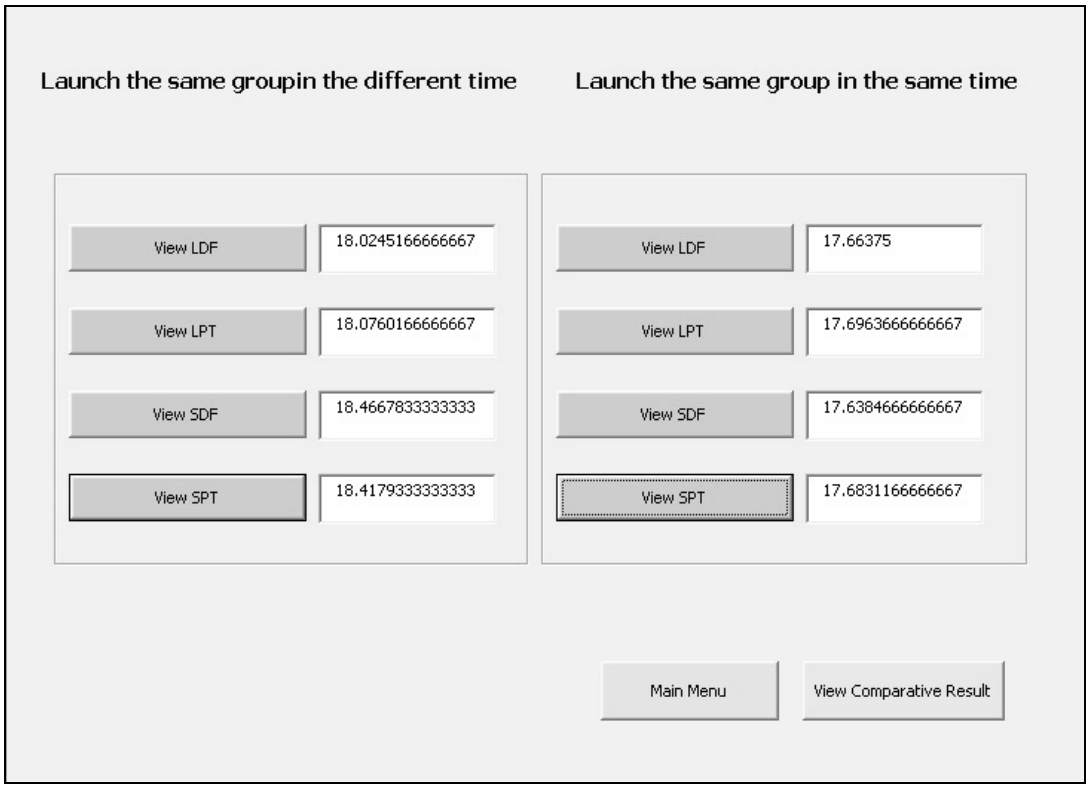


Figure 8 The user form of result from each rule

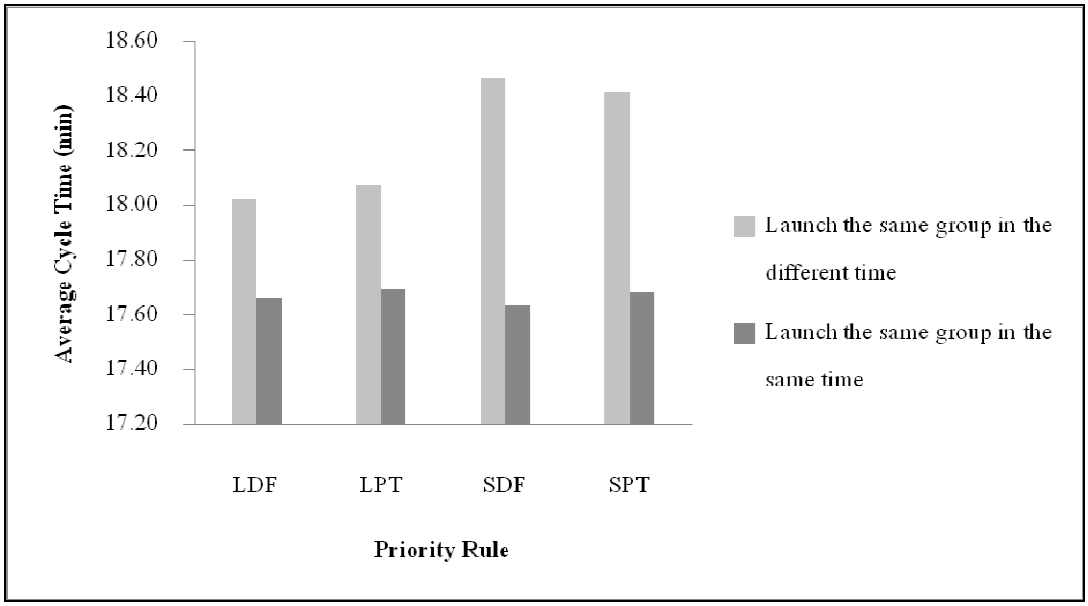


Figure 9 The user form of comparative result from each rule

Table 2 Average cycle time of AGVs with each group launching criterion

AGV	Average cycle time								
	Launch the same group in the different time					Launch the same group in the same time			
	Old system	LDF	LPT	SDF	SPT	LDF	LPT	SDF	SPT
A	21.47	15.77	16.9	16.38	17.41	15.35	16.46	15.41	16.37
B	28.84	18.31	18.91	18.3	18.75	17.36	18.08	17.2	17.76
C	22.77	19.23	19.91	21.76	19.66	19.22	19.89	20.99	19.12
D	24.54	22.79	21.99	21.01	21.85	22.04	21.25	20.43	21.52
E	20.56	25.7	23.81	23.15	22.3	24.55	22.58	22.57	22.02
F	21.43	19.63	20.5	22.27	22.08	19.84	20.51	20.62	20.3
G	37.06	18.15	16.76	18.92	20.02	17.96	16.61	17.89	19.1
H	19.11	21.04	22.11	21.74	20.97	20.64	21.79	21.78	21.14
I	14.71	15.67	16.19	15.64	15.72	15.28	15.58	15.1	15.29
J	24.72	21.75	24.85	21.67	19.2	21.34	24.45	21.76	19.21
K	21.15	21.46	20.13	20.48	21.13	20.67	19.24	19.31	20.01
L	23.86	14.15	15.2	16.73	15.59	13.77	14.88	14.47	13.25
M	22.94	15.93	16.05	16.5	17.42	15.89	15.97	16.06	17.06
N	21.1	19.39	16.85	17	18.57	18.73	16.04	16.48	18.16
O	30.42	14.76	13.47	16.1	15.97	14.97	13.64	15.59	15.77
P	25.12	10.76	10.34	13.98	14.28	11.46	11.08	12.16	12.49
Q	20.86	19.47	18.5	19.02	18.87	18.59	17.59	18.01	17.89
R	27.52	11.68	11.74	11.14	11.34	11.36	11.29	11.61	11.8
S	19.52	16.2	18.27	18.94	17.63	16.39	18.69	17.39	16.29
T	14.4	18.65	19.05	18.63	19.61	17.86	18.31	17.94	19.1
Average	23.1	18.02	18.08	18.47	18.42	17.66	17.7	17.64	17.68

Table 3 Average work in process of AGVs with each group launching criterion

AGV	Average work in process							
	Launch the same group in the different time				Launch the same group in the same time			
	LDF	LPT	SDF	SPT	LDF	LPT	SDF	SPT
A	8.66	9.02	9.53	9.17	5.95	6.02	5.3	5.73
B	7.64	8.05	8.82	8.2	6.73	6.61	5.92	6.21
C	9.18	9.12	10.9	9.53	8.38	8.18	8.12	7.52
D	8.69	8.85	9.6	8.69	8	7.28	6.59	7.06
E	9.77	9.77	11.49	9.59	10.11	8.78	8.25	8.19
F	10.15	10.82	11.34	10.35	8.17	7.97	7.53	7.55
G	8.85	8.7	9.65	9.09	7.4	6.45	6.54	7.1
H	9.3	9.94	10.69	9.56	8.5	8.47	7.96	7.86
I	7.96	8.05	9.06	8.49	6.66	6.41	5.84	6.02
J	10.9	11.37	11.91	10.51	10.75	11.38	10.02	9.30
K	10.6	10.76	11.68	10.55	9.01	7.92	7.47	7.88
L	6.76	7.51	8.88	7.22	6.00	6.12	5.60	5.22
M	7.71	8.13	8.85	8.21	6.15	5.84	5.52	5.97
N	8.67	8.09	9.21	8.79	8.16	6.6	6.37	7.15
O	7.28	7.11	8.73	7.81	6.53	5.61	6.03	6.21
P	5.54	5.65	6.79	6.03	4.72	4.31	4.44	4.64
Q	7.55	7.68	9.04	7.84	7.20	6.43	6.19	6.26
R	5.29	5.52	6.52	5.85	4.95	4.65	4.49	4.64
S	8.13	8.52	9.34	8.5	7.14	7.69	6.73	6.41
T	8.73	9.01	9.5	9.24	7.35	7.12	6.56	7.10
Average	8.37	8.58	9.58	8.66	7.39	6.99	6.57	6.70

Table 4 Utilization of AGVs with each group launching criterion

AGV	Utilization							
	Launch the same group in the different time				Launch the same group in the same time			
	LDF	LPT	SDF	SPT	LDF	LPT	SDF	SPT
A	0.75	0.71	0.76	0.75	8.66	9.02	9.53	9.17
B	0.87	0.85	0.92	0.88	7.64	8.05	8.82	8.2
C	0.68	0.66	0.69	0.68	9.18	9.12	10.90	9.53
D	0.95	0.93	1.00	0.96	8.69	8.85	9.60	8.69
E	0.69	0.65	0.71	0.68	9.77	9.77	11.49	9.59
F	0.68	0.65	0.69	0.69	10.15	10.82	11.34	10.35
G	0.67	0.65	0.69	0.69	8.85	8.70	9.65	9.09
H	0.67	0.65	0.68	0.69	9.3	9.94	10.69	9.56
I	0.42	0.42	0.45	0.41	7.96	8.05	9.06	8.49
J	0.47	0.46	0.48	0.49	10.9	11.37	11.91	10.51
K	0.54	0.53	0.57	0.54	10.6	10.76	11.68	10.55
L	0.53	0.52	0.55	0.54	6.76	7.51	8.88	7.22
M	0.66	0.64	0.68	0.69	7.71	8.13	8.85	8.21
N	0.46	0.44	0.47	0.45	8.67	8.09	9.21	8.79
O	0.74	0.72	0.74	0.73	7.28	7.11	8.73	7.81
P	0.73	0.72	0.76	0.75	5.54	5.65	6.79	6.03
Q	0.85	0.84	0.9	0.87	7.55	7.68	9.04	7.84
R	0.58	0.58	0.63	0.60	5.29	5.52	6.52	5.85
S	0.56	0.54	0.6	0.57	8.13	8.52	9.34	8.50
T	0.67	0.65	0.69	0.67	8.73	9.01	9.5	9.24
Average	0.66	0.64	0.68	0.67	8.37	8.58	9.58	8.66

Verification

To create transportation model of AGV, it should be studied detail about work procedure of automotive assembly line and use them to create a synchronous model.

Validation

The validation is the comparison of data from simulation model and the real data from the industry (Figure 3), an average cycle time is used to validate the model. After creating simulation model, We tested the AGV launching rule of the industry and found that the average cycle time from the model is close to the historical data from the industry because of percent difference of each AGVs are lower 10% .Therefore the model is valid.

CONCLUSIONS

Two strategies to grouping the launch of AGVs are launching the same sequence in difference group together and launching the same group together. The priority rule that used to specify the inner group sequence of AGVs are Largest data balance First (LDF), Longest Processing Time (LPT), Smallest data balance First (SDF), Shortest Processing Time (SPT)

Three performance measures are average cycle time, average work in process, Utilization. We found that Launching AGV by same group in the same time with Smallest data balance First gives the minimum average cycle time of 17.64 minutes that decrease from old system 23.64%. In addition, this rule gives the minimum work in process and confidence and maximum utilization as well.

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