



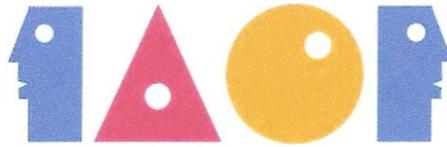
# THE INTERNATIONAL JOURNAL OF ORGANIZATIONAL INNOVATION

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## **Organizational Determinants of Green Innovation Implementation in the Logistics Industry**

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### **ABSTRACT**

The purpose of this study is to examine the influences of organizational factors on the implementation of green innovations in the logistics industry. The data came from the questionnaire survey on logistics companies in Taiwan. Research findings reveal that organizational support for innovation, the quality of human capital, and organizational knowledge accumulation are significantly positively associated with the implementation of green innovations. According to research results, managerial implications and opportunities for future research are discussed as well.

**Key words:** Green innovation, Logistics industry, Organizational determinants

## **INTRODUCTION**

Environmental issues have become critical concerns all over the world. Commitment to the natural environment has become an important variable within the current competitive scenarios while companies worldwide are continuously trying to develop new and innovative ways to enhance their global competitiveness. An amount of companies have enhanced their competitiveness through improvements in their environmental performance to comply with mounting environmental regulations, to address the environmental concerns of their customers, and to mitigate the environmental impact of their production and service activities. As many realize that customers and other stakeholders do not always distinguish between a company and its suppliers (Bacallan, 2000), more and more companies have started to undertake significant efforts towards establishing green supply chain management (GSCM) initiatives (Srivastava, 2007; Zhu, Sarkis & Lai, 2008). Logistics operations play a significant role in GSCM. With the rapid development of the GSCM, the importance of environmental management for the logistics industry has increased dramatically. To deliver products and services to customers more environmentally, logistics companies need to address more efforts on environmental issues (Murphy & Poist, 2003). Integrating environmental management and logistics services has become an important topic for the logistic industry.

Although there is a burgeoning body of literature involving the environmental issues in a variety of business disciplines such as manufacturing and marketing, the corresponding literature involving logistics has been still small but expanding. Up to date, only a few researchers studied environmental issues for the logistics industry (Murphy & Poist, 2003; Rondinelli & Berry, 2000; Wong & Fryxell, 2004). Scant attention has been paid on how these possible determinant factors influence the implementation of green innovations for logistics

companies. The operation of logistics services often leads to several negative impacts on the natural environment, including air pollutants, hazardous waste disposal, solid waste disposal, fuel consumption, and others (Rondinelli & Berry, 2000). This suggests that it is necessary to study environmental issues in the logistics industry. Although a body of research on the implementation of green innovations in the manufacturing sector can provide some guidelines for the development of environmental management in the logistics industry, it is still required to conduct more research on environmental issues in the logistics industry, as firms in different industrial sectors may exhibit dissimilar attitudes toward environmental issues (Zhu et al., 2008). Therefore, the main purpose of this paper is to explore the factors that affect the willingness to implement green innovations in the logistics industry. An understanding of the influencing factors is essential for practitioners to best implement green innovations, and for researchers to best understand what issues need to be addressed.

## **THEORETICAL BACKGROUND**

Innovation is the use of new technical and administrative knowledge to offer a new product or service to customers. It includes any practices that are new to organizations, including equipments, products, services, processes, policies and projects (Kimberly, & Evanisko, 1981). Because the application of green practices in the logistics industry is still in its infancy, the adoption of green practices can be taken as an innovative process for a logistics company. Among several factors influencing innovation, organizational factors are the most widely analyzed in research on innovation (Kimberly & Evanisko, 1981; Tornatzky & Fleischer, 1990). This paper will investigate the influence of organizational factors on the intention to implement green innovations.

Certain features of organizations themselves, including structures, climates, and cultures of organizations, will influence innovation (Kimberly & Evanisko, 1981; Tornatzky & Fleischer, 1990). The management skills, organizational encouragement for innovation, and support of innovation resources would help the improvement of organizational innovation. The support and encouragement of top management is considered an essential factor for the development of innovation strategies because the resources required for the implementation of new technologies will be more easily available if the major person responsible for these resources supports the plans. Moreover, many initiatives of adopting new technologies require the collaboration and coordination of different departments and divisions and this is easier to manage when such initiatives are endorsed from the top. Therefore, we would expect that support for innovation might influence the implementation of green innovations. The following hypothesis is consequently proposed:

***Hypothesis H1** The more the support for innovation, the more the willingness that logistics companies will have to implement green innovations.*

Informal linkages and communication among employees, the quality of human resources, top management's leadership behavior, and the amount of internal slack resources would significantly influence the adoption of technological innovation (Tornatzky & Fleischer, 1990). Technologies can be viewed as one kind of knowledge (Grant, 1996.) An organization will have higher innovative capability when knowledge can be distributed more easily within the organization. Higher quality of human capital such as employees with better education or training is helpful to distribute technological knowledge in an organization. The higher the percentage of employees trained in learning innovative knowledge is, the higher the development of the organization' innovative approaches will be. Therefore, we would expect

that the quality of human capital might influence the implementation of green innovations. The following hypothesis is consequently proposed:

***Hypothesis H2** The higher the quality of human capital, the more the willingness that logistics companies will have to implement green innovations.*

How the technology fits in with the operational knowledge that a firm already possesses is an important factor influencing innovation (Tornatzky & Fleischer, 1990). Innovation usually follows a technological paradigm (Teece, 1996). The organizational accumulation of related knowledge will influence the innovation in technologies. An organization with rich experiences in the application or adoption of related technologies will have higher ability in technological innovation (Grant, 1996). The companies that have an adequately integrated innovation capacity will recognize its express purpose to solve problems. Thereby, the most advanced and most competence- modifying technologies will emerge as a result of accumulated R&D activities. Therefore, we would expect that organizational accumulation of related knowledge might influence the implementation of green innovations. The following hypothesis is consequently proposed:

***Hypothesis H3** The more the organizational accumulation of related knowledge, the more the willingness that logistics companies will have to implement green innovations.*

## **METHODOLOGY**

To examine the possible factors influencing the intention to adopt green practices for the logistics service provider, data were collected by means of mailing questionnaires to logistics companies in Taiwan. This region is interesting because, due to the trend of global

environmentalism, Taiwan's government, industries, and organizations have begun to stress much emphasis on environmental issues for the sustainable development of Taiwan. Moreover, Due to the trend of globalization, Taiwan's government has delivered several policies to make Taiwan become a global logistics center. As efficient and effective logistics is one of the key success factors that makes Taiwan become one of the important sources of electronic hardware products in the world (Shan & Marlow, 2005), it is necessary for Taiwan's logistics industry to implement environmental innovations to help Taiwan's manufacturing companies develop their green competitiveness. The sample frame was drawn from members of the Logistics Council in Taiwan. Five hundred questionnaires were mailed to the sampled companies. In total, 164 completed questionnaires were returned. Of these respondents, 11 unconfident questionnaires were excluded. The overall response rate is 30.6 percent.

The green innovations for the logistics industry suggested by Murphy and Poist (2003) are taken as the green practices in this study. Organizational support for innovation is measured according to the degrees that companies' resource supports and leaders' attitudes (Tornatzky & Fleischer, 1990). Quality of human capital is measured according to employees' information skills and innovation capabilities (Tornatzky & Fleischer, 1990). Organizational accumulation of related knowledge is measured according to the degrees of fitness of related technologies a firm that possessed (Grant, 1996). Each item is measured using the 5-point Likert scales anchored by 'strongly disagree' and 'strongly agree'. The measured scales were submitted to factor analysis. Factors with Eigen values greater than 1.0 for each characteristic are summarized. The result of factor analysis confirms the construct validity of this study. According to the reliability coefficients, the smallest value of Cronbach's alpha for this study is 0.7991. This implies that the sampling results are reliable (Nunnally, 1978).

## RESULTS AND DISCUSSIONS

To find the influences of organizational factors on the implementation of green innovations, the method of multiple regression analysis was used in this study. Support for innovation, quality of human capital, organizational knowledge accumulation and company size are taken as independent variables and the willingness to implement green innovations is taken as the dependent variable. Moreover, company history and company size (Spencer, 2003) are taken as the control variables in the regression analysis. The standardized results of regression analysis are shown in Table 1. We can find that the proposed organizational factors have positive influences on the implementation of green innovations. Support for innovation, quality of human capital, and organizational knowledge accumulation all exhibit significantly positive influences on the willingness to implement green innovations for logistics companies in Taiwan. This means that the hypotheses, *H1*, *H2*, and *H3* are supported. More accumulation of environmental knowledge can make logistics companies have more abilities to implement green practices. Organizational support for innovation can give employees motivation and support to adopt new logistics technologies, such as green innovations. High quality of human capital means that employees are capable of learn and use innovative green technologies.

## CONCLUSIONS

It is generally perceived that green innovations help to enhance environmental performance. Many companies have undertaken significant efforts towards adopting green innovations. The motivation and driving forces for implementing green innovations have been examined in a body of research; however, most of them focused on manufacturing sectors.

There are some explanations as to why manufacturing firms should engage in environmental activities. Yet, all

Table 1 Standardized Regression Results for the Green Innovation Implementation

Dependent variable: Willingness to implement green innovations		
Independent/Control variables	Coefficient $\beta$	<i>t</i>
Support for innovation	0.174	4.912**
Quality of human capital	0.199	5.117**
Organizational knowledge accumulation	0.129	4.986**
Company history	0.036	0.873
Company size	0.102	4.543**
$R^2$		0.558
adj $R^2$		0.517
F		8.336**

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

companies are not exposed to the same types of pressure or to the same extent. Thus, there is a clear research need to determine the potential factors that will influence the willingness to adopt green practices for service sectors. This paper gives some explanations as to what organizational factors influencing the intention to implement green innovations for the logistics industry. Based on the research results, we can find that logistics companies can also increase their abilities to implement green innovations by accumulating more related technologies, by encouraging or supporting their employees to learn new technology and by training and educating their employees to become knowledge workers.

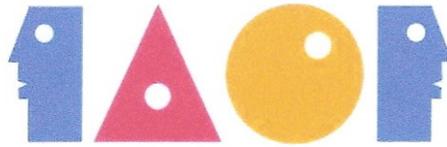
There are some limitations to our research. Because we used the questionnaire survey, it is possible that the results of this study might suffer from the respondent bias. As we know, logistics companies cover a wide range of service types. In this study, we did not take the influences of service types of logistics companies on the adoption of green innovations. There

might be different effects of organizational factors on green innovation implementation for different logistics service types. It is worthwhile to make a further study on the moderating effect of logistics service types. Moreover, other possible influential factors on the implementation of green innovations will also be taken into considerations in a further study. In addition, this paper only studies logistics companies in Taiwan. The current study may be limited in its generalizability. While there are differences between Taiwan and other countries in political structures, cultural background, historical perspective, social value, and so on, logistics companies in different countries may have different views on the influences of these organizational factors on the implementation of green innovations. It will be worthwhile to advance a cross-national comparative study on green innovation implementation among logistics industries in Taiwan and in other countries.

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**Impact of Chinese Cultural Development and Negotiation Strategies, FDI,  
Competitiveness, China International Business Growth, and Management Practice**

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**Abstract**

In this study, the Chinese culture and business strategies, as well as the effect of Chinese values on business and management practices are considered. Next, four critical points of traditional Chinese business are addressed. This is followed by a discussion of how the Chinese business family goes international. In addition, Chinese value adjustments to compete indirectly are discussed. Next is illustrated the change from competition into collaboration. Foreign direct investment (FDI) in China is studied. Furthermore, partner choosing in China, and operating with business partners in China are discussed. This is followed by negotiation challenges with the Chinese, resource contributing negotiation, and bargaining with the Chinese government is explored. Finally, Chinese MNCs strategies for competition and competing in China are explored. In this study, the Chinese business family shall undergo organizational transformation and strategic redirection over the next twenty years, as internal and external pressures challenge the traditional Confucian principles practiced by Chinese families and businesses throughout their history. The Chinese emphasize the interpersonal and social dimensions as well as taking a long term perspective look at how cultural differences inform the three major categories of negotiation context, negotiation teams, and process.

**Keywords:** Cultural development, bargaining, values, Chinese business, and interpersonal/social dimensions of business.

## **The Consequence of Chinese Culture, Strategies and Values on Business and Management Practices**

Chinese businesses are often connected to families. In fact, the majority of Chinese businesses outside China are family-owned. Family concerns drive business decisions of all sizes from small to multinational organizations. The family serves as a broader societal network of morally binding, mutually dependent relationships. In the past China, all sons had equal rights that extended economic obligations to the whole family.

### **Four Critical Points of Traditional Chinese Business**

Four factors critical to traditional Chinese business are as follow: (1) family-accountable corporation, and the family-finance, (2) family obligations and roles, (3) the domination of family head, and (4) family-oriented operation.

### **Family-Accountable Corporation and Family-Finance**

Since they are Family-centered organizations, Chinese businesses do not depend heavily on external institutions such as banks, but they function with a degree of independence and flexibility that is difficult to imagine in a Western business organization. Organizational reporting depends on the personal nature of relationships among officers. Agreements may simply be made over a social gathering or at a family lunch. Record maintaining tends to be informal and remains within the family. Hiring decision making is always based simply on personal recommendations, with background checks from calls placed to trustworthy contacts or close friends. Indeed, for Chinese businesses, a potential employee's personal reputation is more valuable than a salary history or a formal record of achievements. Such informality can lead to confusion about expectations and responsibilities and may build an environment that lacks balances and proper checks. Under the family-based system, decisions may be made with

lower costs and greater speed, and the emphasis on personal trust cuts the need for external institutions, such as lawyers and banks and both paperwork.

While Chinese companies adapt to compete in a new Western-led international expand and reality beyond the family's reach, the business family's basic structure shall be subject to growing tensions. The following discussion will focus on how Chinese business families must face the new economy to reduce the tension between international pressures and traditional approaches.

### **Family Obligations and Roles**

Family businesses pass from one generation to the next. At present, family business tends to be more of a source of financial support. It is a connection with their past: their grandparents, and their parents. However, the extended family often gives preference to family over professional managers. Family members may not be the best qualified for the job, and their privileged position in company can demoralize professional managers.

### **The Domination of Family Head**

Western executives like to control Chinese family business by making all the critical decisions for the business. The family leader has the final say in all major decisions. Without their approval, nothing of result happens. The strength of family leaders builds the core of the business organization. Around them, long-term friends and trusted family members serve as supply the family head and close advisers with much of information, instead of reporting information step-by-step through a hierarchy of commands. In consequence, managers may be left out and feel frustrated. This discourages Western businessmen who do not know the principles which business family system works. The Western CEOs should take time to know

the power in the Chinese firm, and carefully develop relationships with - business's family member.

### **Family-Oriented Operation.**

Chinese family business is guided by those who created the business, and family members keep positions in business. Generally, Chinese families prefer to hold their information in strict privacy. When becoming public, the original family will continue to control the firm's principal businesses and operations. Family members participate in the responsibility of business operations. Family business always spread across different regions as well as industries.

### **The Chinese Business Family Goes International**

More and more, Chinese firms are expanding from their home markets into other parts of the world. Chinese family businesses are applying global business practices as well as standards. To become globally competitive, family businesses must push for more professional management as well as specialization. A good manager must have specific knowledge of his technology and industry, as well as ought to be a strong team player and be creative. Currently, it innovation and the opportunity of reorganization business occurs as it is passed to the next generation. Succession is currently forcing businesses to adapt new, as well as foreign practices. The new generation studies in professional business schools in Asia or they graduate from Western educational institutions. Studying and working abroad offer opportunities to the younger generation and they move away from intensive family network as well as traditional conservative of their own. New management to Chinese family business moves smoothly into the new economy.

### **Chinese Value Adjustment to Compete Indirectly**

As latecomers to international markets, Chinese business must adjust their plans to compete with their more family established and much stronger Western competitors. Chinese strategic selections are strongly effected by their rivals market positions as well as relative economic strength. Because Chinese enterprises follow up with these stronger competitors, they have quickly learned analytical tools as well as Western rivalry concepts and traditional Chinese values are removed. However, as Chinese business applies strategy practices and Western management, they are likely to use their own style. To avoid costly competition, they select a market where there are few if any rivals. Chinese firms take advantage of under-utilized markets ahead of their competitors and they like near-monopolies in their early initiatives.

### **Change From Rivals To Collaboration**

Other ways which Chinese have adjusted to escape confrontation is by turning potential rivalry situations into opportunities for collaboration. The Chinese find channels of common ground as part of competitive strategy. Chinese enterprises' cooperation with their rivals in certain situations may increase regulatory concerns for Western enterprises. Chinese business often escape conflicts with local officials and general respect for authority as well as because the costs of conflict could be much. As the worlds most populated country, China is in the privileged position to select their collaborators, as well as other various conditions. The Chinese have strong feelings of maintaining face and self-sufficiency. This contributes to the strength and uniqueness of the Chinese approach to treating with others. The Chinese business tries to minimize direct confrontation. In consequence, they are more patient than Westerners. Their cultural preference for social interaction is consistent with the Chinese manner of talking and discussion rather than problem solving and direct debate. The Chinese will stress

relationship-building and more informal interactions of the pre and post treating periods rather than formal negotiation. The Chinese long-term perspective as well as their personalize attitude to business may be looked to Western eyes towards a measure of more social element, and informal in treating process.

Chinese negotiation stages, pre, and post formal, always change from case to case. The Chinese treating process depends on business and repeated social interaction. Western enterprises apply formal negotiation. For the Chinese, pre and post negotiation may be more important, because the relationship is begun and commitment is secured. Negotiation success with Chinese depends much on duration and quality relationships. A contract ought to not often be discussed as the document often denotes Western legal sentiment; it looks as consent between two parties on the general principles. Western businessmen expect to reinterpret points and renegotiate contract during their total working relationship with Chinese party. The signing of a contract does not mean the end of business relationship development, rather the beginning of an ongoing process. Negotiation process is continuous after joint venture agreement is contracted. To be successful, we must make a continuing commitment of treating. In China, post negotiation is crucial as a means of facilitating a continuing working relationship. The Chinese are very respectful and sensitive to rank as well as role. In the treating process, enterprises social status and titles are crucial part of projecting gaining respect and authority. The Chinese rapidly assess the authority and power of the Western treating team. If our senior men are not able to achieve the negotiations, we can find creative channels to increase status of negotiators of job. Applying a phone call from high-ranking executives with prestige shall be an effective way for Chinese leaders' concern for status. Using such strategy, the Chinese ought to send senior officers to the treating game to receive new agreement, and ask the higher-

ranking Western officers to participate in the treating. The Chinese group introduced during the pre-negotiation shall usually handle the rest of the total marketing process. The treating group usually does not have actual final decision-marketing power. They are responsible to collect information. In formal treating, we ought to apply an explicit language, in clearest sign of consent. In the Chinese mind, indirect communication is one type of cooperation, to expect their Western negotiators to do the same, if they care to keep the relationship. Chinese leaders often work hard to sure that various parties are well served and consulted. In People Republic of China (PRC), foreign enterprises must be aware and pay close attention to government regulations. All obligations should be approved by several independent agencies of government. Government policies not only change from one region to another, but change quickly. Overseas Chinese business is different from PRC businessmen, with more usage of the Western treating style. However, they still keep traditional Chinese business family values, which influence their attitudes and objectives in decision marketing process.

Overseas Chinese leaders strive to be trusted or use family members who act day-to-day in business. These actors relate to and understand its business partners, as well as the firms' others. Western professional leaders apply pressure to sign a special contract. Government has a less influential role in overseas Chinese leaders than he does in PRC treating. The overseas Chinese possesses good relationships with domestic Southeast Asian governments. Western business needs to be more effective in coping with overseas Chinese in nations like Malaysia, Indonesia, as well as Thailand because they have alternative of signing contract in Singapore or Hong Kong, where more developed Western style legal systems are applied.

## **Foreign Direct Investment in China**

Convincing foreign direct investment (FDI) is a critical path of China's policy to open to the outside world. It enables China to receive valuable capital resources. More crucially, it leads to improvements in management skills, advanced technology, and access to overseas markets. All these are of critical importance for China's economic development. The Chinese government has applied a series of preferential policies to convince foreign direct investment. In consequence, FDI has been very successful and is growing every year. A new FDI trend is the fast growth of investment by multinationals, augmenting technology-intensive projects and inflows of capital from great multinationals. With increasing impact on global markets, China's land-use fee is low, the state has granted preferential treatment in corporate income taxes, and labor is cheap. With their inclusion into the WTO, they can attract leading sophisticated technologies and multinationals by feting their advantages in geographic location, service system, supply of parts and components, infrastructure, investment environment, talent quality, technology and level of science, as well as government efficiency. In the same view, inland regions with advantages in labor costs and land, concentrate on convincing small and medium size investments. FDI in the early years was important in the form of Chinese foreign joint ventures. Wholly foreign-owned companies received popularity in later years, and currently they have become the primary form of FDI in China.

## **Partner Choice in China**

If you must form a joint venture (JV) in China, the challenge is to discover the perfect partner; selecting an active, value-added partner that brings to the venture valuable government-relations, industry knowledge, and business connections, as well as financial

strength. The potential for successful business partnerships in China is enhanced by using the following practices:

1. Shared standards and ethics
2. Effective decision-making
3. Good communications
4. Mutual trust

### **Shared Standards and Ethics**

The potential highest risk of friction in a JV or between MNCs and Chinese firms is in reconciling differing concepts of ethics and standards. For most global companies, the MNCs must find means to guarantee that the local partner adopts corporate procedures and practices. The first decision for MNCs in China is to decide whether to seek joint ventures or to operate as a wholly foreign-owned enterprise. Regulations currently permit international enterprises to invest in more sectors. The first step is to be clear on current regulations. JV is able to offer significant benefits, particularly in providing expertise in negotiating with government offer established operations, and market knowledge.

### **Accountability**

Another frustration in work with JV partners is the possibility of Chinese executives to avoid personal accountability for business decisions.

### **Good Communications**

Global managers must work with Chinese business partners to communicate effectively without causing a loss of “face”. One critical problem is that Westerners like unambiguous, clear communication, while Chinese always rely on an indirect, imprecise manner. Chinese

managers are trained in a business culture in which it is better to avoid speaking of problems to a superior if possible. Generally the Chinese prefer communication, which provides two benefits: avoiding conflict by preserving “face”, and preserving harmony.

### **Mutual Trust**

Global managers agreed that lack of trust is a primary cause of many problems arising in domestic-foreign JVs in China. Winning the trust and support of partners is important for success. Some Chinese managers believe that foreign investors can find their investment as soon as the partnership is formed. Chinese partners often provide land and buildings, which appreciate over time, but MNCs tend to provide equipment and technology that devalue over time. Partnerships often fail when the foreign partner takes a short-term, profit-oriented view.

### **Operating With Business Partners in China**

Factors influencing our decision making to seek joint ventures or not:

- Identify the Regulations and investigate how the regulations pertain to our enterprise, our sector and the region of China we seek to enter.
- In JVs case, apply JVs when local partner supplies market knowledge and connections with authorities that is the partner is unable to achieve on its own.
- In case Against JVs, they are particularly faster, simpler, and more efficient to operate.

The following are guides in how to select a partner:

- Select an active partner, select Chinese partners that can contribute toward the firm goals by introducing insight into the local business environment, a strong client base, established operations, and skill at negotiating with government.
- Identify partner by visiting JV partner, asking for detailed operating records and financials and gathering input from industry insiders.

- Select a weak partner that you can easily monitor.
- Gain agreement of goals with partner.

### **The Challenges of Culture in China**

Culture is the collective sharing of values and norms by groups of people that generally live in specific nations or geographical regions. Facets of culture include religion, language, attitude and values. Meeting the cultural challenge is a critical factor in global business to the extent that different cultures affect global business processes both between the MNE and within the MNE and other entities or people. The values and norms that are collectively held by a group of people influence the way global business is transacted, particularly in the areas of contract negotiation, the sharing of information and incentive orientation. Different cultures have different notions of time and risk, and these factors are likely to impact the effectiveness of various human resource policies, for example socialization, selection, compensation and career development. Compensation policies require flexibility to fit the context in terms of the nature of rewards. In some enterprises in China it is important to reward outstanding staff in non-monetary terms; for example, an award that is presented to the employee in front of his family.

China now possesses the largest FDI in the world. Regulations are a critical consideration in any nation. What makes China particular in this regard is the location of regulatory authority with the constant change and certain government officials. Good relationships with municipal governments and tax bureaus are very essential. Partners who speak the bureaucratic language and understanding the Chinese bureaucracy are in a better position to simulate bureaucratic thinking, and in a more advantageous situation to sell the MNE to the Chinese government. China's vast population with cheap labor provides an

essential rationale for much of the FDI in China. There are various challenges in human resource management. Firstly, the movement of labor is always unpredictable. Enterprises always require one month's wages in advance for security of each worker to remain with the company firm, but this security declines over time and finally workers tend to leave for a chance to work at other companies or move to other locations closer to their families. When workers leave, they always move as a team. Moreover, if a supervisor leaves his job, it is often that several of the best workers shall follow him. Secondly, there is a lack of skilled labor, both non-professional and professional. Firms need to invest more for human resource activities, such as career development and training, or rely on more expensive expatriates to guarantee that operations run smoothly. Over time, the wages in China continue to rise, particularly in the Special Economic Zones (SEZs). This has forced many foreign companies to locate their investments in the west of China where wage rates are lower by more than 50%.

Under the agreement on trade-related intellectual property rights (TRIPS), WTO members must enforce strong and non-discriminatory minimum standards of protection for intellectual property. Intellectual property rights are a serious issue for MNEs in China. Foreign partners lack power to enforce damages obtained through the court system. At the beginning of the century, most of the FDI in China produced mass manufacturing of intermediate and retail goods. Most enterprises tried to control and train locals to use such technology. Ownership by government ministries concentrates in utilities, heavy industry and transportation. All major consumer appliance manufacturers are partially owned by local government enterprises.

With increasing globalization, understanding the opportunities and complexities of managing a global business has become crucial knowledge that every manager must

comprehend. International managers should be familiar with the political and economic rules of the nation in which they are planning to expand. They ought to be familiar with the cultural dictates or informal rules of the nation. While political problems may be the most critical consideration, other factors such as informal relationship employee issues and protection of intellectual property are considered to be more important in decision making. It is important that MNEs maintain good relationships and communication with the relevant government officials and focus on business problems.

This section explored the common cultural principles behind Chinese businesses. One needs to recognize that significant differences exist between Chinese businesses around the world. This is particularly true with respect to the mainland and overseas Chinese business person. Most notably, PRC businesses are much more subject to government involvement and monitor than overseas Chinese companies. The family is a more pervasive and prominent influence than the state. On the mainland, government involvement always means that PRC companies are huge bureaucracies, while overseas enterprises tend to be small and medium sized. Eventually, while the overseas Chinese have tended to operate transnational enterprises, they are much more limited in their geographic scope.

### **Cultural Contract Negotiation in China**

- Selecting a negotiator - Select a negotiator who can win the trust and confidence of those you are trying to negotiate with.
- Building and consolidating the relationship - Successful negotiations are likely to result from a long process of informal: socializing over meals, drinks, and formal company visits meetings.

- Regard the Chinese culture - Paying due respect for the country's culture is critical so that trust can be won quicker. Comprehending the culture can enhance one's knowledge of Chinese negotiation tactics, which may support the negotiation process. At the very least, this will aid us to be more patient in negotiations.
- Forbearance - The goal is to win the Chinese trust and heart, and this takes great tolerance, patience, persistence, calmness and honest dealings with the Chinese.

### ***NEGOTIATION CHALLENGES WITH THE CHINESE***

#### **Finding Decision Makers**

Chinese negotiators generally gather information from Western negotiators, report this to top Chinese officials and come back with new questions. Decision making for the Chinese bureaucracy takes a lot of time. The highest ranking Chinese person can help Westerners assess how much can be achieved.

#### **Creating Trust**

Trust is important for working with the Chinese and long-term partnerships. Contrarily, Westerners are more willing to form alliances before personal trust. When Chinese know a Western enterprise and experience a positive working history with it, trust can be formed.

#### **To Understanding Business Culture Differences**

Westerners must always show respect China. Understanding China's business culture is essentially important.

#### **Reward compensation and systems**

A reward system, an essential mechanism in Western business to encourage productivity, is new to the Chinese. Training and education abroad are very desired by the Chinese and can be used as motivation tools. The Chinese think that everything should be in

harmony for the world to balance and that competition provides disharmony. Most Chinese work in state-owned enterprises having lifetime employment with extensive benefits like retirement, social welfare, housing and schooling, even though their salaries may be low. The Chinese perceive expatriates as being expensive. Westerners ought to negotiate their salaries, expatriates, and the time period they are expected to be in China.

### **Beating Language Barriers**

Westerners ought to apply multiple interpreters who understand Chinese culture and business. Language ought to be translated by a person who not only knows the language, but also the culture to get a correct interpretation. Negotiators must develop a mechanism to check communications. The best translators know business terminology, how to develop and attain objectives, and operate business. Many enterprises are having expatriates learn Chinese. This practice can help in day-to-day operations once the alliance is up and running.

### **Cooperation Mind**

Westerners tend to demand all documents in detail with spelled-out contingencies. The Chinese attach little importance to any signed document. The Chinese depend more on trust built over time and a network of relationships for contracting. Western negotiators ought to strive to receive Chinese commitment to the spirit of an agreement.

### **Lowly Unpretentious**

Making false assumptions based on appearances, such as mistreating a modestly dressed government official or Chinese business, can ruin the prospects of a trusting relationship. The Chinese respect intelligence, power, and hard work. Also, Western negotiators ought to be sensitive to cultural differences, but not to the point of restraining effective bargaining.

### **Respect and Politeness**

Westerners tend to be frustrated that the Chinese sometimes do not tell the whole truth. The Chinese tend to avoid saying no. Expression of anger is unacceptable. Telling others what they believe is considered part of Chinese hospitality. Chinese feel it is essential to avoid putting someone in the position of having to admit failure or a mistake. Chinese do not separate business from personal relationships, and Westerners should be diplomatic when faced with disagreements.

### **Government Approvals**

A business agreement needs approvals by many different departments of local, state, and central government. There are several offices that make decisions, such as the central government, a municipal government and a provincial government.

### **Resource Contributing Negotiation**

In most joint ventures, the Chinese partner shall share the offices, land, and manufacturing facilities while the Western partner shall contribute the machinery, technical skills, equipment, and capital. Western managers must avoid having the Chinese partner perceive the cooperative contributions as unfair.

### **Export Negotiation**

Exports are accepted by the Chinese as a way to fan joint venture growth. Generating foreign exchange is essential to the Chinese government. Most Western enterprises seek a share of China's growing internal markets and want alliance products to be sold domestically. Without a critical export commitment for alliance products, it is difficult to receive approval from various administrative agencies. The Western enterprise may ask for an export waiver for a few years and then promise to export a certain percentage of the products produced. Through

this channel, the joint venture is able to get established in the Chinese market and to export later.

### **Negotiation Monitor of the Alliance**

Western enterprises prefer majority control of the partnership by majority ownership on the board of directors. Currently, Chinese law requires that a Chinese national be the chairperson of a joint venture. In Western firms alliance is highly valued in businesses such as communications, electronics, transportation, energy, and export-oriented products. These industries introduce advanced technology and foreign capital to China. Possessing more control in an alliance shall support Western companies implement Western business policies, control corruption, and choose Chinese business policies that may be beneficial to the partnership. In China, people tend to think in more scientific or technical terms rather than commercial. Western negotiators should be sensitive and diplomatic to Chinese perceptions of mistreatment. Majority control does not refer to total control. Western managers ought to show trustworthiness and credibility and take role of “advisors” to educate Chinese counterparts about recommended policies.

### **Professional Negotiator Management**

The Chinese often apply outside professional negotiators who are good at negotiating, but are not necessarily good at designing with in cooperative relationships. They often try to change the structure of the agreement for what they perceive to be better. One benefit from professional negotiators is that they know how to negotiate and the process can become much take less time and simpler. The strategy of Western negotiators must be to refocus the professional Chinese negotiators on developing a balances partnership that builds benefits to both prospective partners.

### **Applying Consultants Effectively**

Consultants can play a vital role in forming the alliance. They let us know what's normal and not, what's going on, and how to deal with obstacles. Managers ought to use consultants who have solid track records, referred by reliable business connections.

### **Patience and Flexibility Negotiation**

Western managers try to achieve tasks with tight deadlines. But the Chinese usually do not feel such urgency. Meeting deadlines is often not possible, and this frustrates various Western managers. For western negotiators it is necessary to be patient but persistent.

### **Team Work Management**

Westerners generally work well in teams. Contrarily the Chinese may work less effectively in teams. Western managers apply negotiating teams for leverage when dealing with the Chinese. Strategic planners need to choose team players committed to see the negotiations to the end. The Chinese negotiation team ought to be encouraged to maintain continuity as well.

### **The Chinese International Competition**

In China, international corporations have already arrived. Since China opened his doors, foreign direct investment has come to China. China is the most popular destination for FDI. Foreign-founded enterprises are set up in China. The world's largest firms are already in China, and smaller, more specialized firms have arrived in the years following WTO accession. For many global firms, winning in China refers to battling the same major global rivals faced elsewhere in the world. Firms face normal competition in China, but they receive more competition because they are not the only smart person: everyone wants to do business in China. There are a lot of global firms here: Japanese enterprises, European and American

enterprises, plus domestic firms. They all want to compete in China. There are many global rivals in China that have built everywhere in the world, such as in U.S., Germany, and France. In addition, domestic competitors become stronger. In China, MNCs tend to compete against each other to win government approvals, retain and recruit key personnel, form alliances and partnerships with domestic enterprises or to secure land, facilities, equipment, and supplies. MNCs moved their manufacturing to China to save cost. Global companies entered with the goal of selling to domestic market for both consumer and industrial goods. More global enterprise are treating China as a key element in their overall corporate goals, taking strategic opportunities, from manufacturing to R&D to local sales. Some global businesses have already established in China, and are now expanding in term of geography or business scope. All of MNCs in China refer to competition in many industries and become fiercer as foreign firms gain experience, localize and build networks. Newly developing competitors are always unknown quantities, young, unpredictable and aggressive. They are China's local firms.

### **Competing in China**

China is the most competitive market in the world. There are many global enterprises here: European firms, Japanese firms, plus local firms. They all compete in China. China has local companies that are internationalizing more and more, and more global players locate in China. There are the new Chinese firms with advances in products and global competitiveness. Chinese firms are trying as fast as they can to be like MNCs. The best survival strategy is to keep moving and continually to stay ahead of competitors. Chinese and Western enterprises continue to expand into each other's regions, and more and more, Chinese business will be forced into competition. These businesses continue to get advantages by approaching competitive situations from an "outsider" perspective. The benefits of competition can be

unexpected and numerous. For westerners, understanding this “outsider” perspective may enable them both to expect the moves of their Chinese competitors. As business interactions increase around the world, Chinese outlooks can provide managers valuable alternatives to their own long-held assumptions about business competition and strategy. Understanding an “opponent’s” strategy is able to provide the flexibility for seeing a competitive engagement in a different way, and for turning a potentially damaging rivalry into a mutually productive opportunity.

Perceptions of the political, ethical and legal context are all important. These include concerning government influence, the rule of law, and integrity, which include such as the importance of ambiguities in understanding business rules, networks and competitive practices. It is clear that various nations in the Asia Pacific region remain basically difficult places for Western companies to operate in. Most Western companies are reasonably comfortable entering in countries where at least offer the advantage of a clear political, ethical context and legal. China has improved his positions. International business strategists and managers ought to be adaptive and flexible in exercising their judgments on the business conditions in the region. Strategic logic which is used in the West may not apply in the same direction in certain parts of China. Expatriate managers and international executives ought to listen, and not dictate. The qualifications of expatriate managers working in China must meet the demands of the China business environments. Moreover, besides their technical expertise and professional skills, expatriate managers in China must exhibit political and social skills. One such skill is the ability to build, maintain and develop a network of personal contracts. Another skill is political. Western managers must be able to understand the constraints, the logic, and the language of government officials in order to align their business strategies with the industrial policies of the

individual nations. Eventually, cultural sensitivity becomes a fundamental trait for managers if they are to lead, communicate, and negotiate with partners, consumers and employees.

Regional headquarters have a role in analyzing, collecting, and consolidating competitive information across the region as well as fostering the visibility of domestic operations about the central corporate head-quarters. A strong local regional culture supported by intense networking among domestic subsidiaries is necessary in order to take of China business opportunities and overcoming the risks involved.

### **Competition Policy in Chinese Transition Economies**

The supply and distribution of goods and services contribute to raise living standards in China. China's membership of the WTO in December 2001 affected the entry of foreign companies and intense competition in industries that are dominated by state-owned enterprises. Market liberalization is essential for the transition economy as it is able to decentralize of production and trading decisions to firms and households. Liberalization exposes firms to the profit motive, consumer demands and competition. Liberalization also refers to free entry into production, trade, and services, including expanding or breaking up an existing business, the freedom to open a new business, and to change product mix, consumer, suppliers or geographical base. Decentralizing ownership is often the best channel to augment competition and improve performance. Liberalization and competition are key elements in the process of economic development and growth. The key elements for encouraging the development of the private sector are: 1. official recognition of the significant and role of the private sector, the most essential of which being recognition of property right; 2. opening up of markets previously prohibited to private sector competition and companies; 3. providing explicit incentives for private sector investment including protection of intellectual property rights and

intellectual; 4. a legal framework for the proper functioning of a market economy with substantial private sector involvement; 5. accessibility of private enterprises to land use rights and land; 6. bank reforms enabling the private sector to gain greater access to other bank services and credit; 7. open up the economy to expanded trade, enabling private enterprises to export and import without the need for licenses or being subject to quotas and allows, and finally 8. to develop important business support service, provided by the private sector itself, in such areas as legal services, accounting, marketing, insurance, and distribution and transport. To maintain competitiveness in China's rapidly developing market economy will need changes in organizational form, through the development of both scientific alliances and business. There is growing need by the private enterprise for specialized expertise and training to develop the necessary skills. These skill includes corporate planning, financing and management skills, governance, business strategy, marketing and technological know-how. Competitive enterprises in these areas, particularly those from overseas, shall be well placed to provide such services to local companies.

### **How to Reach Chinese Consumers**

Currently, Chinese consumers are increasingly wealthy and worldly, as well as demanding of quality and price conscious. Winning Over Chinese customers depends on successful localization, localizing products, and marketing campaign as well as localizing strategy. Ultimately, many MNCs has been moving production to China, then moving marketing and sales to China, and now bringing R&D to China. While retaining the global power and image of our brand, localize products to suit domestic preferences and tests.

## **Domestic Marketing**

Marketing campaigns should be localized. Chinese customers buying products are always quite different from those in the West. Culture varies in China, marketing programs should vary as well.

## **Select the Destination**

A strategic decision for MNCs in China is to target clients. Selecting the correct markets in the countries is tricky, as different locations vary widely in terms of economic demographics, customs, and challenges. Many of China's cities including Beijing, Shanghai, Chengdu, and Guangzhou have been focal points for global enterprises. While those cities represent the highest concentration of client's wealth, many MNCs are coming to other cities and targeting places with increasing wealth and growth potential. Such cities supply excellent new markets for first-round consumer products.

## **R&D for China**

Since the local China market has emerged as a key strategic “win” for global enterprises the natural progression for an augmenting number of global enterprises serving the China market is to start conducting R&D for China, in China. This is the ultimate method for effectively understanding and serving local consumers. Augmenting support from the Chinese government, the number of foreign funded R&D centers for global enterprises grew rapidly. Most global enterprises conduct product development for the China market, but many companies also conduct world-class fundamental research. MNC shifts research operations into China. The facility is consumer oriented aiding customers to design and develop products. Its R&D in China has formed cooperative agreements with Chinese universities. Research conducted in China center shall ultimately permit the development of innovative new products.

For doing business in China, entrepreneurs must develop new products, designing power, and input engineering. A key problem is how to shorten the development period. Entrepreneurs who want to keep competitive in China and the world market, must go on to produce in China, and must conduct research and development in China. Successful enterprises plan to bring more and more R&D to China, as well as to adapt their designs to the Chinese requirements. R&D for China, in China, is the final method for effectively serving and understanding local consumers. Global companies begin to move crucial strategic research to China. Currently, China offers essential ingredients for conducting world-class research such as growing talent specialists and qualified engineers at relatively low cost. Nearly all universities in China supply a computer Science major. China is emphasizing English in the education system and expanding training in and education in software-related fields, improving and increasing local software industrial parks, accessible to software entrepreneurs. China will be one of the world's largest software producers.

### **Contest the Market**

In retaining global guidelines and standards for their services and products, businesses must operate appropriately, adapting some aspect of their products to the China market. Various global companies apply brands that are the same worldwide, while some products are adapted to Chinese characteristics. Such specialization requires careful tracking of preferences and quick release of new products.

### **SUMMARY**

In the early stages of business formation, family relationships impact various aspects of Chinese and values on business and management practice. Later, as the Chinese business family goes international, it is gradually applying international business practices and

standards. The new generation of graduates from Western education, as well as those attending professional business schools in Asia, leads to an opportunity for the younger generation to move away from the family network and traditional conservative business approaches. The research also discusses Chinese value adjustment and competitiveness. In addition, the Chinese have strived to avoid confrontation by developing potentially competitive situations into opportunities for collaboration. Eventually, we show foreign direct investment in China.

China is becoming the world's largest maker of consumer electronics, DVD players, pumping out more TVs, and cell phones. China is moving quickly and expertly into computer manufacturing and biotech. The country is making parts for Boeing 757s. China buys oil fields globally and is also signing exclusive gas and oil supply deals with Russian and Saudi enterprises. China buys the world's scrap metal, and enormous amounts of steel, to fashion into products sold internationally. The nation is positioning itself for higher levels of industrialization. He exports computers with Chinese brand names. There are giant capital flows from various industries to China currently. He is where the world is investing. China is setting down fiber-optic at a rapid rate. He has the most advanced rapid-transit systems in the world. China is not home to the cheapest labors workforce in the world; there are cheaper workforces in the poorer countries of Africa or Southeast Asia. China is the world's workshop because he is situated in a stable part of the globe and offers the world's manufacturers a capable and reliable industrial workforce, groomed by government-enforced discipline. China's economy is growing rapidly. For other nations, China becomes important both as a consumer and as a supplier. China is now the world's biggest buyer of factory machinery. Chinese people certainly gained respect from their own government and from the world.

Typically, The Chinese like to export products whereas Westerners wish to serve domestic Chinese markets. Regarding handling copyright & legal issues, Western enterprises ought to advise their Chinese partners that copyright compliance serves their long-term interests for exporting. Promises of leading new technology to the venture can also encourage compliance. Regarding managing professional negotiators, while professional negotiators facilitate the negotiation process, they may not hold the best interests for the long range good of the alliance. Westerners ought to strive to concentrate on the negotiations on “win-win” cooperation. Regarding applying consultants effectively, Westerners ought to use seasoned consultants who have both time and dedication. Regarding using team work, because personal relationships are essential team continuity over the time of the negotiation process should be maintained on both sides. Westerners need to commit for long term. It may be at least 18 months.

China’s customers, gaining rapidly in wealth, have received a reputation among MNCs as sophisticated, price conscious, demanding, consumers. China represents various markets. Across the nation, customers groups different widely in educational background, demographic, and international exposure. MNCs should adapt their products and services and marketing strategies to the diversity they face. Global enterprises must constantly control regulatory changes in their industry, and have issues logistical difficulties in reaching customers the best solution to reaching Chinese customers may be to invest in local R&D. China is the most competitive market in the world. Local competitors leap ahead in quality, sophistication, and speed. Many global enterprises are now squeezed by players adept at replicating their best product features while cutting selling prices. The essential survival skills for China now are innovation, flexibility, speed, careful tracking of customer preferences, and marketing. MNCs

in China should avoid competing against domestic cost-based products. The great survival strategy is to continually upgrade, keep moving to stay ahead of competitors. Avoid over-engineered manufacturing products. Offer quality and functionality that matches consumer demand, but don't lose sight of cost.

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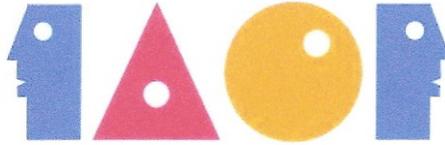
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## WORKLOADS RANKING AND IMPROVEMENT FOR MULTIDIMENSIONAL RATING TECHNIQUES

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### ABSTRACT

Workload improvement is one of the most serious concerns to ergonomics and to managers, since a long-term heavy workload may affect employees' physical and mental health, performance and productivity, as well as turnover. For a multidimensional rating technique, it is important to identify the factor (referred to as the critical factor) that the decision maker should focus on in order to effectively alleviate the workloads of heavy workload employees. This study applies dual analysis to identify the critical factor, and slacks analysis to determine the priorities of employees for workload improvement. Thus, decision makers can effectively improve workload levels of employees to ensure them operating their tasks safely, as well as reduce staff turnover.

**Keywords:** Workload, Data Envelopment Analysis, Slacks Analysis, Ranking

## INTRODUCTION

Heavy workloads have been shown to have a negative impact on employee turnover (Iverson and Pullman, 2000), contribute to a state of stress, and give rise to strain, accidents or illness (Jung and Jung, 2001). Hospital studies have shown that added responsibilities and job stress associated with higher workloads affect nursing staff turnover (e.g. Helmer and McKnight, 1989; Jolma, 1990; Lee et al., 2003). Moreover, workload levels of employees may influence the effectiveness of human resource management practices such as selection, training, promotion, sharing of financial opportunities, and so on. For example, if an employee has a heavy workload it means that she/he may not have much remaining capacity to do additional tasks, and therefore incentives to increase productivity may not have a significant effect. Under this circumstance, the manager should reduce the employee's workload level before implementing incentives.

The techniques for measuring mental workload can be divided into performance-based measures, physiological measures and subjective ratings. However, in a complex task environment, performance measures often cannot indicate workload. The physiological measures attempt to derive workload impact from factors such as heart-rate, respiration rate and blood pressure, though they may be influenced by other factors (Veltman and Gaillard, 1996). In subjective techniques, individuals are asked to assess their workloads by a rating scales procedure, and it is accepted by those asked to complete them, since rating scales are easy to fill in. Although physiological measures of workload are believed by some to be more accurate than their more subjective counterpart (Vidulich and Wickens, 1986), subjective measures are widely applied to workload assessment (e.g. Mayes et al., 2001; Miyake, 2001; Sato et al., 1999).

Subjective measures have been applied to evaluate two types of workloads. The first type focuses on assessing workload for a specified task after the task has been completed (e.g. Matthews et al., 2003; pickup et al., 2005; Stedmon et al., 2007). Its purpose is to improve operating characteristics and to decrease the workload for an operator, as appropriate. The other type of workload assessment is to discriminate relative workloads within a group of employees in the same environment (Chang and Chen, 2006). This study focuses on the second type of workload measurement for the purpose of workload ranking and improvement of the relatively heavy workload employees.

For health care and human resource management, it is necessary to reduce the workload levels of certain employees. However, for a multidimensional workload measure technique (e.g. NASA-TLX, Hart and Staveland, 1988), it is important to identify the factor (referred to as the critical factor) that the manager should focus on to effectively reduce an individual's workload. The critical factor is the factor that has the most contribution to the workload score of a specified employee. This study applies the dual analysis of data envelopment analysis (DEA) to identify the critical factor among all assessment factors. If the decision maker decreases the load of the critical factor, then the workload score of the heavy workload employee will be reduced significantly. Moreover, under the restricted resources such as limited budget and staffs, it is necessary to determine the priorities of employees for workload improvement. To deal with this, we apply the slacks analysis based on peer-evaluation to rank the workload levels of employees.

#### **IDENTIFICATION OF THE CRITICAL FACTOR**

Chang and Chen (2006) proposed the DEA method to discriminate the relative workload level within a group of employees. The workload score of employee  $j$  is obtained from the following model.

$$\text{Max } h_j = \sum_{i=1}^s u_i y_{ij} \quad (1a)$$

$$\text{s.t. } \sum_{i=1}^s u_i y_{ik} \leq 1, \quad k = 1, 2, \dots, n \quad (1b)$$

$$u_i \geq \varepsilon > 0, \quad i = 1, 2, \dots, s \quad (1c)$$

Where  $n$  is the number of employees,  $s$  is the number of assessment factors,  $y_{ik}$  is the level of factor  $i$  of employee  $k$ ,  $u_i$  gives the weight associated with factor  $i$  of employee  $j$ , and  $\varepsilon$  is a positive non-Archimedean infinitesimal. The optimal weights calculated by Model (1) represent the best weights of factors for employee  $j$  in calculating her/his workload score. The higher score of  $h_j$  means the heavier workload of employee  $j$ . If  $h_j$  is equal to one then employee  $j$  is classified as having a relatively heavy workload, otherwise she/he is a non-heavy workload employee.

In Model (1), the objective is to maximize the value of  $\sum_{i=1}^s u_i y_{ij}$ . Therefore, the larger value of  $u_i$  the more the contribution of workload score offered by factor  $i$ . For a heavy workload employee  $j$ , if  $u_p$  is the largest weight among all factors, i.e.  $u_p = \max_i \{u_i\}$ , then factor  $p$  is referred to as the critical factor of employee  $j$ . To effectively reduce the workload score of employee  $j$ , the improvement effort should focus on factor  $p$ . This argument is backed by the dual analysis presented in Appendix.

## **WORKLOADS RANKING BY SLACKS ANALYSIS**

Model (1) generally classifies many employees as having a heavy workload since it allows each employee to choose the best weights that maximize their workload scores. However, the resources for workload improvement may not be enough to satisfy the requirement of all heavy workload employees simultaneously. Therefore, it is necessary for decision makers to further rank the workload levels of heavy workload employees.

In solving Model (1),  $n$  slack variables  $s_{kj}$ ,  $k = 1, 2, \dots, n$ , are added to the constraints in (1b). The value of  $s_{kj}$  is the difference between one and the workload score of employee  $k$  under the best weights of employee  $j$ , i.e.  $s_{kj} = 1 - \sum_{i=1}^s u_{ij}^* y_{ik}$ .  $s_{kj}$  can thereby be interpreted as the remaining capacity of employee  $k$  under the best weights of employee  $j$ . Since a smaller  $s_{kj}$  means a heavier workload of employee  $k$ , we utilize the slacks to rank the workloads of employees and set  $\phi_k = \sum_{\substack{j=1 \\ j \neq k}}^n s_{kj} / (n-1)$  as a workload index of employee  $k$ . If  $\phi_k < \phi_j$  then the workload level of employee  $k$  is heavier than that of employee  $j$ . These ranking indices are based on peer-evaluation logic instead of self-evaluation. A peer-evaluation means attaining the workload scores of an individual employee by using the best weights of other employees, and therefore each employee has  $(n-1)$  slacks. Note that all  $s_{kj}$  values are given in the linear programming solutions of the  $n$  DEA runs, and thus it is easy to obtain the indices of employees.

## NUMERICAL EXAMPLE

The purpose of this section is to demonstrate the proposed techniques by using a numerical example, originally published in Chang and Chen (2006). There are twenty-four

employees assessed by using the NASA-TLX factors: mental demands  $Y_1$ , physical demands  $Y_2$ , temporal demands  $Y_3$ , performance  $Y_4$ , effort  $Y_5$ , and frustration level  $Y_6$ . The raw data and scaled data of these twenty-four employees are presented in Table 1.

The workload scores, by setting the value of  $\varepsilon$  as equal to  $10^{-4}$ , show that employees

Table 1 - The original data and scaled data of the numerical example

Employee	$Y_1$		$Y_2$		$Y_3$		$Y_4$		$Y_5$		$Y_6$	
	Raw data	Scaled data										
1	88	1.113	89	1.097	82	1.002	82	0.936	83	1.025	31	0.877
2	82	1.037	82	1.010	89	1.087	83	0.924	85	1.049	23	0.651
3	78	0.986	83	1.023	87	1.063	81	0.947	87	1.074	27	0.764
4	81	1.024	89	1.097	85	1.038	83	0.924	84	1.037	25	0.708
5	81	1.024	85	1.047	84	1.026	79	0.971	80	0.988	27	0.764
6	82	1.037	85	1.047	85	1.038	82	0.936	84	1.037	36	1.019
7	76	0.961	76	0.936	78	0.953	73	1.051	80	0.988	52	1.472
8	80	1.012	80	0.986	81	0.989	81	0.947	79	0.975	32	0.906
9	81	1.024	87	1.072	86	1.050	81	0.947	85	1.049	34	0.962
10	77	0.974	81	0.998	79	0.965	78	0.984	85	1.049	25	0.708
11	87	1.100	90	1.109	87	1.063	59	1.300	82	1.012	76	2.151
12	79	0.999	87	1.072	83	1.014	81	0.947	84	1.037	27	0.764
13	74	0.936	77	0.949	81	0.989	74	1.037	76	0.938	25	0.708
14	79	0.999	78	0.961	82	1.002	81	0.947	78	0.963	32	0.906
15	75	0.948	79	0.973	83	1.014	75	1.023	79	0.975	30	0.849
16	88	1.113	87	1.072	86	1.050	56	1.370	81	1.000	82	2.321
17	75	0.948	76	0.936	75	0.916	77	0.996	79	0.975	35	0.991
18	77	0.974	76	0.936	75	0.916	80	0.959	80	0.988	25	0.708
19	75	0.948	77	0.949	81	0.989	81	0.947	83	1.025	29	0.821
20	76	0.961	74	0.912	75	0.916	76	1.009	79	0.975	39	1.104
21	71	0.898	74	0.912	75	0.916	73	1.051	72	0.889	34	0.962
22	83	1.050	78	0.961	81	0.989	77	0.996	78	0.963	54	1.528
23	77	0.974	79	0.973	82	1.002	81	0.947	80	0.988	26	0.736
24	76	0.961	79	0.973	83	1.014	85	0.903	81	1.000	22	0.623

1, 2, 3, 4, 9, 11, and 16 have relatively heavy workloads, since their workload scores are all of one. The sets of weights in Table 2 are the best weights for each employee, and the largest weight corresponding to each relatively heavy workload employee is highlighted. As can be seen, the critical factor for employees 1 and 16 is mental demands, employee 2 is temporal

demands, employees 3 and 9 is effort, and employees 4 and 11 is physical demands. The decision maker should focus on the improvement of these employees' critical factors to effectively reduce their workloads.

Table 2 - The relative heavy workload employees and the weights of factors

Employee	Workload score	Weights					
		$Y_1$	$Y_2$	$Y_3$	$Y_4$	$Y_5$	$Y_6$
1	1.0000	0.8911	0.0001	0.0001	0.0001	0.0076	0.0001
2	1.0000	0.0001	0.0001	0.9195	0.0001	0.0001	0.0001
3	1.0000	0.0001	0.0001	0.0001	0.0001	0.9307	0.0001
4	1.0000	0.0001	0.6218	0.0001	0.0001	0.3062	0.0001
9	1.0000	0.0001	0.3156	0.0001	0.0001	0.6292	0.0013
11	1.0000	0.0001	0.9020	0.0001	0.0001	0.0001	0.0001
16	1.0000	0.8979	0.0001	0.0001	0.0001	0.0001	0.0001

If reducing the workloads of all heavy workload employees at the same time are not allowed due to the restricted resources of the organization (for example training budget, staffs, and so on), it is necessary for decision makers to further rank workloads of employees. Based on the proposed ranking method, the workload indices of employees and the ranking result are presented in Table 3.

Table 3 - The workload ranking indices and ranking of employees

Employee	Ranking index $\phi$	Ranking
1	0.0373	6
2	0.0318	5
3	0.0269	3
4	0.0375	7
9	0.0308	4
11	0.0068	1
16	0.0119	2

The workloads of these seven employees are ranked as employees 11, 16, 3, 9, 2, 1 and 4 in sequence. This ranking result assists the decision maker to determine the priorities of employees for workload improvement.

In this example, the two heaviest workload employees are numbers 11 and 16 by the proposed ranking method. Based on the scaled data columns in Table 1, it is noted that employees 11 and 16 have the two highest values in performance,  $Y_4$ , and frustration level,  $Y_6$ . However, the weights of these two factors of employees 11 and 16 are the lowest, being equal to  $10^{-4}$ , meaning that the performance and the frustration level do not offer significant contribution in their workload assessment. If the decision maker omits these two factors and then runs Model (1), the workload scores of the employees 11 and 16 are still equal to one. Moreover, according to the best weights of factors presented in Table 2, the factor that leading to a heavy workload for employee 11 is physical demands, and that for employee 16 is the mental demands. It means that the critical factors of employees 11 and 16 are the physical demands and the mental demands, respectively. This result is supported by the proposed dual analysis. Notably, if an individual employee shows that she/he has larger weights in multiple factors compared to other employees, even after reducing the load of the critical factor, her/his workload score may not be reduced since she/he still has a relatively heavy workload. Therefore, workload improvement is a continuous task for decision makers.

## **CONCLUSIONS**

Heavy workload may affect an employee's turnover and health, and one of goals for decision maker is to ensure that each employee has an appropriate workload level, which means that it does not interfere with the employee's function and capability to operate the tasks safely and efficiently. Because of the restricted resources such as limited budget and staffs, it is

necessary to determine the priorities of employees for workload improvement. Our study applies the slack analysis which utilizes the available information from the linear programming outputs to effectively calculate the ranking indices of all employees, and highlights the critical factors for workload improvement.

In light of the task characteristics of a department, decision makers can introduce appropriate workload assessment factors to evaluate the workloads of subordinates. The proposed approach can also be applied to other multidimensional rating techniques in relative workload assessment (for example, Subjective Workload Assessment Technique). By applying the ranking indices associated with identifying the critical factor, decision makers can effectively exploit workload improvement practices on those employees most in need of them.

## APPENDIX

Based on Model (1), the workload scores of employees are equal to or less than one. If employee  $j$  has a workload score of one, she/he will be classified as having a heavy workload, and the  $j$ th constraint in (1b) will be equal to one, i.e.  $\sum_{i=1}^s u_i y_{ij} = 1$ . We decompose this equation into  $s$  components, i.e.  $u_1 y_{1j} \leq \alpha_1, u_2 y_{2j} \leq \alpha_2, \dots, u_s y_{sj} \leq \alpha_s$ , and join them into

Model (1) as follows:

$$\text{Max } h_j = \sum_{i=1}^s u_i y_{ij} \quad (2a)$$

$$\text{s.t. } u_i y_{ij} \leq \alpha_i, \quad i = 1, 2, \dots, s \quad (2b)$$

$$\sum_{i=1}^s u_i y_{ik} \leq 1, \quad k = 1, 2, \dots, n, \quad k \neq j \quad (2c)$$

$$u_i \geq \varepsilon > 0, \quad i = 1, 2, \dots, s \quad (2d)$$

where  $\alpha_i = u_i^* y_{ij}$  and  $\sum_{i=1}^s \alpha_i = 1$ .  $u_i^*$  is the optimal weight of factor  $i$  obtained from

Model (1). Thus, the dual of Model (2) is shown as Model (3).

$$\text{Min } \sum_{i=1}^s \alpha_i \theta_i + \sum_{\substack{k=1 \\ k \neq j}}^n \lambda_k - \varepsilon \sum_{i=1}^s S_i^+ \quad (3a)$$

$$\text{s.t. } \theta_i y_{ij} - \sum_{\substack{k=1 \\ k \neq j}}^n \lambda_k y_{ik} - S_i^+ = y_{ij}, \quad i = 1, 2, \dots, s \quad (3b)$$

$$\theta_i, \lambda_k, S_i^+ \geq 0, \quad k = 1, 2, \dots, n, \quad k \neq j, \quad i = 1, 2, \dots, s \quad (3c)$$

where  $\theta_i$ ,  $\lambda_k$  and  $S_i^+$  are dual variables.  $\alpha_i$  can be interpreted as the workload contribution of factor  $i$  of employee  $j$ . Based on the original DEA frame, if a decision making unit (DMU) is located on the frontier, it is classified as efficient, and the reference DMU is itself. Similar to this, if employee  $j$  is classified as having a relatively heavy workload, with a workload score of one, then the dual variables corresponding to the constraints in (2c) will be equal to zero, i.e.  $\lambda_k = 0$ ,  $k = 1, 2, \dots, n$ ,  $k \neq j$ , and  $S_i^+ = 0$ ,  $i = 1, 2, \dots, s$ , at an optimum. Under this circumstance, the items in (3a) are only  $\sum_{i=1}^s \alpha_i \theta_i$  retained.

Since the objective values of Model (2) and Model (3) will be the same at an optimum, i.e.

$$\sum_{i=1}^s u_i^* y_{ij} = \sum_{i=1}^s \alpha_i \theta_i^* = 1, \quad \text{hence } \theta_i^* = 1, \quad i = 1, 2, \dots, s. \quad \text{Because all } \theta_i^* \text{'s are equal, the values of}$$

(3a) will be the same for any equivalent changed value of  $\alpha_i$ . In other words, if the decision

maker reduces one unit of  $y_{pj}$ , then the reduced workload score will be the largest one

compared to reducing one unit of other factors, since  $\Delta \alpha_i = u_p \Delta y_{pj}$  where  $u_p = \max_i \{u_i\}$ .

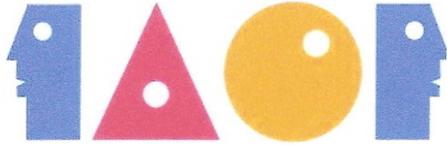
Therefore, based on the dual analysis, the improvement effort should focus on the critical

factor (factor with the largest weight among all factors) to effectively reduce the workload score of employee  $j$ .

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**A PROPOSED PERSPECTIVE INSPIRED BY ENTROPY  
ON DIVERSIFICATION, CORPORATE PERFORMANCE AND RISK**

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**ABSTRACT**

The study aims to provide a new perspective inspired by entropy to explain the reasons behind corporate diversification and its link with performance and risk. 3439 records were extracted from Fortune 500 listed in S&P's Compustat during 2000 to 2006. Correlation analyses were employed to test the relationships between diversification, corporate age, financial performance and risks. Results show that diversification can be explained by "the arrow of time/entropy" which means that diversification may not be controlled by conscious decisions but a natural law. Results also show that diversification is negatively associated with performance and risk. This suggests that diversification can only decrease performance but bring the benefit of being more stable. Therefore, a manager should balance diversification so that the firm can reach good performance with reasonable risk.

**KEY WORDS:** diversification, entropy, risk, corporate performance, corporate strategy

## INTRODUCTION

In the study of corporate strategy, diversification perhaps attracted the most attentions. Many tried to provide the reasons behind diversification decision while others investigated the relationship between diversification and other important constructs. Among these constructs, performance and risk are extensively studied for their significance to the success and failure of a firm. In spite of previous endeavors made to lay the theoretical foundation for diversification or to predict its relationship with performance or risks (e.g., Montgomery, 1984; Markowitz, 1991; Silverman & Castaldi, 1992; Wang & Lim, 2001), there is still a great dispute among different perspectives about diversification and the empirical results of its relationships with performance and risk are inconclusive, if not contradicting (Kaul, 2003). In light of this, there is a great need for a new perspective to explain diversification decision, and provides a guideline for both practitioners and researchers to conduct on-going research in this area (Miller, 2006).

In respond to this need, we employ a concept from physics and information theory, namely entropy, to explain this relationship and provide an explanation to reconcile the dispute. As Ayres (1994) claims that researchers have established that economic activities are inherently dissipative and governed by the second law of thermodynamics (increasing entropy). We proposed that diversification is the consequence of entropy effect. It explains the way heat or particles disperse and reach equilibrium in an isolated system (Jacquemin & Berry, 1979). Applying this concept to the business field, we viewed a firm as an individual system. As time progresses, the system will expand and diversify into a state with higher entropy, a synonym of chaos; consequently, the chaotic composition of the firm will lead to worse performance. In

addition to this, the same rationale was also used to investigate the relationship between diversification and risk.

In the second section of this research, previous and related theories were reviewed to provide concrete foundation for the development for our theory and the generation of the hypothesis. Following the second section, we presented the methodology designed for this research. In order to generalize the results, we used the data of Fortune 500 extracted from Compustate. Results of the analysis were reported in section 4; findings, implications and reflections were given in section 5 and 6 respectively.

## **THEORETICAL FRAMEWORK**

### **Perspectives on Diversification**

Diversification strategy was first explicitly articulated by Ansoff (1957). He indicated that diversification involves developing a new product and entering a new market. Since then, diversification has been defined as the entry of a firm into a new sector (Iacobucci & Rosa, 2005).

Base on prior research, Montgomery (1994) explains that diversification is typically understood from three major perspectives, which are the market-power perspective, the resource-based and the agency perspective. In the market-power perspective, firm diversification occurs to pursue profit maximization and further to obtain market power. Firms which are diversified will gain conglomerate power at the expense of the non-diversified ones (Hill, 1985). Market power is explained as a firm's influence within the industry in terms of predatory pricing, collusive power and reciprocal buying that is supported by the large conglomerate (Montgomery, 1985).

In the agency view, diversification in large firms is associated with managers' behavior, and specifically to their preference for growth. Higher asymmetric information might allow management and large shareholders to more easily exploit the firm for their own purposes which usually result in diversification (Lins & Servaes, 2002; Iacobucci & Rosa, 2005). These ideas can be summarized into the two rationales addressed by previous researchers (e.g., Montgomery, 1994; Miller, 2006): first, a manager directs the firm to diversify in order to increase the dependency on his or her particular skills; and second, the diversification may create a corporate portfolio which will in turn maintain the average financial performance of the firm and secure the bonus of the manager.

The resource-based view stresses that resources have long been considered the motivation for firms to diversify. By pursuing diversification, a firm can create synergy allowing efficient sharing of resources or assets that are relevant to different divisions (Wernerfelt, 1984). A diversified firm can utilize resource sharing and skill transfer to either reduce the overall operating costs or to efficiently differentiate its products and thus charge a higher price (Hill, 1985; Hill & Hoskisson, 1987). In addition, Chatterjee & Wernerfelt (1991) also find that different types of resources also determine the kinds of market a firm enters.

We propose that diversification is not due to sentient decision but the effect of entropy. The concept of entropy originated in the 1800s with Clausius (1822-1888). Entropy has been used to measure the unavailability of a system's energy to do work in regard to physics discipline (Ayres, 1994). More and more researchers have adopted it as a valid measurement for order (Robins & Wiersema, 2003; Kaul, 2003; Miller, 2006). Higher entropy of a system can be interpreted as that the system is at a more chaotic state (Choi & Russell, 2005).

In the physical sciences, entropy is so far the only quantity which exhibits a particular

direction related to time, and it is called “the arrow of time”. The entropy of an isolated system can only increase or remain the same as the time goes by, but it cannot decrease. This phenomenon provides a very useful insight into the force behind diversification. When a firm becomes more diversified, it becomes more complicated with different business divisions, product lines as well as market configurations mingled into one identity. In other words, it becomes more chaotic. We argue that diversification is the consequence of this natural process, entropy, and is not subject to human’s free will. As times goes by, the arrow of time, entropy, will determine the configuration of a firm. It will develop into a more diversified form as Choi and Russell (2005) indicate that, “firm entropy may be a function of the number of business segments and the size of each segment’s sales volume (2005, p.18).” Because entropy represents “the arrow of time”, and diversification is a manifesto of chaos, we can, based on the concept of entropy, predict that:

*H1. Corporate age is positively related to firm diversification.*

### **Diversification and Performance**

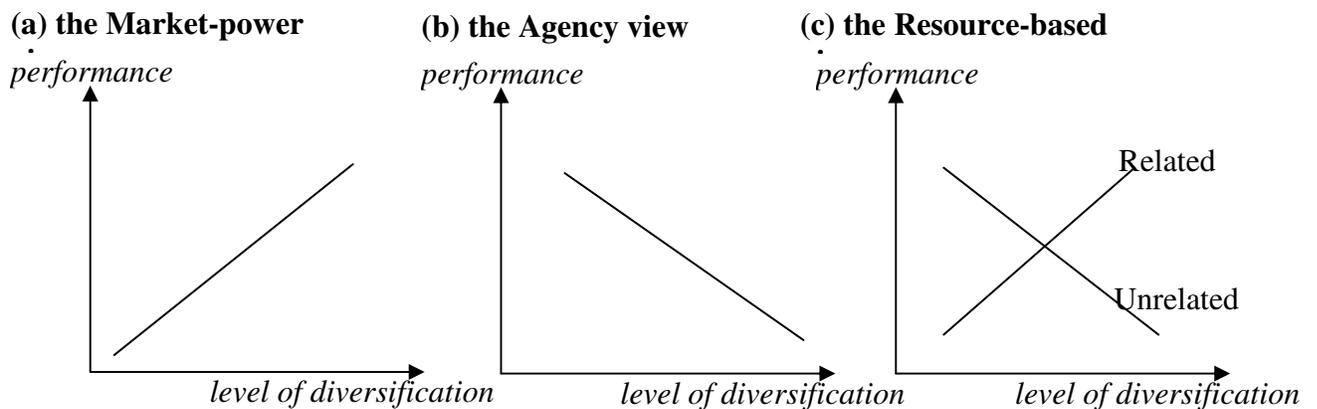
Based on the argument of market-power perspectives, diversification will certainly bring to better performance as Hill (1985) claim that diversified firms can obtain conglomerate power so that it can dictate the price, demonstrate collusive power and facilitate reciprocal buying (Montgomery, 1985). Besides, any kind of product market will eventually enter a mature stage. If a firm keeps exploiting a single market it will thus eventually become less profitable.

In contrast to the market-power view, the agency perspective holds that diversification will lead to worse performance for the agents of a firm diversifies usually not for profit maximization, but for other reasons such as to increase personal benefits or decrease the risk of being concentrated in one market.

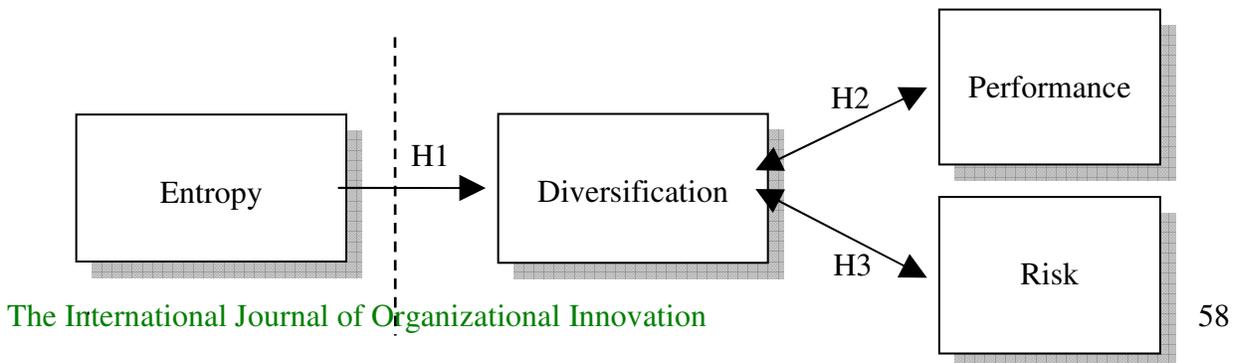
As for resource-based perspective, Rumelt's study (1982) concludes that the high level of profitability involved companies which shifted their core skills or resources into other businesses and low level of profitability involved firms that shift to heterogeneous markets without the ability to leverage the resources. Figure 1 illustrates the relationship between diversification and performance from these three views. Figure 2 displays the research model.

In spite of the predictions made by different perspectives, the overall suggestion from the existing research on the topic is that diversified firms will tend to exhibit diminished performance. The market-power view has failed to explain the negative performance. The

**Figure 1 The Relationship between Diversification and Performance from different views**



**Figure 2 Research Model**



resource view also runs short on clarifying why the prediction for positive result rarely occurs and the agency perspective's circumventions of all the organizational and market factors other than managers cannot provide a holistic and convincing explanation why diversification can only lead to worst performance.

All of these perspectives suffer from some weaknesses and are incapable of providing definite or satisfactory answer to our question. Therefore, we would like to employ our entropy view to investigate the relationship between diversification and performance.

According to previous entropy studies (Choi & Russell, 2005), when a firm diversified in a higher level, the system will tend to be more chaotic. In addition, in the information theory, entropy is considered as a measure of the uncertainty. When a conglomerate spans over more sectors, the complexity and uncertainty can multiply in a rampant fashion. Even with related diversification, different cultures and practices, even insignificant enough, from different sectors will accumulate to momentous amount. Consequently, the firm will become harder to manage as the permutations of tasks and exchange of information increase. Compounded with agency problems, the performance will decline. Therefore, it is hypothesized that:

*H2. The level of a firm's diversification is negatively related to its performance.*

### **Diversification and Risk**

Firms engaged in a single product-market without leveraging the returns of the profit into other new emerging markets or other profitable industries may face higher risk. A product-market itself will sooner or later reach a stage at which sales decline. If a firm does not perceive that problem and seek other strategies to de-concentrate its investment, it is effectively

‘gambling.’

Silverman and Castaldi (1992) claim that risk captures the probability distribution associated with the outcomes of resource commitments.” Holton (2004) overviews the past definitions of risk and concludes that risk is the exposure to a proposition of which one is uncertain (Holton, 2004).

The reason for a firm pursuing diversification is to decrease the dependence on the current product-market where conditions are unfavorable. Such unfavorable conditions in a product-market may include market saturation, unstable local economic conditions, or intensifying levels of competition (Silverman & Castaldi, 1992). These external conditions can force a firm to seriously consider diversification opportunities. Diversification is an effective means of managing risk. A firm that expands the breadth of its industrial activities will be less vulnerable to demand shocks in single markets. As Montgomery (1985) argues, from the defensive move perspective, firms pursue entering new markets to avoid unattractive conditions or limited potential in their present markets. Also based on the agency view, managers will pursue diversification strategies to try to hedge the risk of having all of their human capital invested in a single industry (Miller, 2006). It helps explain why a self-interested manager will seek diversification as a solution to avoid the risk, so when the firm fails in one market, it can still survive by concentrating on another market. Likewise, the manager will not jeopardize his or her career following a crisis. Although the diversification strategy cannot eliminate the risk, it can reduce it (Markowitz, 1991).

Based on prior empirical work on the relationship between diversification and risk, some researchers (e.g., Wang & Lim, 2001) find that the unrelated diversifiers confront higher risk in firms’ portfolio investment while other forms of diversification have lower risk. Prior studies

have not found a significant difference between single-business and related diversification in the level of risk. However, firms concentrated in only one market may also face higher risk than concentrically diversified firms. In general, the single-business company may confront higher risk compared with diversified one. However, previous research fails to adequately address this problem. According to our perspective, a more diversified firm (its entropy is high) is a more evenly distributed system. According to Gibbs (1873), as entropy increases, the free energy available to initiate a change/reaction decreases. When the entropy is high, the whole system becomes very stable and is hard to change. When the concept is translated into business analogy, it can be interpreted that a corporate with higher diversification possesses higher entropy and is as less vulnerable to turbulence and change. Therefore, we've reached the following hypothesis:

*H.3. A firm's diversification is negatively related to its risk.*

## **RESEARCH METHODOLOGY**

### **Data Collection**

The sample was compiled from the Compustat North America database of Standard and Poor's 500 (S&P 500) companies from 2000 to 2006. We chose 2000 for it was the time when internet bubble burst. Such condition is highly relevant because a firm may hold the diversification decision. This provides a perfect starting point for us to study if a firm will continue to diversify in the following years.

### **Instruments**

#### *Measurement of diversification*

Prior research measuring firm's product-market diversification relied heavily on the SIC codes (4-digit industry codes). Many researchers have noted shortcomings with the use of this

categorization scheme (e.g., Rumelt, 1982). Chatterjee and Blocher (1992, p. 875) argue that “the subjectivity inherent in Rumelt’s measures may lead to variance across researchers.” By comparing the different measurements in firms’ diversification and performance, Chatterjee and Blocher (1992) find that in continuous measures of diversification, entropy measurement is superior, as “the consistency of the entropy measure in both the discriminating power and the predictive validity tests suggests that it is the most useful for studying within-group variance since it can be split into related and unrelated categories” (p.885). Besides, the main purpose of this study is to employ the concept of entropy to explain relevant diversification decisions. In order to empirically test our claim, we found the entropy index echoes perfectly to the construct. The entropy index is calculated using the following equation.

$$E = \sum_{i=1}^n P_i \ln \frac{1}{P_i}$$

where “ln (1/P<sub>i</sub>)” refers to the natural logarithm of the fraction 1/P<sub>i</sub>. P<sub>i</sub> is the percentage of total corporate sales generated by business unit “i”.

### ***Measurement of performance***

The return on assets (ROA) over the seven-year period from 2000 to 2006 is used to measure performance. ROA is an effective index to proxy a company’s performance and has long been used in numerous diversification and performance studies (e.g. Chatterjee & Wernerfelt, 1991, Silverman & Castaldi, 1992)

### ***Measurement of Risk***

As for measuring a company’s risk, this research modified the method used by Chatterjee and Wernerfelt (1991). We used the variance of firms’ net profit margins (NPM) from 1995 to 2005 as the measure of risk. For example, in order to calculate the risk of 2000, we calculated

the variance of NPM of the previous five year (1995 to 1999). Higher variance stands for higher risk facing the firm in that year.

## RESULTS

Following the discussion of methodology in the previous chapter, this chapter will present the results produced using SPSS 15.0 (Statistical Package for the Social Sciences). First, a descriptive analysis will be used to clarify the nature of the sample, and the results from the correlation analysis examine the relationships between several variables will be presented. Finally, results from the regression analysis used to further isolate the influence of the key variables will be shown.

### Descriptive Analysis

As seen in Table 1, the sample was composed of seven-year historical data (2000-06) extracted from Standard and Poor’s 500 companies. The total number of companies is 3500

**Table 1 Descriptive Statistics of 7-Year Data from S&P 500 Companies (N=3500)**

	<i>N</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Mean</i>	<i>Std. Deviation</i>
Entropy	2893	0.00000	2.23187	0.7044187	0.54871587
Age	3439	0.00	233.00	68.5714	49.70219
ROA	3228	-458.31	45.80	4.9130	13.62206
Risk	3413	0.00	917398.07	2532.2340	34748.67646
Valid N (listwise)	2784				

(N=3500), with 2893 companies available for entropy, 3439 for age, 3228 for ROA and 3413 for risk. The value of entropy ranges from a minimum of .00 to a maximum of 2.23. Companies with an entropy value of .00 are single businesses without diversification. Higher entropy

values indicate that more diversification activities have been undertaken. 707 cases out of 2893

are at .00, indicating that only about 24.44% are undiversified. The mean entropy value is 0.70. The oldest company has been established for 233 years, while the youngest company has been established for '0 years' (less than one year for companies are founded in year 2000). The average number of established years is 68.57. The valid number of ROA is 3228, with values ranging from -458.31 at the lowest to 45.80 at the highest (mean= 4.91). And the risk value is from .00 to 917398.07 (N=3413). The valid number of the sample is 2784 (approximately 79.54%) in this research.

### Correlation Analysis

Pearson correlation was used in this study. Results are presented in Table 2 (missing values are excluded pairwise). As shown on Table 2, there is a significant positive relationship between entropy and age ( $p < .01$ ). Therefore, Hypothesis 1 is supported. Also, ROA and entropy (diversification) have a significant negative relationship ( $p < .01$ ). It means that the higher a

**Table 2 Correlation Coefficient index of Entropy, Age, ROA and Risk**

	<i>Entropy</i>	<i>Age</i>	<i>ROA</i>	<i>Risk</i>
Entropy	2893			
Age	.267**	3439		
ROA	-.065**	.036*	3228	
Risk	-.038*	-.086**	-.239**	3413

Note 1: \*\*  $p < .01$ , \*  $p < .05$  (2-tailed).

Note 2: The value of the first row in each column is Pearson Correlation coefficient index, and the second row is the valid number of the sample.

company's entropy, the worse its performance. Therefore, Hypothesis 2 is also supported. Again, as shown on table 2, diversification is significantly associated with risk ( $p < .05$ ). Therefore, hypothesis 3 is also supported.

### Summary

The results of relationships among entropy (diversification), age, performance (ROA) and risk are: 1. age and diversification are positively correlated ( $p < .01$ ); 2. diversification and performance are negatively correlated ( $p < .01$ ); 3. diversification and risk are negatively correlated ( $p < .05$ ). The results for the hypotheses are listed in Table 3.

**Table 3 Results of Hypotheses**

	Hypothesis	Result
H1	A corporate age is positively related to firm diversification.	Supported
H2	The level of a firm's diversification is negatively related to its performance.	Supported
H3	A firm's diversification is negatively related to its risk.	Supported

### CONCLUSIONS AND IMPLICATIONS

The results of this study show that diversification correlates positively with corporate age and negatively with performance and risk. The results demonstrate that when corporate age is large, which implies entropy is high, a company tends to get more diversified. In other words, although many reasons were used to explain diversification, we may simply view diversification as a natural consequence related to the passage of time. Although managers seems to be the one who initiates the diversification decision, the results indicates that no matter who assumes the role of decision maker will still make the same decision—to diversify

as the firm ages. The reason may be that humans are physical entities governed by the law of entropy; consequently, the collective entity of humans--the firm--is also governed by it.

In line with previous findings, we also found that relationship between diversification and performance is negative. This can be well-explained with entropy effect. When a firm's configuration gets more complicated, the communication channels and daily operations become harder to maneuver. Critical business information will be lost in the transmission through the complex network. Just as Brillouin (1953) identified entropy as negative information, it would not be a surprise to see performance will degrade as a firm's diversification increases. Therefore, managers seeking to sustain profitability under these conditions may benefit by considering which of their business segments are holding their companies back. By downsizing or reorganizing their business, they can introduce "negative entropy" into the firm and raise the efficiency of the organization. If managers can also combine the results that diversification can lower risks for a firm, they may be able to find a perfect diversification level.

There are, of course, more can be done to investigate the effect of entropy on corporate strategy. As the law of entropy predicts, the entropy can only increase for an isolated system. Therefore, the system will reach the state of maximum entropy eventually. At this state, nothing will ever happen for the system. In other words, the system ceases to function. In our research, risks decrease as the diversification increases. However, based on the theory, when a firm reaches certain threshold, the risk for the firm should suddenly increases and put the firm to decrease. Nevertheless, this phenomenon wasn't found in this study. This may be due to two reasons: first, a firm is not an isolated system and second, the sampling period is simply not long enough (2000 to 2006). Future research may include longer period or study deceased firms

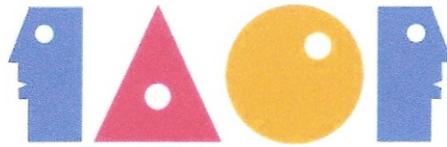
to see if this will happen.

In sum, when managers decides to diversify, they must be aware of the entropy effect and have to balance the degree of diversification in order to reach good performance with satisfactory stability.

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**IMPACT OF USERS ON NETWORK SECURITY IN  
UNIVERSITIES OF PAKISTAN**

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**ABSTRACT**

The number of universities in Pakistan has grown in recent years. They are well equipped and have relatively large networks. They are offering information technology courses, so it is necessary for them to equip themselves with new technology to compete in the market. These universities are also using different online systems such as a digital library, online fee submission, online attendance records, and also have fast internet connections. Teachers and students in these universities store important data on the university's network including personal information, research data, student assignments, and test results. Thus, the importance of Network security in universities can be well understood. Network administrators of universities should be aware of various threats to their networks since their networks are connected to the internet which is the main source for incoming viruses and other threats for data on the network. The paper discusses the impact of users on the university's network and the relationship among users and network security in universities of Pakistan.

**Keywords:** Network, Network Security, Universities, Network Users, Descriptive Survey Design, Correlation, Regression.

## INTRODUCTION

In the last few years, advancements in computer technology have greatly changed the tools available for the means of communication used in universities in Pakistan. Networks have the essential tools for top level education standards and for an efficient administration in a university. Systems linked to networks are exposed to various threats through the network.

Computers have been an integral part of research and academics for a while, and after the increase in processing power and availability of software, they have become indispensable tools for business (Abdullah, 1996). One facet of this movement is network security which is a complex topic. However, as more and more people in Pakistan becoming wired, a growing number of people in the universities need to understand the security basics in a university network.

This paper addresses the basic computer users and network administrator and explains the concepts considered necessary for security in the university, the internal and external risks, and methods to deal with them.. The users in a university can be divided into four groups: students, faculty members, network administrators and staff. Students are the users with less security requirement and confidentiality for the data on the network. Faculty members involved in education progression are users who require both security and confidentiality from internal and external threats. Network administrators and university staff have definite security and integrity needs including accounts and university administration department data.

For academic users, it is ideal to be able to browse among other users or system data sets on the network. The primary concern seems to be in learning how the system worked and in how others were cleverly using the facilities of the system (Kerievsky, 1976).

## **Significance of Network Security**

Network security came to surface as a designed and methodical approach in the latter half of the 20th century. Network security is a very broad topic, but can be summarized as controlling access to the hardware, software and data of the computer network.

When computer networks of university are taken into account, the basic understanding is that the university is a platform with an important role of the creation and distribution of knowledge. Network users in a university should respect each other's privacy. They should not misuse the technological facilities being provided to them for information seeking and for other academic needs.

In a university, students usually store their academic data and personal data on home drives provided to them by the network staff. Students also use the internet facility for their assignments and emails. Faculty members are involved in teaching as well as in research activities and need to update their lectures by having up-to-date information on the internet. Importantly, their data which is on the network is of high importance. The staff includes personnel in accounts, administration, human resources, and finance departments and they also require security for their data.

The Computer Security institute in 2001 surveyed universities on security harms and found problems with unauthorized access, internet usage and viruses. The computers on the network have access to the internet as most of the users in university require the internet for email and research. The internet is a threat to network security along with this data stealing which is common in university environments. Data stealing is aided by the use of portable storage devices.

## **LITERATURE REVIEW**

The implementation of network security is one of the main barriers to internet usage. Universities and colleges apply a variety of safeguards on their networks. System administrators can activate various systems on their network for monitoring abnormal file access on the network (Hawkins, Yen & Chou, 2000). Everything on the network is inherently insecure because of various threats caused by open, unmonitored and shared networks. Communication software usage causes more and more problems for the network and thus, the security of network is becoming an extensive problem for the institutions (Ratnasingam, 2002).

Establishing security on the network is adopted by establishing the interface between internet and the network. Various solutions for network security, including user registration and provisions, are provided by network administrator (Loew, Stengel, Bleimann and McDonald, 1999).

Major security threats are instigated by human hackers and can be prevented by adequate security plans. These security plans should be constantly updated and monitored with network rules that should be enforced and based on knowledge rather than on feelings (Perry, Perry, and Hosack-Curlin, 1998).

## **RESEARCH METHODOLOGY**

### ***Purpose***

Identification of network security internally is a difficult task, but many universities claim that their networks are secure. This idiom has been so often repeated that it is now a golden favorite. Despite this, numerous universities still decline to invest resources in the network security within the institution. This assumption of being secure needs to be carefully tested. This research study addressed these assumptions directly and therefore, the

focus of the research was whether or not network security makes a difference in the university.

The main objectives of this research study were to:

- To examine and realize the association between network security and users in the Pakistani universities, and
- To scrutinize and recognize the degree of association between network security and users of the Pakistani universities.

### ***Research Design***

In this research study, the “Convenience Sampling” (a form of non-probability sampling) method has been used. This technique is used to create a research process more rapidly by obtaining a large number of completed questionnaires quickly and efficiently. Only Higher Education Commission (HEC) listed universities having a minimum three years of operation were selected for this study. The platform used to select the institutions was the website of HEC since the website contained all of the necessary information about the universities. The postal addresses of the campus of these universities were collected and questionnaires were mailed to respondents using these addresses..

### ***Survey Methods***

Due to the deficiency of time and inadequate resources, the mail survey was used for data collection. Through this method, 109 responses were collected from the network administrators, faculty members, staff and students of the universities. Some problems reduced the response rate efficiency as people from different universities were not quick in answering and therefore, the data collection was slow. To alleviate this problem, personal one-to-one interviewing method was started. Universities in the twin cities, e.g. Rawalpindi

and Islamabad, were personally visited and the questionnaires were dispersed in the universities. As a result, the response rate was better with higher quality. Responses were collected from eight universities, but there were other problems like time consumption. To make responses quicker and to eliminate excessive traveling, the telephone interviewing method was used. This method was comparatively more productive and through this method, 284 responses were collected.

Expressive surveys were used to provide a depiction of the current matters and relational surveys were developed for empirical analysis. This research attempt is relational for exploring the association between network security and network users. For the survey, questionnaires developed consisted of a five point Likert scale with five used for strongly agree (yes) and one used for strongly disagree (no). Many times, people were not clear about the terminologies used in the questionnaire, but this matter was solved through detailed clarification and by one-to-one discussion.

### ***Response Rate***

Information regarding network security was collected from the network administrators of the target universities. The network professionals were requested to respond to all the questions to the best of their knowledge with reference to the network implemented in their institutions. There was an open option that any person from the university network department at the administrator level could fill out the questionnaire. During the data collection process, it was observed that a few universities did not have a separate network administration department, but other departments like Information Technology and Computer Science were taking care of the computer network activities.

The overall response rate was 60%. Table 1 shows the percentage of the responses that came from each university, for example, of the responses, 42% of them came from International Islamic University.

Table 1. University Response Rate

	<i>University Name</i>	<i>Sample %</i>
1	International Islamic University	42
2	Bahria University	12
3	Air University	8
4	National University of Modern Language	7
5	Quaid-a-Azam University	13
6	Comsat University	8
7	Federal Urdu University	3
8	National University of Computer & Emerging Science	7

***Description of the Instruments***

This study was conducted on a basic level as there was no data available prior to this research. Therefore a Likert scale questionnaire was developed to find out the network security aspects with an impact on organizational performance. The questionnaire included the age of the university, number of faculty members and number of networks as a control variable with network security as the dependent variable. Faculty members, network administrators, staff and students were selected as independent variables. The response rate for these questionnaires was 60% as mentioned earlier. Statistical tools used were multiple regression and correlation since they are easy to understand produce remarkable and meaningful results. After the data collection, it was coded in Excel 2003 and SASS 10.0.

## ***Variables***

Variables are given in Figure 1 and the research model is given in Figure 2. In this research, eight variables were considered for analysis. Out of these, four were independent variables, three were control variables and one was a dependent variables. These independent variables affected network security internally.

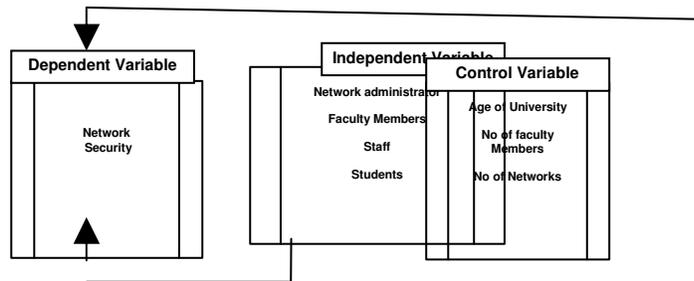


Figure 1. Relationship between Variables

## ***Questionnaire***

The data collection was through questionnaires consisting of a dependent variable (network security), independent variables (faculty member, network administrator, staff, students) and control variables (life of university, number of faculty members and number of networks). The questionnaire was developed depending upon the extensive literature review cited earlier in this paper.

## ***Research Model***

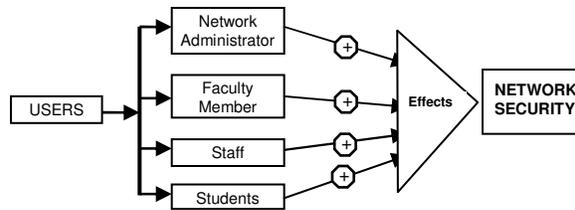


Figure 2. Research Model

## Equations

The equations used in this study were:

$$y = \alpha + \beta_1 (x_1) + \beta_2 (x_2) + \beta_3 (x_3) + \beta_4 (x_4) + \varepsilon$$

$$NS = \alpha + \beta_1 (NA) + \beta_2 (FM) + \beta_3 (S) + \beta_4 (ST) + \varepsilon$$

Where as:

$\varepsilon$  = is common error

$\alpha$  = is constant

$\beta$  = gradient or slope of the line

Y = is dependent variable

$X_1, X_2, \dots, X_4$  = independent variables

And

1.  $X_1 = NA =$  Network Administrator
2.  $X_2 = FM =$  Faculty Members
3.  $X_3 = S =$  Staff
4.  $X_4 = ST =$  Student
5.  $Y = NS =$  Network Security

## *Hypothesis*

Based on literature review, four hypotheses were developed for the study:

- H1** *There is a positive/significant relationship between network security and the behavior of network administrator.*
- H2** *There is a positive/significant relationship between network security and the behavior of faculty member.*
- H3** *There is a positive/significant relationship between network security and the behavior of staff.*
- H4** *There is a positive/significant relationship between network security and the behavior of student.*

## **RESEARCH FINDINGS**

### *Descriptive Statistics.*

Descriptive statistics were a part of statistics used to summarize a set of data. Following are the steps used in descriptive statistics.

*Correlation.* Correlation coefficient indicated the strength and direction of a linear relationship between two random variables with different coefficients are used for different situations. The best known is the Pearson product-moment correlation coefficient which is obtained by dividing the covariance of the two variables by the product of their standard deviations.

*Pearson Correlation Coefficient.* Pearson correlation coefficient is a measure of the correlation of two variables X and Y measured on the same object that is a measure of the tendency of the variables to increase or decrease together. Table 2 shows correlations for all the variables. Table 3 indicates descriptive statistics which are based upon values of standard deviations, means, median, mode, minimum, maximum values and ranges. There was a high correlation amongst the independent and dependent variables, especially between network security and faculty members at 0.49. The mean of the Network Administrator was 3.17, whereas the standard deviation was 0.47 which indicated that if the network administrator is

working well, then a secured network will be created . The correlation between staff members and network security was -0.01 which indicated that staff members were not highly beneficial and had a negative impact on network security. The student showed a correlation value of -0.16 which showed that students also had a negative impact on network security.

For the correlation independent variables, the network administrator had a high value of correlation with staff members of 0.58 which indicated that it has strong positive

Table 2. Correlations of Variables

	<i>Network Security</i>	<i>Network Admin</i>	<i>Faculty member</i>	<i>Staff</i>	<i>Students</i>
<i>Network Security</i>	1				
<i>Network Admin</i>	0.49	1			
<i>Faculty member</i>	0.37	0.064	1		
<i>Staff</i>	-0.01	0.58	0.44	1	
<i>Students</i>	-0.16	0.22	0.07	0.03	1

impact on network security. Moreover, awareness of faculty members and students showed that these variables are also having good correlation (0.64). The significant association between the faculty member and network security was 0.37 and network administrator was 0.49 which reflected the psyche of the users in the Pakistani universities and showed that if these two independent variables are powerfully connected, then there would be high positive impact on network security as measured on the basis of quantifiable results.

The mean of the network administrator is 3.17 and the standard deviation is 0.47 which is comparatively lower than the faculty members. The impact of the faculty member on network security showed a positive relationship up to 0.43. While it was not very high,

still it was important. It indicated that faculty members should be more and more confident about network security so that a network can be truly safe. Finally, it provided an opportunity to suggest improvements in the way of thinking.

Table 3. Descriptive Statistics

	<i>Network Admin</i>	<i>Faculty member</i>	<i>Staff</i>	<i>Students</i>
<b>Mean</b>	3.17	3.50	3.59	3.32
<b>Standard Error</b>	0.06	0.06	0.067	0.05
<b>Median</b>	3.13	3.5	3.6	3.25
<b>Mode</b>	3.25	3.8	3.6	3.75
<b>Standard Deviation</b>	0.47	0.43	0.52	0.40
<b>Sample Variance</b>	0.22	0.19	0.26	0.17
<b>Range</b>	1.75	1.4	1.8	2
<b>Minimum</b>	2.25	2.8	2.4	2.25
<b>Maximum</b>	4	4.2	4.2	4.25
<b>Sum</b>	190	210.2	215.6	199.25

*Regression.* The contribution of independent variable towards dependent variable was also critical. To explain this, the multiple regression technique was used. Table 4 exhibits the regression outcomes for selected Pakistani universities and represents the regression of network security.

Table 4. Regression

	<i>Coefficients</i>	<i>P-value</i>
Intercept	3.42	16
Network Administrator	0.06	0.39
Faculty member	0.21	0.01
Staff	-0.11	0.09
Students	-0.07	0.22

## **CONCLUSIONS**

Universities in Pakistan today are being well equipped with new technology. Students, teachers and administrators in universities are enjoying many facilities for their use. Computer networks have become an important variable in providing information to teachers and students and they are not only providing internet services, but are also being used for information sharing and access to data bases.

The users need to be aware of different threats present in the university computer networks and they should abide by the network usage policy and respect the privacy of other users on the network. Network administrators need to ensure the safety and reliability of the network, enforce the network usage policy, and make clear to users that network should be used only for academic and research purpose.

The staffs of universities should use computers responsibly and trainings should be conducted for them on computer network usage. Students should be briefed about the policy of network usage, the services provided to them for information seeking, and the expectation that their behavior towards learning should be positive.

All of the users of a university computer network are responsible for their network security. They all have an impact on network security. In order to improve and secure a university network, the four groups of users should cooperate with network administration staff and use the facilities provided to them responsibly.

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## **A Hybrid Whittle Approach to Test Spurious Regression with the REML Estimator**

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### **ABSTRACT**

This paper proposes an approach to test the spurious regression problem in the one-way panel data model whereby a hybrid Whittle approach is demonstrated for the restricted maximum likelihood (REML) estimator. The model applies the Fejér window, in which the remainder disturbance can be either a stationary or a non-stationary process, in the domain of the integrated degree  $\delta \in [-0.5, 1.5)$ . This research shows the merits of combining two conventional approaches, differencing and tapering, to estimate the model without prior knowledge.

Through Monte Carlo experiments, the consistency of the estimator is examined by growing the individual number  $N$  and time length  $T$ , in which the remainder disturbances are simulated by distinct models including stationary and non-stationary processes. Observation of the power tests shows that the estimators are quite successful and powerful.

**Keywords:** Whittle MLE, Tapering, Panel Data Model, Long Memory, Pseudo Spectral Density Function, Restricted Maximum Likelihood Estimator.

## INTRODUCTION

The restricted maximum likelihood (REML) procedure maximizes the joint likelihood of all error contrasts, rather than all contrasts, as in the widely-adopted ordinary maximum likelihood procedure; see Gilmour, Thompson, and Cullis (1995), Searle, Casella, and McCulloch (1992), etc. An important aspect of the estimation of variance components is that the use of REML can reduce the bias in the estimation of the variance component parameters. This article applies the REML estimator on a one-way panel data model with a conventional assumption of Gaussian random terms. Aside from the stationary remainder disturbance assumption, we also extend the model to include both long memory and non-stationary processes.

In conventional time series models, the non-stationary error term causes  $t$ -values to diverge, the  $DW$ -statistic to approach zero, and  $R^2$  to approach unity as the sample size  $T$  goes to infinity (e.g. Entorf, 1997; Kao, 1999; Harris and Tzavalis, 1999; Maddala and Wu, 1999). This is the so-called spurious regression problem, as proposed by Granger and Newbold (1974). For this important issue, our concern is focused on developing a consistent estimator for a panel data model by the REML estimator, even if the remainder disturbance is a non-stationary process.

Concerning the non-stationary process estimation, Velasco and Robinson (2000) developed a useful tapered periodogram estimator for the pseudo spectral density function (SDF) of a non-stationary process. Applying tapered data to a periodogram estimator provides

an interesting and feasible approach to dealing with non-stationary processes. Conventionally, the frequencies are assumed to be fixed and non-zero, and therefore if the sample size approaches infinity, a consistent estimator can be obtained. In practice, when we apply the harmonic frequencies, the frequencies near zero will also approach zero as the sample size increases to infinity, causing an inconsistent result. Hence, a precise relationship among the sample size, magnitude of the chosen frequencies, and periodogram estimator should be recognized. This article focuses on such a problem and provides a solution regarding the construction of a consistent estimator which can be utilized by the REML estimator.

### **Hybrid Whittle Objective Function For A Non-Stationary Process**

This section develops a useful approach which can be applied to both stationary and non-stationary processes where the domain of the integrated order is set to  $-0.5 \leq \delta < 1.5$ . Here, the Fejér window is used to reduce leakage in the periodogram estimation.

In practice, we usually apply the harmonic frequencies in the estimation. If the process is non-stationary, the frequencies near zero will cause the periodogram estimator to be inconsistent even though the tapered data is used. Hence, a precise relationship among the sample size, magnitude of frequencies, and the estimator's properties is recognized.

Let us first assume a stationary process.

Definition 1: Let  $\varepsilon_t$  be a fractional ARIMA( $p, d, q$ ) process. Assume that

$\phi(B)\varepsilon_t = (1 - B)^{-d} \theta(B)a_t$ , where  $a_t$  is a white noise process,  $\phi(B)$  and  $\theta(B)$  represent corresponding AR and MA polynomial operator functions with roots outside the closed unit circle, where  $-0.5 \leq d < 0.5$ ,  $\phi(B) = 1 - \phi_1 B - \dots - \phi_p B^p$ , and  $\theta(B) = 1 - \theta_1 B - \dots - \theta_q B^q$ .

In particular,  $\{\varepsilon_t\}$  is a negative memory process if  $-0.5 \leq d < 0$ . It is a short memory process when  $d = 0$ , and is a long memory process when  $0 < d < 0.5$ . If the data generating mechanism is such as in definition 1, then its spectral density function can be expressed as:

$$f_\varepsilon(\lambda) = \frac{\sigma_a^2}{2\pi} |1 - e^{-i\lambda}|^{-2d} |\phi(e^{-i\lambda})|^{-2} |\theta(e^{-i\lambda})|^2 \text{ for } -0.5 \leq d < 0.5.$$

The periodogram is usually used to estimate the spectral density function. If the process is stationary, then the periodogram estimator is a consistent estimator. Furthermore, the tapered data is also often used to obtain a consistent estimator which can rapidly reduce the leakage.

Raw and tapered periodograms are demonstrated respectively as:

$$I_\varepsilon(\lambda) = \frac{1}{2\pi T} \left| \sum_{t=1}^T \varepsilon_t e^{-it\lambda} \right|^2 \text{ and } I_\varepsilon^{(T)}(\lambda) = \left( 2\pi \sum_{t=1}^T h_t^2 \right)^{-1} \left| \sum_{t=1}^T h_t \varepsilon_t e^{-it\lambda} \right|^2,$$

where  $h_t$  is a taper window for  $t = 1, \dots, T$ . If  $\varepsilon_t$  is a stationary process, then according to

Brillinger (1981):

$$E[I_\varepsilon(\lambda)] \rightarrow f_\varepsilon(\lambda) \text{ and } E[I_\varepsilon^{(T)}(\lambda)] \rightarrow f_\varepsilon(\lambda) \text{ as } T \rightarrow \infty \text{ for } \lambda \in [-\pi, \pi] - \{0\}.$$

We exclude the zero frequency here because the process can be a long memory process and its zero frequency spectral density function is unbounded. According to Gradshteyn and Ryzhik (1965, p.372), if  $\{\varepsilon_t\}$  is a fractional ARIMA process,  $\rho(k)$  is its corresponding autocorrelation coefficient, and  $k$  is the lag number, then:

$$\rho(k) \sim \frac{\Gamma(1-d)}{\Gamma(d)} |k|^{2d-1} \text{ for } d \in (0, 0.5), \text{ as } |k| \rightarrow \infty,$$

where  $\Gamma(\cdot)$  is a gamma function. If  $d \in [-0.5, 0]$ , then the auto-correlation function approaches zero when  $|k|$  approaches infinity. We now have the following lemma.

**Lemma 1:** If  $\{\varepsilon_t\} \sim I(d)$  is a stationary process for  $t = 1, \dots, T$ , then its autocorrelation can be

given by  $\rho(k) \sim c_\rho |k|^{2d-1}$  for  $d \in (0, 0.5)$  and  $k \rightarrow \infty$ . Let  $\bar{\varepsilon} = \frac{1}{T} \sum_{t=1}^T \varepsilon_t$ , where the

corresponding variances employ these properties:  $\text{var}(\bar{\varepsilon}) = O_p(T^{2d-1})$  for  $d \in (0, 0.5)$  and

$\text{var}(\bar{\varepsilon}) = O_p(T^{-1})$  for  $d \in (-0.5, 0]$  as  $T \rightarrow \infty$ , where  $O_p$  is the Landau order.

**Proof:** The proofs are shown in Appendix A.

As most economics time series data are first-differenced stationary processes, in the following context we move to a non-stationary process where the integrated order set is on  $0.5 \leq \delta < 1.5$ . Assume a non-stationary process  $\{v_t\}$  which is an accumulation of  $\varepsilon_t$ , i.e.:

$$v_t = v_0 + \sum_{j=1}^t \varepsilon_j,$$

where  $\varepsilon_t \sim I(d)$  and  $-0.5 \leq d < 0.5$ . Here,  $v_0$  is an initial number which can be regarded as a fixed number. If  $\varepsilon_t \sim I(d)$ , then  $v_t \sim I(\delta)$  where  $\delta = d + 1$ , indicating that  $\{v_t\}$  is a non-stationary process and  $0.5 \leq \delta < 1.5$ . The Fourier transform of  $\{v_t\}$  can then be expressed as:

$$\begin{aligned} \frac{1}{\sqrt{2\pi T}} \sum_{t=1}^T v_t e^{-i\lambda t} &= \frac{1}{(1 - e^{-i\lambda})} \left( \frac{1}{\sqrt{2\pi T}} \sum_{t=1}^T \varepsilon_t e^{-i\lambda t} - \frac{v_T}{\sqrt{2\pi T}} e^{-i\lambda(T+1)} + \frac{v_0 e^{-i\lambda}}{\sqrt{2\pi T}} \right) \\ &= \frac{1}{(1 - e^{-i\lambda})} \left( w_\varepsilon(\lambda) - \frac{v_T}{\sqrt{2\pi T}} e^{-i\lambda(T+1)} + o_p(1/\sqrt{T}) \right), \end{aligned} \quad (1)$$

for  $\lambda \in [-\pi, \pi] - \{0\}$ . According to lemma 1, if  $T \rightarrow \infty$ , then  $\text{var}(\bar{\varepsilon}) = O_p(T^{2d-1})$  for  $d \in (0,$

$0.5)$ , and  $\text{var}(\bar{\varepsilon}) = O_p(T^{-1})$  for  $d \in (-0.5, 0]$ , which is equivalent to  $\text{var}(v_T/\sqrt{T}) = O_p(T^{2d})$  for

$d \in (0, 0.5)$  and  $\text{var}(v_T/\sqrt{T}) = O_p(1)$  for  $d \in (-0.5, 0]$  as  $T \rightarrow \infty$ . Apparently, if  $v_t$  is a non-

stationary process, then the raw periodogram estimator of  $\{v_t\}$  in (1) is not a consistent estimator for the pseudo spectrum  $|1 - e^{-i\lambda}|^{-2} f_\varepsilon(\lambda)$  at  $\lambda \in [-\pi, \pi] - \{0\}$ .

The tapered data is therefore considered when the Fejér window is used. The Fourier transform for the tapered data of  $\{v_t\}$  can be represented by:

$$w_v^{(T)}(\lambda) = \left(2\pi \sum_{t=1}^T h_t^2\right)^{-1/2} \left(h_1 v_1 e^{-i\lambda} + h_2 v_2 e^{-i2\lambda} + \dots + h_T v_T e^{-iT\lambda}\right),$$

where  $h_t = 1 - |1 - t/(T^* + 1)|$  and  $T = 2T^* + 1$ , for  $1 \leq t \leq T$ . The above equation can then be represented as follows (see the proofs in Appendix B):

$$w_v^{(T)}(\lambda) = \frac{1}{(1 - e^{-i\lambda})} \left( w_\varepsilon^{(T)}(\lambda) + \frac{1}{\alpha(T^* + 1)} \left( 2 \sum_{t=1}^{T^*+1} \frac{v_t}{\sqrt{2\pi T}} e^{-i\lambda t} - \sum_{t=1}^{T+1} \frac{v_t}{\sqrt{2\pi T}} e^{-i\lambda t} \right) \right),$$

where  $\alpha = \sqrt{\sum_{t=1}^T h_t^2 / T}$  and  $\lambda \in (-\pi, \pi) - \{0\}$ . The second term in the bracket can be expanded by (1):

$$\begin{aligned} & \frac{1}{\alpha(T^* + 1)(1 - e^{-i\lambda})} \left( 2 \sum_{t=1}^{T^*+1} \frac{v_t}{\sqrt{2\pi T}} e^{-i\lambda t} - \sum_{t=1}^{T+1} \frac{v_t}{\sqrt{2\pi T}} e^{-i\lambda t} \right) \\ &= \frac{1}{(T^* + 1)(1 - e^{-i\lambda})^2} \left( 2w_\varepsilon^*(\lambda) - w_\varepsilon(\lambda) - \frac{2v_{T^*}}{\alpha\sqrt{2\pi T}} e^{-i\lambda(T^*+1)} + \frac{v_T}{\alpha\sqrt{2\pi T}} e^{-i\lambda(T+1)} + \frac{v_0}{\sqrt{2\pi T}} e^{-i\lambda} \right), \end{aligned} \quad (2)$$

where  $w_\varepsilon^*(\lambda) = \frac{1}{\sqrt{2\pi T}} \sum_{t=1}^{T^*} \varepsilon_t e^{-i\lambda t}$ , which is a partial sum of  $w_\varepsilon(\lambda)$ . In addition,  $v_{T^*}$  is also a partial sum of  $v_T$ .

From the above equation, we can see that the RH term is different from the non-tapered data form in (1). Plugging in the divisor  $(T^* + 1)$  here reduces the degree of the power. If  $\lambda$  is fixed and moved away from zero, i.e. the term  $|1 - e^{-i\lambda}|^{-2}$  is set to a finite value, then the highest order term in (2) is:

$$\left| v_T e^{-i\lambda(T+1)} / \left[ (T^* + 1) \sqrt{2\pi T} \right] \right|^2 = O_p(T^{2d-2}) \text{ as } T \rightarrow \infty \text{ for } d \in (0, 0.5), \text{ and}$$

$$\left| v_T e^{-i\lambda(T+1)} / \left[ (T^* + 1) \sqrt{2\pi T} \right] \right|^2 = O_p(T^{-2}) \text{ as } T \rightarrow \infty \text{ for } d \in [-0.5, 0].$$

This implies that we have a consistent estimator that coincides with the result in Velasco and Robinson (2000). However, in practice, when the harmonic frequencies  $\lambda_j = 2\pi j/T$  are used,

$$\left| (1 - e^{-i\lambda_j})^{-2} \right| \text{ will approach infinity when } \lambda_j \rightarrow 0.$$

Under general conditions,  $\left| (1 - e^{-i\lambda_j})^{-2} \right|$  will approach infinity when  $\lambda_j \rightarrow 0$ . We have to recognize the relationship, in a precise manner, between the magnitude of  $\lambda_j$  and the estimator's properties. In order to find out which region is consistent for the tapered periodogram estimator, we assume  $j = T^\eta/2$  for  $\eta \in [0, 1]$ . Then,  $\lambda_j = \pi T^{\eta-1}$  and  $\lambda_j \in (0, \pi]$ . In this case, if  $0 \leq \eta < 1$ , it indicates that  $j/T \rightarrow 0^+$  as  $T \rightarrow \infty$ , which in turn implies that  $\lambda_j \rightarrow 0^+$ . If the frequency  $\lambda_j$  is not fixed and approaches zero, then the highest term in (2) can be obtained:

$$\left| \frac{v_T e^{-i\lambda_j(T+1)}}{(T^* + 1)(1 - e^{-i\lambda_j})^2 \alpha \sqrt{2\pi T}} \right|^2 = O_p(T^{-4\eta+2(1+d)}) \text{ as } T \rightarrow \infty.$$

We shall note here that if  $\lambda = \zeta T^\tau$  for  $-1 < \tau \leq 0$ , then  $|w_\varepsilon(\lambda)|^2 = O_p(T^{-2d\tau})$  which is smaller than  $\left| v_T e^{-i\lambda(T+1)} / \sqrt{2\pi T} \right|^2 = O_p(T^{2d})$ , and so we can obtain the highest term. Thus, because  $v_t$  is the accumulation of  $\varepsilon_t$ , it can be seen that when  $v_t \sim I(\delta)$ , then  $\delta = d+1$ . Therefore, if  $\eta \in ((1+d)/2, 1)$ , meaning  $\eta \in (\delta/2, 1]$ , then:

$$\left| \frac{v_T e^{-i\lambda_j(T+1)}}{(T^* + 1)(1 - e^{-i\lambda_j})^2 \alpha \sqrt{2\pi T}} \right|^2 \rightarrow 0 \text{ as } T \rightarrow \infty.$$

This indicates that we can use the region  $\eta \in (\delta/2, 1]$  to devise a consistent estimator. If we only know  $\delta \in [0.5, 1.5)$ , then the smallest intersecting closed set  $[0.75, 1]$  is consequently applied, i.e.  $[\sup(\delta)/2, 1]$ . According to this region, we can simply divide the harmonic frequencies  $\lambda_j = 2\pi j/T$  into two subsets, i.e.:

$$\Omega_1 = \{\lambda_j \mid 1 \leq j < T^{0.75}/2\} \text{ and } \Omega_2 = \{\lambda_j \mid T^{0.75}/2 \leq j \leq T/2\}, \quad (3)$$

where the tapered data employs the following properties:

$$|w_v^{(T)}(\lambda_j)|^2 \rightarrow f_\epsilon(\lambda_j) |1 - e^{-i\lambda_j}|^{-2}, \text{ where } \lambda_j \in \Omega_2 \text{ and } T \rightarrow \infty.$$

In practice, the process can either be stationary or non-stationary. We assume  $v_t \sim I(\delta)$ .

Therefore, a consistent discretely hybrid Whittle objective function can be established:

$$Q^s = \frac{4\pi}{T} \left( \sum_{\lambda_j \in \Omega_1} \frac{I_{\Delta v}(\lambda_j)}{g_v(\lambda_j; \Theta^*)} + \sum_{\lambda_j \in \Omega_2} \frac{I_{v_t}^{(T)}(\lambda_j)}{g_v(\lambda_j; \Theta)} \right) \text{ if } 0.5 \leq \delta < 1.5, \text{ and} \quad (4)$$

$$Q^s = \frac{4\pi}{T} \sum_{\lambda_j \in \Omega} \frac{I_{v_t}^{(T)}(\lambda_j)}{g_v(\lambda_j; \Theta)} \text{ if } -0.5 < \delta < 0.5, \quad (5)$$

where  $\Theta = (\phi_1, \dots, \phi_p, \delta, \theta_1, \dots, \theta_q)'$  and  $\Theta^* = (\phi_1, \dots, \phi_p, \delta - 1, \theta_1, \dots, \theta_q)'$ ,  $\lambda_j \in (0, \pi]$  are the

harmonic frequencies, i.e.  $\lambda_j = 2\pi j/T$ ,  $\Omega_1 = \{\lambda_j \mid 1 \leq j < T^{0.75}/2\}$ ,  $\Omega_2 = \{\lambda_j \mid T^{0.75}/2 \leq j \leq T/2\}$ ,

and  $\Omega = \{\lambda_j \mid 1 \leq j \leq T/2\}$ . In addition, if  $\Theta \rightarrow \Theta_0$  where  $\Theta_0$  is the true value, then  $Q^s \rightarrow \sigma_a^2$  as

$T \rightarrow \infty$ .

We now note that if the process is non-stationary, then the spectrum may be different when  $\lambda \in \Omega_1$  and  $\lambda \in \Omega_2$  in (4). However, each periodogram divided by its corresponding spectrum (which may be pseudo) has the same relationship when  $\Theta \rightarrow \Theta_0$ , i.e.:

$$\lim_{T \rightarrow \infty, \lambda_j \in \Omega_1} E \left( I_{\Delta v}(\lambda_j) / g(\lambda_j; \Theta^*) \right) = \lim_{T \rightarrow \infty, \lambda_j \in \Omega_2} E \left( I_v^{(T)}(\lambda_j) / g(\lambda_j; \Theta) \right) = \sigma_a^2 / 2\pi \text{ for } 0.5 \leq \delta < 1.5.$$

The result is also applied at the stationary process, i.e.:

$$\lim_{T \rightarrow \infty, \lambda_j \in \Omega} E \left( I_v^{(T)}(\lambda_j) / g(\lambda_j; \Theta) \right) = \sigma_a^2 / 2\pi, \text{ for } -0.5 \leq \delta < 0.5.$$

Using the one-step predictor seen in Rosenblatt (2000, page 17), an estimator  $\Theta$  that is convergent in probability to  $\Theta_0$  is easily constructed. Hence, we can estimate the parameters without prior knowledge of  $\delta$ . The only limitation is on  $\delta$  where  $-0.5 \leq \delta < 1.5$ , which satisfies general economical series requirements.

### REML using the Whittle Approach

This section demonstrates a one-way panel data model that applies the REML estimator where the remainder disturbance is assumed to be a short memory process, i.e.  $v_{kt}$  is a ARMA( $p, q$ ) process. Here, the random effects model is assumed to construct the Whittle objective function. To begin, let us consider a one-way panel data model:

$$y_{kt} = x'_{kt} \beta + \mu_k + v_{kt} \quad k = 1, \dots, N; t = 1, \dots, T,$$

which becomes, in vector form:

$$y = x\beta + z_\mu \mu + v,$$

where  $k$  denotes individuals and  $t$  is time. The  $k$  subscript represents the cross-section dimension,  $t$  denotes the time-series dimension,  $\beta$  shows the regression coefficients,  $x_{kt}$  is the  $kt$ th observation explanatory variable that includes  $K$  exogenous variables, the individual effect  $\mu_k \sim \text{NID}(0, \sigma_\mu^2)$  denotes the unobservable individual-specific effect, and  $v_{kt}$  denotes the remainder disturbance. The vector  $y$  is  $NT \times 1$ , the matrix  $x$  is  $NT \times K$ , the remainder disturbance  $v$  is an  $NT \times 1$  vector, the vector  $\mu$  is  $N \times 1$ , and  $z_\mu = I_N \otimes I_T$ .

Assume  $v_{kt}$  is a stationary ARMA process, that is:

$$\phi(B)v_{kt} = \theta(B)a_{kt} \text{ and } \text{var}(a_{kt}) = \sigma_a^2,$$

where  $B$  denotes the backshift operator, and  $\phi(B)$  along with  $\theta(B)$  are polynomials with roots outside the unit circle. The corresponding covariance matrix for the individual effects and the remainder disturbances can be represented as:

$$\begin{bmatrix} \mu \\ v \end{bmatrix} \sim N \left( \mathbf{0}, \sigma_a^2 \begin{bmatrix} \eta I_N & 0 \\ 0 & I_N \otimes \Sigma(\Theta) \end{bmatrix} \right), \quad (6)$$

where  $\eta = \sigma_\mu^2 / \sigma_a^2$ ,  $v' = [v'_1, \dots, v'_k]$ ,  $v'_k = [v_{k1}, \dots, v_{kT}]$ , and  $E(v_k v'_k) = \sigma_a^2 \Sigma(\Theta)$ . Let  $A(\Theta) = \Sigma^{-1}(\Theta)$ , and according to Gilmour, Thompson, and Cullis (1995),  $H$  and its inverse matrix can be obtained as:

$$H = I_N \otimes \Sigma(\Theta) + \eta(I_N \otimes J_T), \quad H^{-1} = I_N \otimes (A(\Theta) + ((\gamma - 1)/\tau) A(\Theta) l_T l_T' A(\Theta)), \quad (7)$$

where  $\gamma = 1/(1 + \eta\tau)$ ,  $\tau = l_T' \Sigma^{-1} l_T$ , and  $\eta = \sigma_\mu^2 / \sigma_a^2$ .

According to Beran [1994, page 110, lemma 5.3] the elements of  $A(\Theta)$  have the following relationship:

$$A(\Theta) = [\alpha(j-l)]_{j,l=1,\dots,T}, \text{ where } \alpha[j-l] = (2\pi)^{-1} \int_{-\pi}^{\pi} \frac{1}{g_v(\lambda; \Theta)} e^{i(j-l)\lambda} d\lambda \text{ and}$$

$$g_v(\lambda; \Theta) = \left| \frac{\theta(e^{-i\lambda})}{\phi(e^{-i\lambda})} \right|^2.$$

By the Riemann sum of harmonic frequencies, the approximation is:

$$\tilde{\alpha}[m-l] \approx \frac{1}{T} \sum_{j=-M}^M \frac{1}{g_v(\lambda_j; \Theta)} e^{i(m-l)\lambda_j}, \quad (8)$$

where the harmonic frequencies  $\lambda_j = 2\pi j/T$ ,  $j = -M, -(M-1), \dots, 0, \dots, M$ , which correspond to (-

$\pi, \pi$ ).  $M = T/2$  if  $T$  is even, or  $M = (T-1)/2$  if  $T$  is odd, and  $d\lambda$  is replaced by  $2\pi/T$ . Let

$u = z_\mu \mu + v$ . Putting (8) into (7), we can obtain the quadratic form:

$$u'H^{-1}u = 2\pi \sum_{k=1}^N \left( \sum_{j=1}^M \frac{2I_{u_k}(\lambda_j)}{g_v(\lambda_j; \Theta)} + \gamma \frac{I_{u_k}(\lambda_0)}{g_v(\lambda_0; \Theta)} \right), \quad (9)$$

where  $\gamma = 1/(1 + \eta\tau)$ ,  $\tau = l'_T \Sigma^{-1} l_T = T/g_v(\lambda_0; \Theta)$ , and  $\eta = \sigma_\mu^2 / \sigma_a^2$ .

As  $u = y - x\beta$ ,  $I_{u_k}(\lambda_j) = I_{y_k}(\lambda_j) - 2\text{Re}(I_{y_k, x_k}(\lambda_j))\beta + \beta' I_{x_k}(\lambda_j)\beta$ , and

$$\sum_{j=-M}^M \frac{I_{u_k}(\lambda_j)}{g_v(\lambda_j; \Theta)} = \sum_{j=1}^M \frac{2I_{u_k}(\lambda_j)}{g_v(\lambda_j; \Theta)} + \frac{I_{u_k}(\lambda_0)}{g_v(\lambda_0; \Theta)}.$$

We can express the log REML likelihood according to Cullis and Gleeson (1991, equation (6)) as:

$$\begin{aligned} l &= \text{constant} - \frac{1}{2} \left\{ \ln |x'H^{-1}x| + \ln |H| + (NT - K) \ln \sigma_a^2 + y'Py / \sigma_a^2 \right\} \\ &= \text{constant} - \frac{1}{2} \left( \ln |\Gamma_{xx}(\Theta, \gamma)| + \frac{NT}{2\pi} \int_{-\pi}^{\pi} \ln g_v(\lambda) d\lambda - N \ln \gamma + (NT - K) \ln \sigma_a^2 \right) \\ &\quad - \frac{1}{2\sigma_a^2} \left( \Gamma_{yy}(\Theta, \gamma) - \Gamma_{yx}(\Theta, \gamma) \Gamma_{xx}^{-1}(\Theta, \gamma) \Gamma_{xy}(\Theta, \gamma) \right), \end{aligned} \quad (10)$$

where

$$\Gamma_{xx}(\Theta, \gamma) = x'H^{-1}x = 2\pi \sum_{k=1}^N \left( \sum_{j=1}^M \frac{2\text{Re}[I_{x_k}(\lambda_j)]}{g_v(\lambda_j; \Theta)} + \gamma \frac{I_{x_k}(\lambda_0)}{g_v(\lambda_0; \Theta)} \right),$$

$$\Gamma_{xy}(\Theta, \gamma) = x'H^{-1}y = 2\pi \sum_{k=1}^N \left( \sum_{j=1}^M \frac{2\text{Re}(I_{x_k, y_k}(\lambda_j))}{g_v(\lambda_j; \Theta)} + \gamma \frac{I_{x_k, y_k}(\lambda_0)}{g_v(\lambda_0; \Theta)} \right),$$

$$\Gamma_{yy}(\Theta, \gamma) = y'H^{-1}y = 2\pi \sum_{k=1}^N \left( \sum_{j=1}^M \frac{2I_{y_k}(\lambda_j)}{g_v(\lambda_j; \Theta)} + \gamma \frac{I_{y_k}(\lambda_0)}{g_v(\lambda_0; \Theta)} \right),$$

and  $\ln|H| = N \ln|\Sigma| - N \ln \gamma = \frac{NT}{2\pi} \int_{-\pi}^{\pi} \ln g_v(\lambda; \Theta) d\lambda - N \ln \gamma$ . If we set the condition of the spectrum according to Beran (1994, (5.38) and (5.55)) and Priestley (1981, page 741), i.e.

$$\frac{1}{T} \ln|\Sigma| = \frac{1}{2\pi} \int_{-\pi}^{\pi} \ln g_v(\lambda; \Theta) d\lambda = 0, \text{ and rule out } \sigma_a^2 \text{ by a first order condition, then the}$$

concentrated log-likelihood function can be achieved:

$l = \text{constant}$

$$-\frac{1}{2} \left\{ \ln|\Gamma_{xx}(\Theta, \gamma)| - N \ln \gamma + (NT - K) \ln \frac{1}{NT - K} \left[ \Gamma_{yy}(\Theta, \gamma) - \Gamma_{yx}(\Theta, \gamma) \Gamma_{xx}^{-1}(\Theta, \gamma) \Gamma_{xy}(\Theta, \gamma) \right] \right\}, \text{ an}$$

$$d \hat{\sigma}_a^2 = \frac{1}{NT - K} \left[ \Gamma_{yy}(\Theta, \gamma) - \Gamma_{yx}(\Theta, \gamma) (\Gamma_{xx}(\Theta, \gamma))^{-1} \Gamma_{xy}(\Theta, \gamma) \right]. \quad (11)$$

We note now that the concentrated log-likelihood function is based on the short memory process assumption. As a short memory process, the spectrum density function of zero frequency is bounded. From (11), we can easily test the individual effects. Furthermore, as the non-zero frequencies part in (9) is orthogonal to the zero frequencies part, the non-zero part can be regarded as the fixed effects, which can be easily extended to the familiar Hausman test. This can test whether the random effects part will cause the estimator to be inconsistent or not under comparison with the fixed effects.

If the process is long memory or non-stationary, then the spectrum of the zero frequency is no longer bounded. Therefore, the estimator in (11) cannot be applied anymore. Aside from that, these individual effects are all involved in the zero frequencies part which can be seen in (9). If we want to establish the estimator for long memory or non-stationary processes, we have to take away the zero frequencies that include the individual effects.

## Extension To The Long Memory And Non-Stationary Disturbance Model

We first assume that the disturbance is a long memory process, i.e.  $v_{kt} \sim I(\delta)$  and  $\delta \in (0, 0.5)$ , whose spectrum is unbounded at frequency zero. Equation (9) is no longer used. As such, the log-likelihood function shall be revised, so as to be suitable for the long memory process.

Assume that the data-generating function of  $v_{kt}$  is:

$$\phi(B)v_{kt} = (1-B)^{-\delta} \theta(B)a_{kt} \text{ for } 0 < \delta < 0.5.$$

Its corresponding spectral density function can then be expressed as:

$$\frac{\sigma_a^2}{2\pi} g_v(\lambda) \text{ for } 0 < \delta < 0.5,$$

$$\text{where } \text{var}(a_{kt}) = \sigma_a^2 \text{ and } g_v(\lambda) = |1 - e^{-i\lambda}|^{-2\delta} \left| \frac{\theta(e^{-i\lambda})}{\phi(e^{-i\lambda})} \right|^2.$$

From equation (8), as the individual effects  $\mu_k$  are time invariant, only the zero frequency part is affected in the estimation. In the time domain, we can use the deviation form to remove the individual effects which will not influence the non-zero frequencies part. The estimation is similar to the fixed effects model that removes the individual effects by a partial regression model, which is still a consistent estimator. If the zero frequency parts are excluded, then the quadratic form relative to (9) can be expressed as:

$$\Gamma_{\hat{u}\hat{u}}(\Theta) = 4\pi \sum_{k=1}^N \left( \sum_{j=1}^M \frac{I_{u_k}(\lambda_j)}{g_v(\lambda_j; \Theta)} \right). \quad (12)$$

Following (10), the REML can thus be represented as:

$l = \text{constant}$

$$-\frac{1}{2} \left\{ \ln |\Gamma_{\hat{x}\hat{x}}(\Theta)| + (2MN - K) \ln \frac{1}{2MN - K} \left[ \Gamma_{\hat{y}\hat{y}}(\Theta) - \Gamma_{\hat{y}\hat{x}}(\Theta) \Gamma_{\hat{x}\hat{x}}^{-1}(\Theta) \Gamma_{\hat{x}\hat{y}}(\Theta) \right] \right\},$$

where  $\Gamma_{\hat{x}\hat{x}}(\Theta)$ ,  $\Gamma_{\hat{y}\hat{y}}(\Theta)$ , and  $\Gamma_{\hat{x}\hat{y}}(\Theta)$  are the corresponding quadratic forms that exclude the

zero frequencies, and  $M = (T-1)/2$  (here it is clearly appropriate to assume that  $T$  is an odd number). The degrees of freedom are  $2MN$  due to a lack of zero frequencies.

In the following context, the model is extended to a non-stationary process, where the domain of the integrated order is  $-0.5 \leq \delta < 1.5$ . From Section 2, we can see that if one wants to obtain a consistent estimator for a non-stationary process, then one has to use the tapered data. In practice, we notice that if the data is tapered by the original form, then these tapered individual effects will no longer be constant terms. This will affect the parts near zero. Therefore, we use a simple method, incorporating the deviation form, to obtain the periodogram. The model can be rewritten as:

$$\dot{y}_{kt} = \dot{x}_{kt} \beta + \dot{v}_{kt},$$

where  $\dot{y}_{kt} = y_{kt} - \bar{y}_k$ ,  $\dot{x}_{kt} = x_{kt} - \bar{x}_k$ ,  $\dot{v}_{kt} = v_{kt} - \bar{v}_k$ , and  $\bar{y}_k = \sum_{t=1}^T y_{kt} / T$ .

If we want to construct an estimator that can be extended to be non-stationary, Section 2 is referenced. Assume that the remainder disturbance  $v_{kt} \sim I(\delta)$  and  $-0.5 \leq \delta < 1.5$ . Equation (12) can then be revised as:

$$\Gamma_{\dot{u}\dot{u}}^{(T)}(\Theta) = 4\pi \sum_{k=1}^N \left( \sum_{\lambda_j \in \Omega_1} \frac{I_{\Delta u_k}(\lambda_j)}{g_v(\lambda_j; \Theta^*)} + \sum_{\lambda_j \in \Omega_2} \frac{I_{\dot{u}_k}^{(T)}(\lambda_j)}{g_v(\lambda_j; \Theta)} \right) \text{ if } 0.5 \leq \delta < 1.5, \text{ and}$$

$$\Gamma_{\dot{u}\dot{u}}^{(T)}(\Theta) = 4\pi \sum_{k=1}^N \sum_{\lambda_j \in \Omega} \frac{I_{\dot{u}_k}^{(T)}(\lambda_j)}{g_v(\lambda_j; \Theta)} \text{ if } -0.5 < \delta < 0.5, \quad (13)$$

where  $\lambda_j = 2\pi j/T$ ,  $\Omega_1 = \{\lambda_j \mid 1 \leq j < T^{0.75}/2\}$ ,  $\Omega_2 = \{\lambda_j \mid T^{0.75}/2 \leq j \leq T/2\}$ ,

$\Omega = \{\lambda_j \mid 1 \leq j \leq T/2\}$ ,  $I_{\dot{u}_k}^{(T)}(\lambda_j)$  is the tapered periodogram computed by the deviation form,

and  $I_{\Delta u_k}(\lambda_j)$  is the periodogram calculated by differencing the data. In addition, as the tapered

periodogram is a consistent estimator for the spectrum density function, we can obtain

$\Gamma_{\hat{u}\hat{u}}^{(T)}/(2MN) \rightarrow \sigma_a^2$  as  $T \rightarrow \infty$ . Applying (13), we obtain a concentrated REML, i.e.:

$l = \text{constant}$

$$-\frac{1}{2} \left\{ \ln |\Gamma_{\hat{x}\hat{x}}^{(T)}(\Theta)| + (2MN - K) \ln \frac{1}{2MN - K} \left[ \Gamma_{\hat{y}\hat{y}}^{(T)}(\Theta) - \Gamma_{\hat{y}\hat{x}}^{(T)}(\Theta) (\Gamma_{\hat{x}\hat{x}}^{(T)}(\Theta))^{-1} \Gamma_{\hat{x}\hat{y}}^{(T)}(\Theta) \right] \right\}, \quad (14)$$

where  $\frac{1}{M} \sum_{j=1}^M \ln g_v(\lambda_j; \Theta) = 0$ . The estimator of the beta coefficients and the variance of the

disturbance are given respectively by

$$\tilde{\beta} = (\Gamma_{\hat{x}\hat{x}}^{(T)}(\Theta))^{-1} \Gamma_{\hat{x}\hat{y}}^{(T)}(\Theta) \text{ and}$$

$$\tilde{\sigma}_\varepsilon^2 = \frac{1}{2NM - K} \left[ \Gamma_{\hat{y}\hat{y}}^{(T)}(\Theta) - \Gamma_{\hat{y}\hat{x}}^{(T)}(\Theta) (\Gamma_{\hat{x}\hat{x}}^{(T)}(\Theta))^{-1} \Gamma_{\hat{x}\hat{y}}^{(T)}(\Theta) \right].$$

When the concentrated log-likelihood function is established, we easily obtain its asymptotic covariance through the information matrix, which can be used for testing. In the following section, we apply the Monte Carlo experiments and power tests to evaluate the consistency of the estimator.

### Monte Carlo Experiments And Power Tests

This section applies the simulations and power tests that are used to evaluate the asymptotic properties for the estimators. Through the Monte Carlo experiments, we examine the properties of the individual number and time length growth, in which a mixed model is applied for evaluation, i.e.  $(1 - \phi B)(1 - B)^\delta v_{kt} = (1 - \theta) \varepsilon_{kt}$  and  $\varepsilon_{kt} \sim \text{NID}(0, I)$ .

In the simulations, four models (including stationary and non-stationary remainder disturbances) are demonstrated. The first one shows a traditional long memory model where

the remainder disturbance is a fractional ARMA process,  $\phi = 0.5$ ,  $\theta = 0.3$ , and  $\delta = 0.2$ . The result can be seen in Table 1.

Table 1. Empirical size and power test based on 1000 replications for the model  $y_{kt} = x_{kt}\beta + \mu_k + v_{kt}$ , where  $(1 - \phi B)v_{kt} = (1 - B)^{-\delta}(1 - \theta B)\varepsilon_{kt}$ ,  $\mu_k \sim NID(0, 1)$ ,  $\varepsilon_{kt} \sim NID(0, 1)$ . The sizes are  $(N, T) = (30, 400)$ ,  $(40, 500)$ , and  $(50, 600)$ , respectively, and the parameters are  $\phi = 0.5$ ,  $\theta = 0.3$ , and  $\delta = 0.2$ , respectively. The power test is based on 1000 replications, the significance level is at 5%, and the two-tailed standard normal distribution test is used.

$H_0: \phi =$	0.30	0.35	0.40	0.45	<u>0.50</u>	0.55	0.60	0.65	0.70	0.75	0.80
(30, 400)	0.791	0.655	0.444	0.205	0.069	0.034	0.121	0.441	0.881	0.998	0.999
(40, 500)	0.931	0.809	0.551	0.270	0.063	0.042	0.287	0.812	0.996	1.000	1.000
(50, 600)	0.976	0.901	0.695	0.306	0.054	0.099	0.543	0.972	1.000	1.000	1.000
$H_0: \theta =$	0.10	0.15	0.20	0.25	<u>0.30</u>	0.35	0.40	0.45	0.50	0.55	1.30
(30, 400)	0.891	0.746	0.525	0.206	0.047	0.128	0.491	0.863	0.973	0.998	0.999
(40, 500)	0.974	0.912	0.667	0.251	0.027	0.195	0.732	0.981	1.000	1.000	1.000
(50, 600)	0.995	0.966	0.813	0.342	0.034	0.293	0.895	0.996	1.000	1.000	1.000
$H_0: \delta =$	0.00	0.05	0.10	0.15	<u>0.20</u>	0.25	0.30	0.35	0.40	0.45	0.50
(30, 400)	0.992	0.910	0.546	0.139	0.048	0.350	0.860	0.997	0.995	0.998	1.000
(40, 500)	1.000	0.987	0.832	0.233	0.059	0.573	0.983	1.000	1.000	1.000	1.000
(50, 600)	1.000	1.000	0.972	0.400	0.042	0.742	1.000	1.000	1.000	1.000	1.000

The means of these estimates of  $\phi$  for different sizes (30,400), (40,500), and (50, 600) are 0.5123, 0.5107, and 0.5078, respectively, and their standard deviations are 0.0766, 0.0530, and 0.0426, respectively. For  $\theta$ , the means are 0.2989, 0.2983, and 0.2989, respectively, and the standard deviations are 0.0717, 0.0436, and 0.0329, respectively. For  $\delta$ , the means are 0.1848, 0.1866, and 0.1904, respectively, and the standard deviations are 0.0403, 0.0295, and 0.0219, respectively.

In contrast, the other models are presented for the non-stationary remainder disturbance.

The second model assumes that the remainder disturbance is a non-stationary process

combined with an AR form, where  $\phi = 0.5$ ,  $\delta = 1.2$ . The result is illustrated in Table 2.

Table 2. Empirical size and power test based on 1000 replications for the model  $y_{kt} = x_{kt}\beta + \mu_k + v_{kt}$ , where  $(1-\phi B)v_{kt} = (1-B)^\delta \varepsilon_{kt}$ ,  $\mu_k \sim NID(0,1)$ ,  $\varepsilon_{kt} \sim NID(0, \sigma_\varepsilon^2)$ . The Fejér window is used. The sizes are  $(N, T) = (30,400)$ ,  $(40,500)$ , and  $(50, 600)$ , respectively, and the parameters are  $\phi = 0.5$ ,  $\delta = 1.2$ , respectively. The power test is based on 1000 replications, the significance level is at 5%, and the two-tailed standard normal distribution test is used.

$H_0: \phi =$	0.30	0.35	0.40	0.45	<u>0.50</u>	0.55	0.60	0.65	0.70	0.75	0.80
(30, 400)	1.000	1.000	0.944	0.400	0.064	0.494	0.937	0.998	1.000	1.000	1.000
(40,500)	1.000	1.000	0.998	0.653	0.059	0.704	0.997	1.000	1.000	1.000	1.000
(50,600)	1.000	1.000	1.000	0.831	0.075	0.843	1.000	1.000	1.000	1.000	1.000
$H_0: \delta =$	1.00	1.05	1.10	1.15	<u>1.20</u>	1.25	1.30	1.35	1.40	1.45	1.50
(30, 400)	1.000	0.998	0.948	0.546	0.068	0.436	0.975	1.000	1.000	1.000	1.000
(40,500)	1.000	1.000	0.997	0.747	0.051	0.711	1.000	1.000	1.000	1.000	1.000
(50,600)	1.000	1.000	1.000	0.893	0.061	0.886	1.000	1.000	1.000	1.000	1.000

The means of these estimates of  $\phi$  for different sizes (30,400), (40,500), and (50, 600) are 0.4973, 0.4982, and 0.4987, respectively, and their standard deviations are 0.0290, 0.0210, and 0.0179, respectively. For  $\delta$ , the means are 1.2025, 1.2015, and 1.2013, respectively, and the standard deviations are 0.0271, 0.0196, and 0.0163, respectively. It is a well known property of consistent estimators that when the sample size increases, the mean will approach its true value, and the standard deviation will decrease. The progression of values indicated above follows directly from this property.

The third model extends the non-stationary process in such a way as to mix with the RMA form, where  $\phi = 0.5$ ,  $\theta = 0.3$ ,  $\delta = 1.2$ , and the result is shown in Table 3.

Table 3. Empirical size and power test based on 1000 replications for the model  $y_{kt} = x_{kt}\beta + \mu_k + v_{kt}$ , where  $(1-\phi B)v_{kt} = (1-B)^\delta(1-\theta B)\varepsilon_{kt}$ ,  $\mu_k \sim NID(0,1)$ ,  $\varepsilon_{kt} \sim NID(0, \sigma_\varepsilon^2)$ . The Fejér window is used. The sizes are  $(N, T) = (30,400)$ ,  $(40,500)$ , and  $(50, 600)$ , respectively, and the parameters are  $\phi = 0.5$ ,  $\theta = 0.3$ ,  $\delta = 1.2$ , respectively. The power test is based on 1000 replications, the significance level is at 5%, and the two-tailed standard normal distribution test is used.

$H_0: \phi =$	0.30	0.35	0.40	0.45	<u>0.50</u>	0.55	0.60	0.65	0.70	0.75	0.80
(30, 400)	0.860	0.720	0.497	0.234	0.097	0.157	0.477	0.895	0.996	1.000	1.000
(40,500)	0.963	0.858	0.627	0.273	0.082	0.261	0.772	0.993	1.000	1.000	1.000
(50,600)	0.993	0.953	0.783	0.386	0.089	0.343	0.900	0.999	1.000	1.000	1.000
$H_0: \theta =$	0.10	0.15	0.20	0.25	<u>0.30</u>	0.35	0.40	0.45	0.50	0.55	0.60
(30, 400)	0.941	0.835	0.609	0.290	0.104	0.297	0.740	0.971	0.998	1.000	1.000
(40,500)	0.987	0.948	0.765	0.363	0.121	0.434	0.900	0.998	1.000	1.000	1.000
(50,600)	0.999	0.989	0.899	0.499	0.123	0.521	0.968	1.000	1.000	1.000	1.000
$H_0: \delta =$	1.00	1.05	1.10	1.15	<u>1.20</u>	1.25	1.30	1.35	1.40	1.45	1.50
(30, 400)	1.000	0.999	0.925	0.453	0.065	0.449	0.963	1.000	1.000	1.000	1.000
(40,500)	1.000	1.000	0.998	0.699	0.064	0.662	1.000	1.000	1.000	1.000	1.000
(50,600)	1.000	1.000	1.000	0.848	0.070	0.823	1.000	1.000	1.000	1.000	1.000

The means of these estimates of  $\phi$  for different sizes (30,400), (40,500), and (50, 600) are 0.4923, 0.4919, and 0.4964, respectively, and their standard deviations are 0.0640, 0.0475, and 0.0386, respectively. For  $\theta$ , the means are 0.2915, 0.2929, and 0.2981, respectively, and the standard deviations are 0.0517, 0.0406, and 0.0323, respectively. For  $\delta$ , the means are 1.1994, 1.2015, and 1.2016, respectively, and the standard deviations are 0.0284, 0.0207, and 0.0180, respectively. This follows from the consistent estimator's property that when the sample size increases, the mean will approach its true value and the standard deviation will decrease.

The last model is applied on a different integrated degree where parameters are set to  $\phi = 0.5$ ,  $\theta = 0.3$ ,  $\delta = 0.7$ . The result can be seen in Table 4.

Table 4. Empirical size and power test based on 1000 replications for the model  $y_{kt} = x_{kt}\beta + \mu_k + v_{kt}$ , where  $(1-\phi B)v_{kt} = (1-B)^\delta(1-\theta B)\varepsilon_{kt}$ ,  $\mu_k \sim NID(0,1)$ ,  $\varepsilon_{kt} \sim NID(0, \sigma_\varepsilon^2)$ . The Fejér window is used. The sizes are  $(N, T) = (30,400)$ ,  $(40,500)$ , and  $(50, 600)$ , respectively, and the parameters are  $\phi = 0.5$ ,  $\theta = 0.3$ ,  $\delta = 0.7$ , respectively. The power test is based on 1000 replications, the significance level is at 5%, and the two-tailed standard normal distribution test is used.

$H_0: \phi =$	0.30	0.35	0.40	0.45	<u>0.50</u>	0.55	0.60	0.65	0.70	0.75	0.80
(30, 400)	0.683	0.451	0.223	0.075	0.022	0.032	0.170	0.601	0.960	1.000	1.000
(40,500)	0.857	0.648	0.343	0.108	0.019	0.081	0.469	0.915	0.999	1.000	1.000
(50,600)	0.949	0.823	0.480	0.137	0.020	0.149	0.722	0.995	1.000	1.000	1.000
$H_0: \theta =$	0.10	0.15	0.20	0.25	<u>0.30</u>	0.35	0.40	0.45	0.50	0.55	0.60
(30, 400)	0.843	0.679	0.382	0.124	0.025	0.086	0.395	0.819	0.980	0.999	1.000
(40,500)	0.954	0.845	0.546	0.196	0.024	0.147	0.644	0.970	0.999	1.000	1.000
(50,600)	0.995	0.942	0.756	0.267	0.033	0.212	0.844	0.999	1.000	1.000	1.000
$H_0: \delta =$	0.50	0.55	0.60	0.65	<u>0.70</u>	0.75	0.80	0.85	0.90	0.95	1.00
(30, 400)	1.000	0.991	0.869	0.326	0.022	0.089	0.727	0.998	1.000	1.000	1.000
(40,500)	1.000	1.000	0.986	0.573	0.029	0.222	0.965	1.000	1.000	1.000	1.000
(50,600)	1.000	1.000	1.000	0.803	0.028	0.376	0.998	1.000	1.000	1.000	1.000

The means of these estimates of  $\phi$  for different sizes (30,400), (40,500), and (50, 600) are 0.4821, 0.4849, and 0.4880, respectively, and their standard deviations are 0.0675, 0.0524, and 0.0406, respectively. For  $\theta$ , the means are 0.2902, 0.2941, and 0.2976, respectively, and the standard deviations are 0.0555, 0.0436, and 0.0337, respectively. For  $\delta$ , the means are 0.7096, 0.7100, and 0.7100, respectively, and the standard deviations are 0.0289, 0.0219, and 0.0171, respectively.

In a conventional approach, the non-stationary remainder disturbance will provoke the spurious regression problem, but our model allows for a consistent estimator to be obtained.

Using the data from the following tables, we evaluate the asymptotic properties of the

estimator when the sample sizes are growing. For instance, Table 1 shows that when the sample size grows from (30, 400) to (40, 500), and then to (50, 600), the rejected probabilities for the null hypothesis ( $\phi = 0.5$ ) go from 0.069 to 0.063, and then to 0.054. This is obviously different from the false null hypothesis ( $\phi = 0.45$ ), where the rejected probability increases from 0.205 to 0.270, and then to 0.306. Overall, we see that the larger the sample size, the more powerful the estimator is. This agrees with our concept - that these estimators are consistent - in which the asymptotic normality property is also employed.

### **CONCLUDING REMARKS**

This paper shows a hybrid Whittle approach by applying Fejér tapering on the REML function where the remainder disturbance could be either a long-memory or non-stationary process. In the Monte Carlo simulations, we see that the hybrid Whittle approach is quite successful and powerful. It incorporates the merits of traditional methods, tapering and differencing, to be treated with an unknown remainder disturbance term. The only limitation is on the domain of the integrated degree of the remainder disturbance, i.e.  $-0.5 \leq \delta < 1.5$ . This is quite useful for empirical studies, especially when trying to ascertain whether the spurious regression problem exists or not.

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## APPENDIX A

Assume  $\{x_t\}$  is a stationary process and  $x_t \sim I(d)$ . From lemma 1, the variance of the sample mean can be obtained:

$$\text{var}(\bar{x}) = \text{var}\left(\frac{1}{T} \sum_{t=1}^T x_t\right) = T^{-2} \sigma^2 \sum_{i,j=1}^T \rho(i, j),$$

where  $\rho(i, j)$  is the correlation between  $x_i$ , and  $x_j$ . If the series is stationary, then  $\rho(i, j)$  depends only on the lag  $|i-j|$ . Assume  $\rho(k) \approx c_\rho k^{2d-1}$ , as  $k \rightarrow \infty$ ,

$$\text{var}(\bar{x}) = \frac{\sigma^2}{T} \left[ 1 + 2 \sum_{k=1}^{T-1} \left(1 - \frac{k}{T}\right) \rho(k) \right] = \frac{\sigma^2}{T} \left( 1 + 2c(\rho) \sum_{k=1}^{T-1} \left(1 - \frac{k}{T}\right) k^{2d-1} \right),$$

where  $c(\rho)$  is a finite positive constant. We then have the following inequalities:

$$\sum_{k=1}^{T-1} \int_k^{k+1} \inf_{x \in (k, k+1)} \left( \left(1 - \frac{x}{T}\right) x^{2d-1} \right) dx \leq \sum_{k=1}^{T-1} \int_k^{k+1} \left(1 - \frac{k}{T}\right) k^{2d-1} dk \leq \sum_{k=1}^{T-1} \int_k^{k+1} \sup_{x \in (k, k+1)} \left( \left(1 - \frac{x}{T}\right) x^{2d-1} \right) dx.$$

Because  $2d-1 < 0$ , we can obtain the following equations:

$$\sum_{k=1}^{T-1} \int_k^{k+1} \inf_{x \in (k, k+1)} \left( \left(1 - \frac{x}{T}\right) x^{2d-1} \right) dx = \sum_{k=1}^{T-1} \left(1 - \frac{k+1}{T}\right) (k+1)^{2d-1} \quad \text{and}$$

$$\sum_{k=1}^{T-1} \int_k^{k+1} \sup_{x \in (k, k+1)} \left( \left(1 - \frac{x}{T}\right) x^{2d-1} \right) dx = \sum_{k=1}^{T-1} \left(1 - \frac{k}{T}\right) k^{2d-1}.$$

Putting these equations into the inequalities, we obtain:

$$\sum_{k=1}^{T-1} \left(1 - \frac{k}{T}\right) k^{2d-1} - \left(1 - \frac{1}{T}\right) \leq \sum_{k=1}^{T-1} \int_k^{k+1} \left(1 - \frac{x}{T}\right) x^{2d-1} dx \leq \sum_{k=1}^{T-1} \left(1 - \frac{k}{T}\right) k^{2d-1},$$

Rearranging the terms, we can achieve:

$$\sum_{k=1}^{T-1} \int_k^{k+1} \left(1 - \frac{x}{T}\right) x^{2d-1} dx \leq \sum_{k=1}^{T-1} \left(1 - \frac{k}{T}\right) k^{2d-1} \leq \sum_{k=1}^{T-1} \int_k^{k+1} \left(1 - \frac{x}{T}\right) x^{2d-1} dx + \left(1 - \frac{1}{T}\right).$$

If  $d \in (0, 0.5)$ , we can obtain

$$\sum_{k=1}^{T-1} \int_k^{k+1} \left(1 - \frac{x}{T}\right) x^{2d-1} dx = \int_1^T \left(1 - \frac{x}{T}\right) x^{2d-1} dx = O_p(T^{2d}).$$

From the pinching theorem, we can obtain:

$$\sum_{k=1}^{T-1} \left(1 - \frac{k}{T}\right) c_\rho k^{2d-1} = O_p(T^{2d}) \quad \text{for } d \in (0, 0.5).$$

Here, we should note even if  $d \in (-0.5, 0)$  we can obtain:

$$\int_1^T \left(1 - \frac{x}{T}\right) x^{2d-1} dx = O_p(1).$$

This indicates:

$$\sum_{k=1}^{T-1} \left(1 - \frac{k}{T}\right) c_p k^{2d-1} = O_p(1) \text{ and } \text{var}(\bar{x}) = O_p(T^{-1}) \text{ for } d \in (-0.5, 0).$$

The result coincides with Beran (1994, eq 1.16). Eventually, we can conclude:

$$\text{var}(\bar{x}) = O_p(T^{2d-1}) \text{ for } d \in (0, 0.5) \text{ and } \text{var}(\bar{x}) = O_p(T^{-1}) \text{ for } d \in (-0.5, 0).$$

## APPENDIX B

The Fourier transform of the tapered  $v_t$  can be expanded as:

$$\begin{aligned} \sqrt{2\pi \sum_{t=1}^T h_t^2} w_v^{(T)}(\lambda) &= \frac{1}{T^*+1} v_1 e^{-i\lambda} + \frac{2}{T^*+1} v_2 e^{-i2\lambda} + \dots + \frac{T^*}{T^*+1} v_{T^*} e^{-iT^*\lambda} + v_{T^*+1} e^{-i(T^*+1)\lambda} \\ &\quad + \frac{T^*}{T^*+1} v_{T^*+2} e^{-i(T^*+2)\lambda} + \dots + \frac{1}{T^*+1} v_T e^{-iT\lambda}, \end{aligned}$$

where  $w_v^{(T)}(\lambda)$  indicates the tapered Fourier transform. This can be also represented by:

$$\begin{aligned} \sqrt{2\pi \sum_{t=1}^T h_t^2} w_v^{(T)}(\lambda) &= \frac{1}{T^*+1} (v_0 + \varepsilon_1) e^{-i\lambda} + \frac{2}{T^*+1} (v_0 + \varepsilon_1 + \varepsilon_2) e^{-i2\lambda} + \dots + \frac{T^*}{T^*+1} (v_0 + \sum_{t=1}^{T^*} \varepsilon_t) e^{-iT^*\lambda} \\ &\quad + \left( v_0 + \sum_{t=1}^{T^*+1} \varepsilon_t \right) e^{-i(T^*+1)\lambda} + \frac{T^*}{T^*+1} (v_0 + \sum_{t=1}^{T^*+2} \varepsilon_t) e^{-i(T^*+2)\lambda} + \dots + \frac{1}{T^*+1} (v_0 + \sum_{t=1}^T \varepsilon_t) e^{-iT\lambda}, \end{aligned}$$

which can be represented by an alternative form, derived by multiplying by  $1 - e^{-i\lambda}$ :

$$\sqrt{2\pi \sum_{t=1}^T h_t^2} w_v^{(T)}(\lambda) = \frac{1}{(1 - e^{-i\lambda})} \left( \frac{1}{T^*+1} \sum_{t=1}^{T^*+1} v_t e^{-i\lambda t} - \frac{1}{T^*+1} \sum_{t=T^*+2}^{T+1} v_t e^{-i\lambda t} + \frac{1}{T^*+1} \sum_{t=1}^{T^*+1} (t-1) \varepsilon_t e^{-i\lambda t} \right) + \frac{1}{T^*+1} \sum_{t=T^*+2}^T (T-t+2) \varepsilon_t e^{-i\lambda t} \Bigg), \text{ for}$$

$\lambda \in (-\pi, \pi) - \{0\}$ . Let  $h_t^* = 1 - \left| 1 - (t-1)/(T^*+1) \right|$  be the Fejér kernel for  $1 \leq t \leq T$ . The above

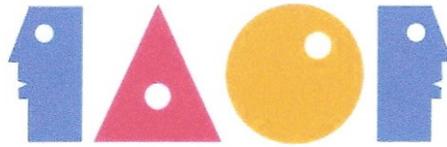
equation can be represented as:

$$w_v^{(T)}(\lambda) = \frac{1}{(1 - e^{-i\lambda})} \left( \frac{1}{\sqrt{2\pi \sum_{t=1}^T h_t^2}} \sum_{t=1}^T h_t^* \varepsilon_t e^{-i\lambda t} + \sqrt{\frac{T}{\sum_{t=1}^T h_t^2}} \left( \frac{1}{T^*+1} \left( 2 \sum_{t=1}^{T^*+1} \frac{v_t}{\sqrt{2\pi T}} e^{-i\lambda t} - \sum_{t=1}^{T+1} \frac{v_t}{\sqrt{2\pi T}} e^{-i\lambda t} \right) \right) \right).$$

Here, we note that  $h_t^*$  is the same as  $h_t$ , being a Fejér kernel. The only difference is the place of the window's location. In addition, as  $\sum_{t=1}^T h_t^2 \approx \sum_{t=1}^T h_t^{*2}$  when  $T \rightarrow \infty$ , or  $\sum_{t=1}^T h_t^2 = \sum_{t=1}^T h_t^{*2} + (T^* + 1)^{-2}$ , we can represent the above equation as:

$$w_v^{(T)}(\lambda) = \frac{1}{(1 - e^{-i\lambda})} \left( w_\varepsilon^{(T)}(\lambda) + \frac{1}{\alpha(T^* + 1)} \left( 2 \sum_{t=1}^{T^*+1} \frac{v_t}{\sqrt{2\pi T}} e^{-i\lambda t} - \sum_{t=1}^{T+1} \frac{v_t}{\sqrt{2\pi T}} e^{-i\lambda t} \right) \right),$$

where  $\alpha = \sqrt{\sum_{t=1}^T h_t^2 / T}$ .



**THE EFFECTS OF ALIGNMENT COMPETITIVE STRATEGY, CULTURE, AND  
ROLE BEHAVIOR ON ORGANIZATIONAL PERFORMANCE IN SERVICE FIRMS**

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**ABSTRACT**

In this study, we empirically examined the alignment level of service firm's competitive strategy and its context. This research uses a configuration and contingency approach to establish if there is a relationship with organizational performance. The sample used in this research was taken from service firms in Yogyakarta and Central Java. The technique of sampling was non probability sampling. The examining of the configuration and contingency approach included regression euclidence distance. The result of the configuration and contingency approach explained that there is alignment between competitive strategic and elements of contingency such as organizational culture and role behavior. Upon further analysis, it was determined that there is no alignment between the competitive strategic of defender strategy and contingency variable such as role behavior.

**Key words:** alignment, competitive strategic, culture, role behavior and organizational performance.

## INTRODUCTION

Historically, one of the biggest challenges facing the service firms is human resources management and its context. The strike alteration in human resources role is the more important of human resources in developing and implementing the strategy (Dessler, 1997). Since a competition is a game, particularly the service firms in hostile environment that the competed firms look for way to defend their success for a long time and not be imitated their competitor easily. It means that the service firms want to attain competitive superiority. Increasingly, the strategy depends on empowering organizational response and organizing a loyal team work, and it is placed human resources become the central role. In contrast to manufacturing related activities, service work involves primarily symbolic interactions-interchanges with other people of tangible product as well as intangible service (Fenkel, 2000; Singh, Hu, & Roehl, 2007). Singh, et al. (2007) suggests that human resources management will continue to be one of the challenges faced by managers throughout the foreseeable future. Some scholars suggest that these organizations are unique (i.e., different than manufactures), and, as such require the development of new models in order to further our understanding of them (Mills, Hall, Leidecker, & Margulies, 1983; Skaggs & Youndt, 2004). In Indonesia, growing of service industry is very significant for service firms, government and society in order to assist in achieving pro-growth, pro-job and pro-poor. Therefore, research concerning in improving of performance especially organizational performance in service industry is most actualized.

This research concerns in significance of “*alignment/fit*” competitive strategy. It is followed by contingency variable that has effect on organizational performance of service firms either configuration or contingency, such as culture and role behavior. Some experts like Kotter

& Heskett (1992); Gordon & Tomasso (1992); Tidball (1988), Cremer (1993), Besanko, Dranove & Shanley (2000); Hickman & Silva (1984); Schuler & Jackson (1995); and Muafi (2008a, 2008e, 2007) have taken researches that linked between competitive strategy and contingency variables, such as culture and role behavior. Generally, the result conclude that “*alignment*” of contingency between competitive strategy as the main variable and contingency variable have effect on performance, however, not at all have “*alignment*” of strategy. More increasing of alignment relation between competitive strategy and contingency variables is more increasing the organizational performance, vice versa. This research will examine the effect of “*alignment*” among competitive strategy, culture and role behavior to organizational performance, since these three variables have typology in the level of organizational analysis, so there is possible examined by configuration and contingency approaches.

Moreover, the configuration approach takes a holistic approach by looking at the ideal type and explicitly adopts a system assumption of equifinality (Doty, Glick, & Huber, 1993). They examine how a pattern of several independent variables relates to a dependent variable. Wright & McMahan (1992) argued that to be effective, a firm’s HRM system must be aligned with the firm’s strategy and with each other. The contingency approach links choice of practices within HRM system to firm level position (Schuler & Jackson, 1987). Both the contingency and configurational approach holds the idea that given a competitive strategy, certain will support that strategy through shaping behaviors and outcomes (Twomey & Drew, 2000). Muafi (2008a, 2008c) explains that the configuration perspective means examining two sides of alignment concept; they are horizontal fit and vertical fit. The horizontal fit shows consistency of human resources practices or internal employment system, whereas the vertical

fit shows appropriation of relation among strategy, culture and role behavior that will influence the performance finally. The concept of horizontal fit in configuration perspective is principally similar with the concept of Human Resources Bundles (Macduffie, 1995), it is said that the concept of Human Resources Bundles is more appropriate to analyze the relation to organizational performance, than analyze it individually. Similar with Dyer & Reeves (1995) argue that (1) bundles or configuration from human resources activity is more important in increasing labor productivity than single productivity, and (2) can control the employee shifting and enhance product quality. So HRM Bundles must be integrated into the practice of other business function or complementary bundles in order the organization more effective. This argument is held up by Delaney and Husehild (1996); Bjorkman & Xiucheng (2002); Luo (1999); Guest (1997).

## **LITERATURE REVIEW**

### *Culture and Competitive Strategy*

The organization values are the basic of the organizational culture from the interaction strategy, structure, system, style, staff and skill (Muafi, 2008b). Many researchers defines the organizational culture is the values, ideology, philosophy, trust, ritual, symbol and norm that influence organizational performance (Bourantas, Anagnostelis, & Mantes, 1990; Bourantas & Papakadis, 1996; Hatch, 1993; Muafi, 2008b; Kreitner & Kinicki, 2007; Helriegel & Slocum, 2004). Some expert like Kotter & Heskett (1992), Tidball (1988), Cremer (1993), Besanko, Dranove, & Shanley (2000), have established that corporate culture has a significant effect on an organization's long-term sustainability, economic performance and outcomes such as profitability, turnover and commitment. They indicate that congruence of beliefs seems to create a unifying force that boosts organizational performance. Vestal, Fralix, & Spreier

(1997) explain that there is relationship between organizational culture and strategy. This result is also supported by Semler (1997); Tushman & O' Reilly (1996). Bates (1992) provided empirical support for a theoretical model that links manufacturing strategy to organizational culture. Related empirical support, in the case of public sector organizations, is provided by Weber & Pliskin (1996) who explain culture as a determinant of quality strategy in public sector organizations.

Previous research concerning the management of Greek organizations suggests that management as an art and science is underdeveloped relative to other national European Union (EU) partners (Bourantas & Papakadis, 1996). From the few empirical studies referring to the Greek culture of management, is not easy to classify Greece as belonging to any one of the clusters of countries suggested (Bourantas & Papakadis, 1996). The management culture in Greek organizations has been researched by the first author and his colleagues (Bourantas & Mantes, 1988; Bourantas, et. al., 1990; Bourantas & Papakadis, 1996). The conceptual framework for this research was provided by Harrison (1972); Handy (1978, 1980).

According to Bourantas & Papakadis (1996), this framework conceives of a manager as possessing some characteristics of one of four gods of Greek mythology. These gods are chosen as representing the four main pillars of wisdom. The name of each of the four gods is used to describe the cult or philosophy of management and an organizational culture. The following four types of organizational culture were measured:

*The Club Culture (Zeus):*

Zeus culture, which is similar to Handy's power culture, is seen as a spider in the centre of a web with informal colleagues sharing the same thinking as their leader. Zeus culture, like power culture, is verbal and intuitive (Zwaan, 2006). Zeus the king of gods who is feared and

respected by all other gods is the patron gods of the club culture. He represents the power-centered patriarchal tradition with irrational but often benevolent power, impulsiveness and charisma. Historically, the Club Culture is found in smaller entrepreneurial organization. Organizations which use this culture are most likely to be divided either along functional or product lines, and experience a centralized management style.

*The Role Culture (Apollo):*

Apollo culture, which is similar to that of Handy's role culture, is highly formalized, centrally directed and are bureaucratic (Zwaan, 2006). The role culture places at the center of its conceptual framework are the role rather than personalities. Apollo, the god of order and rules, is the patron of god. The culture assumes that humans are rational and that everything can be and should be analyzed in a logical fashion. The culture's symbol is the Greek temple which draws its strength and its beauty from its pillars. The pillar represents function and divisions in a role organization. The role, or the set of duties, is fixed. Individual of the role culture are parts of the machines, doing their job, more or less in a freely interchangeable fashion.

*The Task Culture (Athena-the gods of wisdom):*

Athena culture, like Handy's task culture, consists of inter-disciplinary project groups organized around a task. Work is decentralized but still formalized by the disciplines that should be joined (Zwaan, 2006). The task culture recognizes only expertise as the basis of power and influence. Management is concerned with the successful solution of problems. To achieve this it draws resources from various parts of the organization in order to focus them on a particular knot or problem. The youth, energy and creativity associated with Athena fit the task culture very well.

*The Existential Culture (Dionysus):*

Dionysus culture, like Handy's atomistic culture, is a decentralized, informal culture. Bonds of respect and affection often characterize this relationship of free spirits united by common interests. This culture would be typical of independent experts joined together for mutual convenience (Zwaan, 2006). It assumes that the world is not part of some higher purpose and that everybody is in charge of her or his own destiny. This philosophy has tremendous implications for management. In all other cultures, the individual is subordinated to the organization, but in a Dionysus culture, the individual is there to help the organization to reach its goals and the organization is there to help the individual achieve his or her purposes. This is the culture preferred by professionals. They can preserve their own identity and freedom, feeling owned by no one, but nevertheless they can be part of the organization.

According to Bourantas et. al. (1990), typology of organizational culture can be classified into two cultures: *Apollo* and *Athena*. These typologies have two contradictory continuums. Priyono (2004; Muafi, 2008b) underline that culture and competitive strategy will have an effect on organizational performance. The interaction between prospector competitive strategy and Athena culture will result higher performance than if the firm implementation prospector competitive strategy and Apollo. This result is also supported by Peters & Waterman (1996); Hickman & Silva (1984). Gomez (2004) state that strategies have the ability to effect employee behavior and instill certain values that build an internal culture and can therefore be used as a control mechanism in the firm.

#### *Role Behavior and Competitive Strategy*

Noe, Hollenbeck, Gerhart, & Wright (2006) states that while all of the strategic types require competent people in a generic sense. Each of the strategies also requires different types

of employees with different types of behaviors and attitudes. Role behavior is the behaviors required of an individual in his or her role as a job holder in a social work environment.

Whereas linked to the role behavior aspect, the different strategy and organizational condition need different role behavior from manager or employee. The profiles of employee's role behavior who choose innovative strategy are: long term focus; cooperative; free behavior; moderate in quality; moderate in quantity; balance in process and result; like take the risks; and tolerant with ambiguity and uncertainty. The profiles of employee's role behavior who choose the cost leadership strategy vice versa are: relatively repetitive; predicted behavior; short term focus; pressure in authority or individual activity; moderate in quality; high pressure in quantity from output; main concern in result; taken low risks and relatively agree or comfort with stability (Schuler & Jackson, 1987). According researcher, this role behavior is identical with strategic posture which study about the tendency of employee's behavior that has competitive orientation (Muafi, 2008a, 2008c, 2008e). This strategic posture is divided into two: entrepreneur and conservative. Entrepreneur has characteristics like: product innovation and intensive technology, aggressive competitive orientation, brave to take the risks, and proactive (Covin & Slevin, 1989). While vice versa, conservative has characteristics like: minimal product and technology innovation, careful competitive orientation and less brave to take the risks, reactive and passive. Hunger & Wheelen (1996) argue that experience, skill and personal factors of CEO tend to have relation to one type of strategy or combination of some strategies. Covin & Slevin (1989) find a result that the interaction between posture strategy entrepreneur and hostile environment will have influence towards the export performance. Whereas fit orientation strategy conservative and benign environment also will have influence towards the export performance. Therefore, the entrepreneur strategic posture will alignment with

innovative strategy and conservative strategic posture will alignment with cost leadership strategy.

Schuler & Jackson (1987); Baker & Feldman (1991) stated that several role behaviors are assumed to be instrumental in the implementation of the competitive strategies. The dimensions shown are the ones which there are likely to be major differences across competitive strategies. Overall, then, for firms pursuing a competitive strategy of innovation, the profile of employee behaviors includes; a high degree of creative behavior; a long term focus; a relatively high level of cooperative, interdependent behavior; a moderate degree of concern for quantity; an equal degree of concern for process and result; a greater degree of risk taking; a high tolerance of ambiguity and unpredictability. The implications of pursuing a competitive strategy of innovation for managing people may include selecting highly skilled individuals, giving employees more discretion, using minimal controls, making a greater investment in human resources, providing more resources for experimentation, allowing and even rewarding occasional failure, and appraising performance for its long run implications. As a consequence of these conditions, pursuing as innovation strategy may result in feelings of enhanced personal control and morale, and thus a greater commitment to self and profession rather than to the employing organization. The profile of employee behaviors necessary for firms pursuing a strategy of quality enhancement is; relatively repetitive and predictable behaviors; a more long term or intermediate focus; a modest amount of cooperative, interdependent behavior; a high concern for quality; a modest concern for quantity of output; high concern for process; low risk taking activity; and commitment to the goals of the organization. In summary, the profile of employee role behaviors necessary for firm seeking to gain competitive advantage by pursuing the competitive strategy of cost reduction is as follows;

relatively repetitive and predictable behaviors; a rather short term focus; primarily autonomous or individual activity; modest concern for quality; high concern for quantity of output (goods or services); primary concern for result; low risk taking activity; and a relatively high degree of comfort with stability.

In this research, the role behavior has point at typology conservative (cost reduction) role behavior and entrepreneur (innovation) role behavior because these typologies have two contradictory continuum. This explains is also supported by Muafi (2008e) claims that innovation role behavior, hostile environment, and organic structure have positive relationship with entrepreneur strategic IT management. More increasing of alignment relation level between competitive strategy and role behavior, environment, and structure is more increasing the organizational performance, by configuration, vice versa. Alignment prospector strategy-innovative role behavior will influence the performance. Research explains that there is significant effect of role behavior and strategy to organizational performance (Offstein, Gnyawali, & Cobb, 2005; Edelman, Brush, & Manolova, 2005; Alleyne, Doherty, & Greenidge, 2005; Carmeli, 2004; Hoogervorst, Koopman, & Flier, 2002; Wielemaker & Flint, 2005; Baker & Feldman, 1991).

### *Competitive Strategy*

According to Miles & Snow (1984) classify strategy into three types: defender, prospector and analyzer. In the same typology, Porter (1980, 1985), typology of strategy can be classified into three generic strategies: cost leadership, differentiation and focus. Refer to strategy classification from Porter and Miles Snow. Schuler & Jackson (1987) clearly differentiate the classification of competitive strategy in Human Resource Management strategy into three: cost reduction, innovation and quality enhancement. In the competitive

strategy of cost reduction, the firm typically achieves competitive superiority through low cost production. Innovative competitive strategy is applied to develop a different product or service from the competitors; the main focus is offering a new or a unique thing. Meanwhile, strategy of product or service quality enhancement is the major focus in the strategy of quality enhancement. This strategy is pure for single unit or in functional area, but it also overlaps where in a business unit or functional area has two or more competitive strategies simultaneously all at once (Schuler & Jackson, 1987). It is said that this strategy must not be separated apart since an organization is possible concerning about one strategy for one product or service and different strategy for another product or service (Mathis & Jackson, 2000).

Based on Muafi (2008a, 2008c, 2008d); Kumar, Subramanian, & Yauger (1997), actually generic strategy of Miles and Snow is similar with Porter. *Defender* (Miles & Snow) is similar with *Low cost* (Porter) and *Efficiency*. *Prospector* (Miles and Snow) is similar with *Differentiation/Innovation* (Porter/Miller and Friesen's). Porter explains that Cost Leadership and Differentiation is mutually exclusive. It is also said that if both of them are combined it will be stuck in the middle, since they are completely contradictory. However, if each strategy Cost Leadership or Differentiation is combined with focus strategy, it will be Hybrid. It does not mean that stuck in the middle condition can not happen. Refer to one of researches by Kumar, et al. (1997) and Hlavacka, Bacharova, Rusnakova, & Wagner (2001) this condition precisely said that the generic strategy by Porter is not mutually exclusive and each strategy can be related to other variation strategy. These variation strategies are able to create competitive superiority. Remember that condition of stuck in the middle can not be predicted previously. Like reactor strategy explained by Miles & Snow, this stuck in the middle never recommended as a way to success (Robbins, 1990).

In this research, not all of the Miles and Snow's typology is applied but there are two typologies of strategy mainly applied in the research, prospector and defender. Miles and Snow argue that the strategy of prospector and defender is two types of strategy on two extreme points. Prospector emphasizes innovation in the process of organizational adaptation in its environment, and defender emphasizes the efficiency. Nevertheless, the strategy of analyzer and reactor do not have distinct characteristics. According to Delery & Doty (1996), the Miles and Snow's typology of strategy has some considered superiorities; (1) it relatively has ability as predictor of organizational performance, (2) it has implication on policy of human resources, (3) it is applicable and implemented in many literatures of human resources management strategy, (4) it is more available in contingency and configuration approaches. Therefore, Simon (1987) asserts that; (1) the strategy of prospector and defender has significant relation to the performance improvement and cost minimization or as the pioneer in creating product or service, (2) the Miles and Snow's typology of strategy affirm that the system of company control should have the appropriateness with the strategy, (3) the Miles and Snow's typology of strategy is successfully examined in many researches and applicable as generic strategy in some kinds of industries either service or manufacture.

### *Organizational Performance*

Most studies on organizational performance use a variety of success measures both financial and non financial. Some experts have examined the organizational performance theoretically and empirically and the results show different measurement (Muafi, 2008a; 2008c). The result is shown in Table 1.

Beal (2000) clarifies that performance plays the key role in research strategy. Nevertheless, there is considerable controversy in the conceptualization and measurement of performance.

Performance complexity is the main contribution in debate. Moreover, agreement among theoreticians who measuring the performance are better based on the manager's

**Table 1: The Result of Hypotheses Testing Regression  
The Prospector and Defender Strategies**

Regression equation model	R <sup>2</sup>	Constanta	Coeffisient (beta)	t	sign
H1. Y = a + b1 dist (OC.RB.S)+e	0.346	6.085	-0.588	-10.128	0.000*
H2. Y = a + b1 dist (OC.S)+e	0.063	4.482	-0.251	-3.624	0.000*
H3. Y = a + b1 dist (RB.S)+e	0.262	5.008	-0.512	-8.325	0.000*

\* Significance at the 5% level

perception. As the reason there is no available objective field collecting data, even less a small firm which never publishing it (Muafi, 2008a, 2008c, 2008d). Furthermore, when there is an available financial report, it is not accurate because not audited. So the owner of the firm or CEO can prepare subjective evaluation for the firm performance. Some experts convinced that a good performance organization will have a few un-alignments; on the contrary a bad organizational performance will have a lot of un-alignment. If it has alignment, so the organization will be designed and positioned well, effective and efficient in each activity.

## METHODOLOGY AND RESEARCH DESIGN

### *Research Model and Hypotheses*

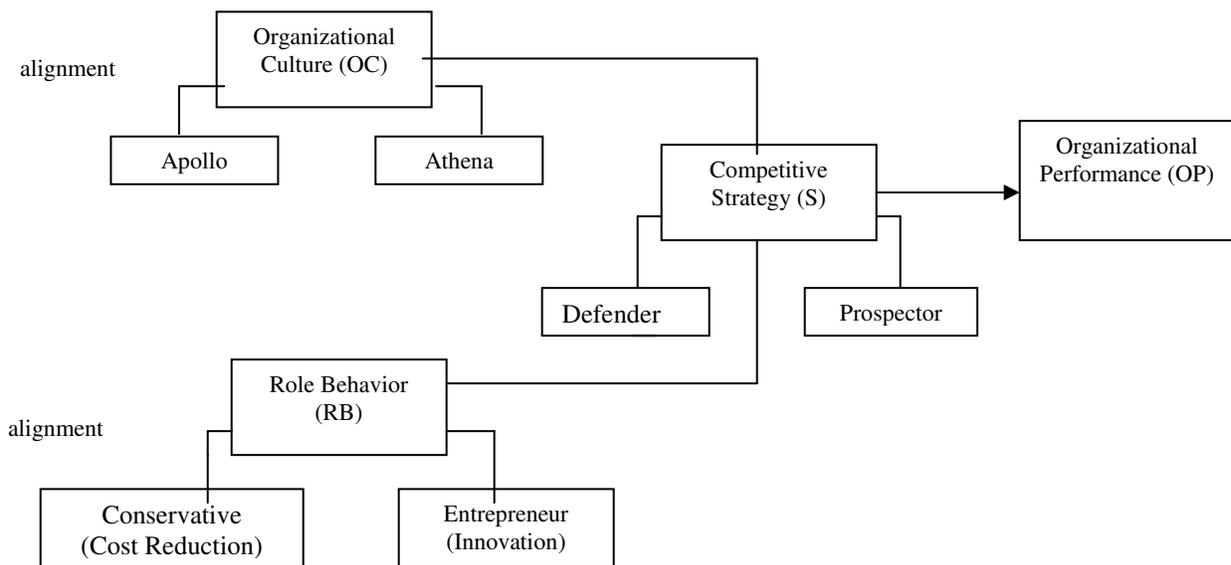
The research model proposed here is described in figure 1. The research hypotheses are as follows;

H1. In configuration approach, there is more alignment between competitive strategy and each variable of organizational culture and role behavior; it will be able increase the organizational performance.

H2. In contingency approach, there is more alignment between competitive strategy and variable of organizational culture; it will be able increase the organizational performance.

H3. In contingency approach, there is more alignment between competitive strategy and variable role behavior; it will be able increase the organizational performance.

**Figure 1: The Effect of Alignment Competitive Strategy, Culture, Role Behavior to Organizational Performance**



*Sampling and Data Collection*

The sample targets in this research are 200 service firms in Yogyakarta and Central Java. The result of questionnaire spreading is respondents who answer the questions completely are 196 respondents. The subsection mean of employee is 50. Service firms with less than 50 employees were not included in the sample because they usually do not have a formal organizational unit dealing with human resources (Minner & Minner, 1995). We then used criterion of greater than 100 million rupiah in sales and larger than employees in order to

increase the likelihood the organizations possessed somewhat formalized strategic and HR activities (Skaggs & Youndt, 2004). The investigated services firms are industries of banking, hospital, courier service, and entertainment. The technique sampling applies non probability sampling by giving questionnaires to be filled in mail. The managers in those firms are determined as the key information in this survey. The questionnaires were sent to managers for two main reasons. First and foremost, they have the greatest access to the data related to organizational activities. Second, they have the firms of knowledge about the overall activities of the organization at the macro level. They attempt to minimize the respondents' subjectivity as much as possible (Becker & Gerhart, 1996).

#### *Research Instrument*

Technique of scale arrangement applied in this research in asserting the organizational culture, competitive strategy, role behavior utilizes semantic differentials scale, whereas for variable of organizational performance uses Likert scale. This semantic differentials scale is utilized to measure an object or a concept for a respondent and it contains two contrary adjectives (Muafi, 2008a, 2008c, 2008d, and 2008e). The result of validity and reliability examining conclude that for each indicator in examined variable points out significant or loading factor  $>0.5$  (valid) (Appendix A). However, in reliability examining points out Cronbach's alpha  $>0.6$  (reliable) (Appendix B).

Technique of statistics carried out in this research is Regression Euclidience Distance, and also Anova (analysis compare means one way Anova). Van de Vend & Drazin (1985); Selto & Renner (1995); Muafi (2008a, 2008c, 2008d, 2008e) suggest that the most appropriate in operationalization of configuration and contingency approaches is alignment system approach by looking for Euclidience Distance (ED). The excess of this method is the

coefficient of regression negative and significant. The bigger of euclidience distance score the smaller of alignment among variable, it means give effect on organizational performance.

## **RESULTS AND DISCUSSION**

### *Result of the Research*

A simple regression analysis is utilized to examine the hypotheses like stated in H1, H2, and H3 for group of firms applying prospector and defender strategies. In the simple linier regression equation, each independent variable of euclidience distance is examined its effect on organizational performance. The result is shown in Table 1.

Regression equation is carried out in examining H1, H2, and H3. Actually, all of group points out negative and significant coefficient regression in all model of equation. Seen from t-test result on table 1, significance of each hypothesis is less than 0.05 it means that the first until the third hypotheses are accepted. (H1, H2, and H3 accepted).

Research continued by proving whether hypothesis 1 until hypothesis 3 is still consistent to be implemented in groups of prospector and defender. In the regression analysis, data is classified into two groups; (1) firm group with prospector strategy (n=108) and (2) defender strategy group (n=88). By applying Anova the result shows that F value is significant (F value = 18, 4 with sign. 0.000), it means clearly there is different strategy between prospector and defender groups.

### *Regression Analysis of Prospector and Defender Strategy Groups*

The final result of examining prospector strategy group concludes that by configuration and contingency there is obviously alignment between prospector strategy and organizational culture, role behavior towards the organizational performance by significant level 0.000 (Table 2). Nevertheless, in the defender strategy groups conclude that there is no alignment relation

between strategy of defender and role behavior towards organizational performance by significant level 0.741 (Table 3).

**Table 1: Organizational Performance Measure**

Measure	Indicator	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Non Financial measure	Effectivity	*	*													
	Efficiency	*														
	Organisastion adaptation	*														
	Service		*	*					*	*						
	Productivity			*					*				*			*
	Employee Stability											*				
	Innovation															
	Morale of employee											*				
	Customer relationship							*			*					
	Supplier relationship							*								
	R&D Outlay							*								
	Commitment & loyalty									*						*
	Corporate image									*						*
	Corporate Ability									*						*
	Financial measure	Work Satisfaction								*	*					
Financial performance				*		*			*				*			
Market share				*	*						*					*
Sales growth				*					*		*					*
Total revenue					*											
Total Asset					*											
Net Income					*											
Overall					*		*									
Export Performance						*		*								
ROA							*							*		
ROS							*	*			*			*		
ROI								*								
Profit Margin											*	*				*
Domestic Sales Volume									*		*					

**Source;**

(1) Homburg, et al. (1999); (2) Mathis and Jackson (2001); (3) Alleyne, et al. (2005); (4) Allen and Helms (2002); Bou and Beltran (2005); (5) Lefebvre, et al. (1997); (6) Gilley, et al. (2004); (7) Hidayat (2004); Edelman, et al. (2005); Coltman, et al. (2003); Heijltjes and Witteloostuijn (2003) (8) Priyono (2004); (9) Harel and Tzafirir (1999); (10) Huang (1999); (11) Cunha and Cunha., (2004); (12) Dolan, et.al. (2003); (13) Choe (2002); (14) McCarthy and Keefe (2000) and (15) Adu (1999).

**Table 2: Regression Result of Hypotheses Testing  
Innovation Strategy**

Regression equation model	R <sup>2</sup>	Constanta	Coeffisient (beta)	t	sign
H1. Y = a + b1 dist (OC.RB.S)+e	0.359	5.658	-0.600	-7.748	0.000*
H2. Y = a + b1 dist (OC.S)+e	0.089	4.034	-0.299	-3.239	0.002*
H3. Y = a + b1 dist (RB.S)+e	0.278	4.578	-0.527	-6.419	0.000*

\* Significance at the 5% level

**Table 3: Regression Result of Hypotheses Testing  
Cost Leadership Strategy**

Regression equation model	R <sup>2</sup>	Constanta	Coeffisient (beta)	t	sign
H1. Y = a + b1 dist (OC.RB.S)+e	0.179	5.619	-0.423	-4.422	0.000*
H2. Y = a + b1 dist (OC.S)+e	0.234	5.211	-0.484	-5.245	0.000*
H3. Y = a + b1 dist (RB.S)+e	0.001	4.751	0.035	0.332	0.741

\* significance at the 5% level

## DISCUSSION

Generally, these research findings are prospector and defender strategies applied in service firms in Yogyakarta and Central Java have had alignment strategy with contingency variable such as organizational culture and role behavior from the point of view either configuration or contingency. It means supporting research findings carried out by Kotter & Heskett (1992); Gordon & Tomasso (1992); Tidball (1988), Cremer (1993), Besanko, et al. (2000); Hickman & Silva (1984); Schuler & Jackson (1995); Muafi (2008a, 2007). Therefore,

in service firm utilized prospector strategy, based on configuration or contingency it has alignment in variable of organizational culture and role behavior. However, in service firms utilized strategy of defender does not have alignment in its role behavior yet.

Based on the study findings, it is necessary giving understanding for the service firms especially which concern in service business orientation in Yogyakarta and Central of Java that the chosen and implemented strategy should be consistent and appropriate with deal variable of contingency. Based on configuration and contingency, service firms which applying prospector strategy operating in Athena culture and innovative role behavior are expected having more enhancing of organizational performance than the firm which utilized prospector strategy operating in Apollo culture and conservative role behavior.

In this case, the no alignment on defender strategy is caused by demand for the service firms' managers to be able to produce high quality and innovative service/product, so it is more proactive and innovative behavior, but in other side it is faced on troubled industry setting, tight competitive intensity, hard and tight business climate, less opportunity be exploited, full of risks, pressure and domination from competitors. Moreover, the condition of role behavior is still limited in predictable behavior, very short term focus, highly cooperative, very low risk taking, and very inflexible to change. If this condition is neglected, so it will be decreasing organizational performance at service firms in Yogyakarta and Central Java.

According to Noe et. al. (2006; Arthur, 1992), recent study of HRM among steel mini-mills in the United States found that mills pursuing different strategies used different system of HRM. Mills seeking cost leadership tended to use control oriented HRM systems that were characterized by high centralization, low participation, low training, low wages, low benefit, and highly contingent pay, whereas differentiator mills used 'commitment' HRM systems,

characterized as the opposite on each of those dimension. A later study from the same sample revealed that the mills with the commitment systems had higher productivity, lower scrap rates, and lower employee turnover than those with the control system. Therefore Porter (1985, 1980) stated that competitive advantage stems from a company's being able to create value in its production process. Value can be created in one of two ways. First, value can be created by reducing costs. Second, value can be created by differentiating a service or product in such a way that it allows the firm a charge a premium price relative to its competitor. In conclusion, the differentiation value attempts to create the impression that the firm's service is different from that of others in the same industry. The perceived differentiation can come from unique customer service, from creating a brand image, from technology, or from offering unique feature. If a firm succeeds in differentiating its service, it will achieve above average returns, and the differentiation may protect it from price sensitivity. For example, IBM has consistently emphasized its brand image and its reputation for superior service while charging a higher price for its computer.

Accordingly, HR policies must be consistent with other organizational aspects in order to be effective and that is important that there be appropriate alignment between HR strategy and culture or role behavior in which the organization operate. Furthermore, the configuration among competitive strategy-organizational culture and competitive strategy-role behavior will influence organizational performance. The more implementation of competitive strategy the more it will influence culture, role behavior and organizational performance. The Prospector strategy will align with Athena culture. Defender strategy will alignment with Apollo culture. Prospector strategy will alignment with entrepreneur role behavior. Defender strategy will

alignment with conservative role behavior. Differentiation of choosing the strategy will influence the differentiation of managers' perception towards culture and role behavior.

## **CONCLUSIONS, IMPLICATIONS AND LIMITATIONS OF THIS STUDY**

In this case, the service firms entirely in Yogyakarta and Central Java have alignment of strategy with organizational culture and role behavior in enhancing organizational performance either configuration or contingency. Therefore, it goes on service firms which chose and implemented prospector strategy. However, in service firms which chose and implemented defender strategy do not have alignment with role behavior. Accordingly, the service firms in Yogyakarta and Central Java: (1) necessity to analyze and diagnose the environment aspects which have influence to competitive strategy, culture and role behavior and finally it influence organizational performance; (2) take care in classifying the aspects Athena and Apollo culture, and entrepreneur and conservative role behavior; (3) alignment configuration and contingency between competitive strategy-culture and competitive strategy-role behavior are required in order to enhance the organizational performance; (4) necessity to consider the flexibility concept in configuration and contingency between competitive strategy-culture and competitive strategy-role behavior are required in order to enhance the organizational performance, and (5) necessity to care the implementation of the competitive strategy to influence the organizational performance.

A further implication of this study is that prospector firms achieve better organizational performance than defender ones, while firms that adopt no explicit business strategy may have trouble retaining entrepreneur (innovation) role behavior and maintaining Athena culture. By implementing this alignment competitive strategy, culture and role behavior can significantly improve organizational performance.

It should be emphasized that this study suffer form certain limitation. *First*, one of its limitations is its single industry focus. Undoubtedly, each industry is subject to varying issues arising from competition, service form, government regulation and level of technological advancement. *Second*, a reliance on subjective measures, due to an inability to source objective data. *Third*, no efforts were made to investigate and interview the nature of causality therefore the inclusion of this issue in the future research will be particularly useful. *Fourth*, the performance indicators used in the present study are based on subjective response to question comparing the performance respondent service firms with that of competitors. A few scholars believe that such subjective measures may be as reliable as more objective indicators (Dess & Robinson, 1984).

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## APPENDIX A.

### *Correlation Between Multiple And Single Measure*

	Pearson Correlation	Sign.
Organizational Culture (5 item)	0.324	0.000
	0.219	0.002
	0.282	0.000
	0.363	0.000
	0.559	0.000
Role Behavior (4 item)	0.244	0.000
	0.184	0.009
	0.963	0.000
	0.974	0.000
Competitive Strategy (5 item)	0.239	0.000
	0.616	0.000
	0.701	0.000
	0.495	0.000
	0.342	0.000
Organizational performance (4 item)	0.208	0.000
	0.412	0.000
	0.189	0.000
	0.390	0.000

## APPENDIX B.

### *Scale Reliability*

	Standardised Alpha
Organizational culture (5 item)	0.733
Role Behavior (4 item)	0.774
Competitive Strategy (5 item)	0.657
Organizational performance (4 item)	0.716

## **A Conceptual Framework of Antecedents and Consequences of Superordinate Identity of New Product Success**

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### **ABSTRACT**

This study develops an integrated model that simultaneously captures the associations among the three key constructs of integration mode of conflict resolution, superordinate identity and new product performance. Discretionary slack, encouragement to champion product leadership, participation in rewarding decision, and provision of risk-free reward are proposed as moderating factors of the above relationships. The proposed conceptual framework aims to provide a foundation from which empirical studies might be designed to examine the moderating effects of leadership effectiveness and the use of human resources on the relationship between the integration mode of cross-functional conflict resolution, superordinate identity, and new product success. It is expected that the present study will motivate more scholars to move forward on the study of the antecedents and consequences of superordinate identity on new product success. Future research should continue to validate this conceptual model by conducting large-scale surveys of new product development project managers.

**Key Words:** Mode of Conflict Resolution, Superordinate Identity, New Product Development, Cross-Functional Teams

## INTRODUCTION

Cross-functional integration, in the context of a new product development (NPD) team, contributes vital drivers of success to the new product development process, providing the fundamental building blocks of knowledge creation (Griffin & Hauser, 1996). As a result, firms are increasingly entrusting new product development to cross-functional teams, which generally consist of members from various functional areas such as marketing, engineering, and manufacturing (Sethi, Smith, & Park, 2001). While the growing popularity of cross-functional teams for new product development mandates a strong management role in establishing the foundation of cross-functional integration, empirical research indicates that disharmony between functions is the rule, rather than the exception (Moenaert & Souder, 1990).

Despite the substantial research that examines the cause of cross-functional disharmony (Brown & Eisenhardt, 1995; Griffin & Hauser, 1996; Song, Xie, & Dyer, 2000), it is generally recognized that cross-functional disharmony, and the resulting conflicts, to a certain degree reside in the physical composition of cross-functional teams. The multifunctional nature of such new product development teams and the way they are usually structured create cross-functional biases and stereotypes, which largely arise from deeply rooted functional identities that organizational members hold (Ashforth & Mael, 1989; Sethi, 2000; Sethi et al., 2001). Functional identities can easily give rise to formidable barriers among team members. Even if the functional identities, biases, and stereotypes are not based in fact, if one or the other functional group believes in them, this belief alone can become a barrier to mutual understanding. Such misunderstanding can lead to strong 'not invented here' attitudes, thereby decreasing team members 'ownership' of new product success and then adversely affecting the

team's effectiveness in developing successful products (Ashforth & Mael, 1989; Griffin & Hauser, 1996).

To promote successful cross-functional integration and foster new product effectiveness, functional identities, biases, and stereotypes must be either eliminated or circumvented. According to research on the social identity area, unless functional identities are replaced by a sense of team identity, it may be difficult for members in a team to discover critical linkages among diverse perspectives (Ashforth & Mael, 1989; Mackie & Goethals, 1987; Sethi, 2000; Sethi et al., 2001). In terms of a cross-functional product development team, superordinate identity refers to the extent to which team members identify with the team and perceive a stake in the success of the team (Brewer & Miller, 1984; Mackie & Goethals, 1987).

To explore how to enhance the influence of superordinate identity, Sethi (2000) has comprehensively examined the antecedents and effects of superordinate identity on new product performance using a causal model, relating both special team structure and traditional group factors to superordinate identity and new product performance. However, superordinate identity in the context of a cross-functional team presumes a degree internal dynamics in a team, which can be affected by the characteristics of the team and its immediate context (Amabile 1988). Thus, in addition to examining the effects of team-related factors, including organizational factors, further study on how to develop strong team-based superordinate identity will provide a valuable complement to future theoretical development.

Not surprisingly, there is growing employment of cross-functional teams for new product development and a substantial body of empirical evidence has shown that the creation of strong superordinate identity might override the detrimental effects of team members' functional

Identities and biases. Considering the virtues of cross-functional new product development teams to facilitate creativity in the new product ideation and design process, this study aims to conceptualize how new product performance can be enhanced by strengthening the positive effect of superordinate identity in cross-functional NPD teams.

Cross-functional new product development teams are different from traditional groups, which generally comprise members from common background/functional areas. In a cross-functional team, personnel from diverse functional areas often differ in training and background, thereby breeding grounds for conflict given the diverse “thought worlds” (Dougherty, 1992, p.182). In other words, the multifunctional nature of cross-functional teams and the way they are usually structured in organizations not only create functional identities and the resulting cross-functional biases and stereotypes but also can induce strong cross-functional conflicts making it difficult for members of cross-functional teams to constructively work together. Sethi (2000) echoes this concern, noting that “the way in which these cross-functional product development teams are generally structured compounds the problem further” (p.331). Based on the assumption that cross-functional integration and the resulting superordinate identity involve the creation of a new solution that satisfies the underlying needs of diverse functional areas in a team, this study specifically examines whether the integration mode of cross-functional conflict resolution (Joshi & Sharma, 2004) is effective in creating superordinate identity and enhancing the performance of the new product development.

As noted previously, superordinate identity can be affected by the characteristics of the team and its immediate context (Amabile, 1988). Regarding the team characteristics, this study focuses on cross-functional conflict handling in the context of cross-functional teams, that is,

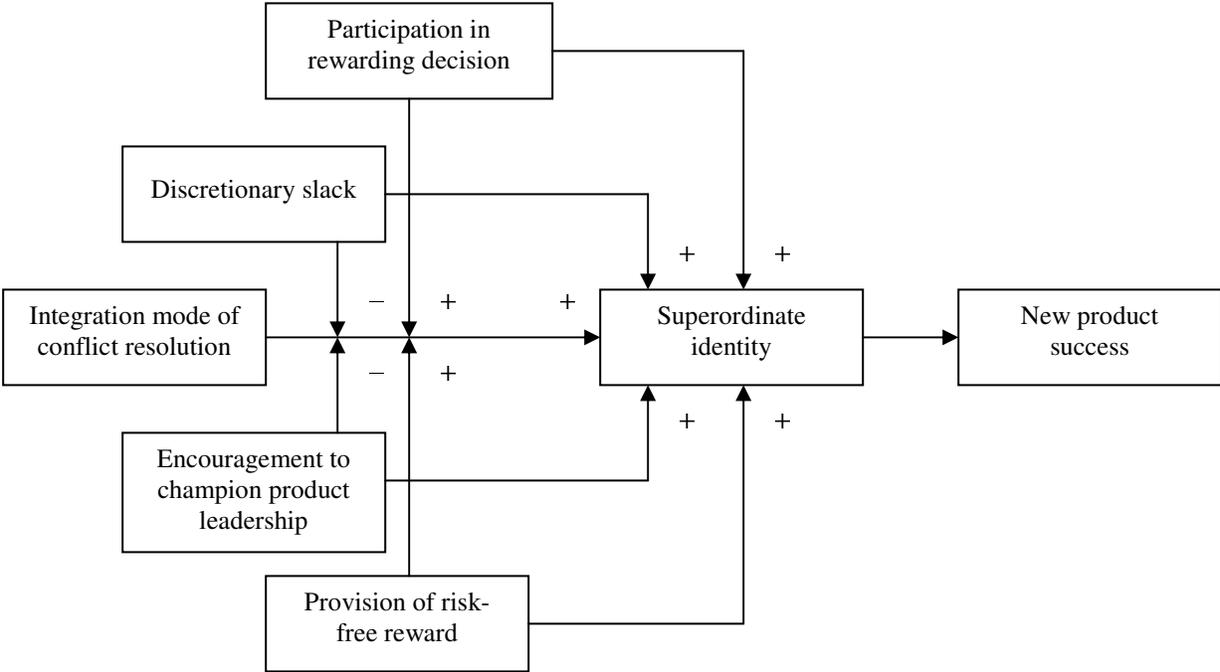
integration mode of cross-functional conflict resolution. For the purpose of examining contextual influences on the cross-functional teams, this study takes into account leadership effectiveness (e.g. discretionary slack and encouragement of risk-taking) and the use of human resources (e.g. participation in rewarding decision and provision of risk-free reward). It is assumed that both discretionary slack and encouragement of risk-taking pertain to leadership effectiveness and enable the creation process of superordinate identity to meet resource and motivation requirements. The management literature has shown their influence on developing a climate favorable to innovation (Sethi et al., 2001; Joshi & Sharma, 2004).

In terms of participation in rewarding decisions and provision of risk-free rewards, previous research has shown that the creation of a special team structure makes teams highly autonomous and outcome interdependence involves some cost for firms. For example, Ford and Randolph (1992) claimed that firms need to create special project-based evaluation and reward systems. Song et al. (2000) also found that by encouraging people in all functions to participate in decision making, managers increase members “ownership” of new product success. This ownership motivates people with different backgrounds and responsibilities to collaborate with others for overall success and to confront conflicts rather than passively avoid them (Brewer & Miller, 1984). Therefore, the third specific aim of this study is to examine the extent to which leadership effectiveness and the use of human resources influence superordinate identity and moderate the effect of integration mode of cross-functional conflict resolution on superordinate identity.

To explore these concerns, this study begins with a conceptual model that describes (1) how the performance of new product development is influenced by superordinate identity, and (2) how superordinate identity is impacted by the integration mode of conflict resolution,

leadership effectiveness, and the use of human resources. On the basis of literature review, this paper develops research propositions linking new product success to superordinate identity, the integration mode of conflict resolution, leadership effectiveness, and the use of human resources, as shown in Figure 1. We hope that this analysis of the literature and/or empirical findings on antecedents and consequences of superordinate identity on new product success motivate more scholars to move forward such research and study.

**Figure 1.**  
**Antecedents and Consequences of Superordinate Identity on New Product Success in the Context of Cross Functional Teams**



## CONCEPTUAL FRAMEWORK

### *Effect of Cross-functional Conflict Handling*

*Integration mode of conflict resolution.* Cross-functional teams are, to a certain degree, regarded as a necessary evil in the innovative process. By bringing together persons with pertinent expertise about the proposed innovation problem from different disciplines and functions, cross-functional teams foster both information flow and synergistic coordination, thereby enhancing new product success (Nonaka & Takeuchi, 1995; Kanter, 1988; Griffin & Hauser, 1996; Lovelace, Shapiro, & Weingart, 2001). But cross-functional diversity is not always helpful in improving team performance (Kanter, 1988; Dougherty, 1992). Research has shown that the advantages provided by multiple perspectives in a team are often offset by problems generating consensus (Lovelace et al., 2001) and that these teams are breeding grounds for conflict given the diverse “thought worlds” (Dougherty, 1992, p.182) and the interests that exist within them (Song et al., 2000). Moreover, the way in which cross-functional teams are generally constructed compounds the problem further. Research by Dougherty (1992), and Ancona and Caldwell (1992) further warned that the multifunctional nature of teams had less capacity for teamwork, had more difficulty in achieving consensus, and were more open to political and goal conflicts between functions.

When cross-functional teams are unable to reconcile their different perspectives and lessen the likelihood of conflicts, they are unable to be successful. Cross-functional disharmony or conflicts have their roots in strong functional identities, biases, and stereotypes (Ashforth & Mael, 1989). These functional identities, biases, and stereotypes make it difficult for cross-functional team members to constructively work together, especially in a low team-based superordinate identity cross-functional team context, thereby adversely affecting the team’s

effectiveness in developing successful products (Maltz & Kohli, 1996; Dougherty, 1992; Ashforth & Mael, 1989; Sethi, 2000). Studies have shown that an effective way of overriding the adverse influence of functional identities and then constructively integrating the diverse perspectives is to create a strong team-based superordinate identity (Brewer & Miller, 1984; Ashforth & Mael 1989; Sethi, 2000).

Cross-functional integration inevitably involves the creation of a new solution that satisfies the underlying needs rather than disregards the diverse perspectives of functional areas in a team. The integration mode of conflict resolution involves the creation of novel solutions that satisfy the underlying needs of the conflicting parties (Follett, 1982). As a result, the integration mode of conflict resolution is expected to foster the development of creative solution to cross-functional disharmony, thereby enhancing the perception of intra-team similarities, leading to psychological acceptance of members from other functions, and eventually creating a strong superordinate identity in a cross-functional team. Consequently, this study suggests:

*Proposition 1. The integration mode of conflict resolution in a cross-functional product development team is positively related to the level of team-based superordinate identity.*

### ***Effect of Leadership Effectiveness***

#### ***Discretionary slack.***

One of the most important principles in building a knowledge-creating in Japanese company is redundancy, which refers to the conscious overlapping of company information, business activities, and managerial responsibilities (Nonaka & Takeuchi, 1995; Nonaka, 1994).

By creating and encouraging dialogue and communication among functional areas, redundancy provides 'a common cognitive ground' among employees, thereby facilitating an organization-wide transfer of tacit knowledge. For example, at Canon, the redundant exercise enables cross-functional new product teams to form a new and more encompassing conceptualization of the problem, which then becomes the final solution, namely a common understanding, a synthesis, or a consensus (Nonaka & Takeuchi, 1995). To create such redundancy, it is not uncommon to find firms employing discretionary slack for organizational adaptation and renewal.

Discretionary slack refers to a situation in which, in addition to the original budgeted allocation, free resources controlled by senior management may be made available to support the activity (Nohria & Gulati, 1996; Sharma, 2000). Discretion is defined as latitude of managerial action, and slack resources include excess inputs such as redundant employees, unused capacity, and unnecessary capital expenditures (Nohria & Gulati, 1996).

Naturally, a low superordinate identity team will be characterized by retention of functional identities (Sethi et al., 2001). This problem is aggravated by cross-functional rivalry and political maneuvering over scarce organizational resources (Maltz & Kohli, 1996; Sethi, 2000), thereby damaging the effectiveness of cross-functional relationship and integration. In addition, the difficulty in forecasting resource requirements accurately for the requisite activities in a cross-functional team could compound cross-functional disharmony further. Consequently, a resource cushion is required for dealing with inter-function contention and developing team-based superordinate identity to avoid functional identities even worse. Thus, the greater of discretionary slack provided to senior management in managing the cross-functional interface in a new product team, the greater the likelihood of resolving functional identities and creating superordinate identity.

Consistent with this reasoning, studies have shown that there is a positive relationship between the provision of resource slack and customer knowledge development activities in a cross-functional new product team (Joshi & Sharma 2004) and that resource availability enhances customer-related learning in the new product development process (Dougherty & Hardy, 1996). Consequently, based on theoretical rationale and empirical evidences, this study postulates:

*Proposition 2. The level of discretionary slack provided to senior management in managing the interface in a cross-functional product development team is positively related to the level of team-based superordinate identity.*

#### ***Encouragement to champion product leadership.***

One of the most significant determinants of the creativity of outcomes is the motivation people have to engage in the task at hand (Amabile, 1983). Employees can be motivated to engage in particular activities either because of outcomes they derive from the activities or because they regard the activities as intrinsically significant (Schein, 1992). To motivate team members to persist with new product innovativeness, encouraging them to champion leading-edge products infuses innovative process with meaning.

Basically, innovation can be regarded as a trial-and-error process in which inevitable technical and human-related obstacles are likely to reduce team members' motivation, thereby diminishing the creative process. By championing product leadership as the team's goal, senior managers not only signal to team and to others that the critical role the team played but also infuse the innovation process with meaning or intrinsic significance, thereby enhancing team members' motivation to engage in innovation activities. This contributes to creating a sense of

pride among team members and builds enthusiasm and excitement toward the project (Kanter, 1988; Van De Ven, 1986).

Specifically, this study contends that team members who devote themselves to creating leading-edge products are more willing to identify with the team and perceive a stake in the success of the team than are team members who do not devote themselves to creating leading-edge products. Consistent with this argument, prior research has shown that congruence between employee and organizational values reduces role conflict and role ambiguity, thereby enhancing employees' motivation to perform (Flaherty, Dahlstrom, & Skinner, 1999; Sigauw, Brown, & Widing, 1994). Consequently, senior managers who want cross-functional new product teams to create a strong sense of superordinate identity should encourage team members to champion product leadership. Thus, this study hypothesizes:

*Proposition 3. Encouragement to a cross-functional product development team to champion product leadership is positively related to the level of team-based superordinate identity.*

### ***Effect of the Use of Human Resources***

#### ***Participation in rewarding decision.***

An important role of human resource function in strategic planning is to develop the culture necessary to support organization-wide, coordinated innovation (Kanter, 1988), and participative management is often quoted as the prime example of the use of human resource. By encouraging members in various functional areas in a team to participate in decision making, managers increase their 'ownership' of new product success. This ownership

motivates members with different backgrounds and responsibilities to collaborate with others for overall success rather than pursue their own functional goals (Song et al., 2000).

The underlying assumption in the preceding premise is that team members accept this organizational message. Message acceptance by team members depends on their prior belief (Areni, 2002), which was largely affected by their perceptions of equity or internal consistency within a team, particularly internal consistency in compensation (Coombs & Gomez-Mejia, 1991). However, unless team members are able to perceive and recognize the internal consistency in the reward system, mere participative management may not be able to overcome strong functional identities. Consequently, this study contends that, to develop a strong team-based superordinate identity, all functions must participate in rewarding decisions about how to allocate rewards resulting from NPD success (Chang, Yeh, & Yeh, 2007; Chang, Yeh, & Lin, 2007), the internal inconsistency in the compensation system can be resolved, and cross-functional interaction can be achieved. In other words, while participative management is likely to encourage team members to collaborate with others for overall team success, the perceptions of team members of equity, commitment, and job satisfaction gained by participating in the reward process lead to voluntary or pro-social behavior, i.e. providing information to coworkers (LePine, Erez, & Johnson, 2002).

Combining participative management with jointly determined rewarding policy, participation in rewarding decision not only develops a cooperative climate among team members, which promotes the acceptance of members from other functions, thereby reducing the adverse effect of cross-functional biases and stereotypes (Brewer & Miller, 1984; Ashforth & Mael, 1989; Sethi, 2000), but also enhances the perception of equity within teams, which leads to voluntary or pro-social behavior (LePine, Erez, & Johnson, 2002), thereby generating

positive job attitude like team-based identity and cross-functional cooperation and integration. Consistent with this argument, Brewer and Miller (1984) suggested that joint working and decision-making on various aspects of the product development project increase the possibility of individuation of members from other functional areas. Thus, this study suggests:

*Proposition 4. The level of participation in rewarding decision in a cross-functional product development team is positively related to the level of team-based superordinate identity.*

***Provision of risk-free reward.***

Innovative ideas are more likely to arise in environments that encourage risk taking (Amabile, 1988). While encouraging risk taking or entrepreneurship promotes new product success, team members are also capable of differentiating between personal risk and the risk borne by their firms (Sarin & Mahajan, 2001). Team members are willing to share risk with their firms, but are also eager to minimize their risk exposure or secure risk-free positions (Sasaki, 1991; Sarin & Mahajan, 2001). If teams are put into a position where they must take risks to move their firms forward, it is unfair to reward them solely based on results (Pascarella, 1997).

Robbins and Finley (1995) noted that team members would not strive to realize business objectives if they are placed at risk. Congruence between employee and organizational values reduces role conflict and role ambiguity, thereby enhancing employees' motivation to perform (Flaherty et al., 1999). The agency theory also echoed that an optimal compensation system is contingent on the need to balance agent effort and risk aversion (Bloom & Milkovich 1998). To balance personal and organizational risk, for example, an intelligent-failure system rewards team members based on the extent to which they undertake creative and learning-oriented

activities regardless of the immediate success or failure of the activities (Kanter, 1988; Sarin & Mahajan, 2001). Similarly, by providing risk-free reward to cross-functional team members, Chang et al. (2007) suggested that a special team-based joint reward system can enhance the sharing of innovation knowledge in a cross-functional new product team.

Given the trial-and-error nature of innovative activities and the propensity for failure in product development, and considering that risk-free entrepreneurial funds aiming to start new projects or ventures are frequently used for R&D personnel or technical professionals (Coombs & Gomez-Mejia, 1991), this study contends that a team-based reward system should be either low risk or risk-free for overall team members in order to effectively facilitate cross-functional integration. In others words, by actually providing incentives for engaging in risk-taking activities, the provision of risk-free reward for cross-functional new product teams can enhance team members' involvement and commitment to the team, which is expected to increase superordinate identity in the team. Thus, we hypothesize the following:

*Proposition 5. The provision of risk-free rewards to a cross-functional product development team is positively related to the level of team-based superordinate identity.*

### ***Moderating Influence of Leadership Effectiveness***

Despite the fact that the integration mode of conflict resolution and leadership effectiveness are helpful to mitigate the adverse effect of functional identities, both of them consume large amount of the firm's resources, particularly the consumption of time and energy associated with senior managers. Thus, there is a need to determine whether the effect of integration mode of conflict resolution on superordinate identity is contingent upon leadership effectiveness or varies among different organizational contexts where teams operate on a daily

basis. As such, this study examines the moderating effect of leadership effectiveness on the relationship between integration mode of conflict resolution and superordinate identity.

***Moderating effect of discretionary slack.***

An increase in the provision of discretionary slack provided by senior managers reduces functional managers' interference in the team's work through their functional representatives (Sethi, 2000), thereby avoiding the adverse effect of functional identities that might be reinforced or triggered by those representatives. Furthermore, when senior managers provide necessary financial and political resources, they motivate team members to confront cross-functional conflicts rather than ignore them (Song et al., 2000). Combining the effectiveness of mitigating salience of functional identities with the potential for resolving cross-functional conflict, an increase in discretionary slack is expected to create strong team-based superordinate identity even in a team that might not be characterized by the integration mode of conflict resolution.

This study argues that not all cross-functional teams need equal levels of leadership effectiveness in their product development process even within a particular firm. For example, when a cross-functional new product team is characterized by the integration mode of conflict resolution, the destructive potential of conflicts is contained (Joshi & Sharma, 2004), thereby enhancing cross-functional integration in product development process. Such a team by itself is quite productive to overcome the detrimental effect of functional identities and to build a strong team-based identity, thus an increase in discretionary slack may not contribute to the strength of superordinate identity.

Consequently, this study contends that when the autonomy-generating potential of discretionary slack in a team is developed, the relationship between integration mode of

conflict resolution and superordinate identity may not be strong, or integration mode of conflict resolution plays a less significant role in increasing superordinate identity. Alternatively, when there is an increase in the level of discretionary slack, the positive effect of integration mode of conflict resolution on superordinate identity might be diminished progressively. Thus, this study hypothesizes:

*Proposition 6. The positive effect of integration mode of conflict resolution on superordinate identity in a cross-functional new product team will be diminished as the level of discretionary slack increases.*

***Moderating effect of encouragement to champion product leadership.***

Similar to the rationale applied to the previous hypothesis, an increase in encouragement to champion product leadership infuses innovative process with meaning or intrinsic significance (Bartlett & Ghoshal, 1993), which motivates team members dedicate themselves to creating leading-edge products, thereby enhancing their involvement and commitment to the team. Increased involvement and a cooperative attitude are expected to increase superordinate identity in the team (Sethi, 2000), because members in a highly motivated team are more likely to perceive themselves as distinct from other teams or functional areas in the firm, and such perception of distinction will strengthen the feeling of superordinate identity (Mackie & Goethals, 1987). Furthermore, when senior managers provide clear objectives, particularly team members regard product leadership as a meaningful team's goal, it not only enhances cross-functional integration but also provides plenty opportunities for creating an environment that directly facilitates collaborating behavior (Song et al., 2000). As a result, this study contends that an increase in encouragement to champion product leadership

can be expected to develop strong superordinate identity even in a team that might not be characterized by the integration mode of conflict resolution.

In contrast, when a cross-functional new product team is characterized by the integration mode of conflict resolution, the destructive potential of conflicts is contained (Joshi & Sharma 2004), thereby enhancing cross-functional integration in product development process. Such a team by itself is quite productive to overcome the detrimental effect of functional identities and to build a strong team-based identity, thus an increase in encouragement to champion product leadership may not lead to any major enhancement in developing superordinate identity.

Consequently, this study argues that when the autonomy-generating potential resulted from team members are willing to challenge leading-edge products is developed, the relationship between integration mode of conflict resolution and superordinate identity may not be strong, or integration mode of conflict resolution plays a less significant role in increasing superordinate identity. Alternatively, when the extent of encouragement to champion product leadership is increased, the positive effect of integration mode of conflict resolution on superordinate identity might be diminished progressively. Thus, this study suggests that:

*Proposition 7. The positive effect of integration mode of conflict resolution on superordinate identity in a cross-functional new product team will be diminished as the level of encouragement to champion product leadership increases.*

### ***Moderating Effect of the Use of Human Resources***

Among the various managerial applications, the use of human resource management functions is considered important in the development of a firm's culture that is needed to support organization-wide and coordinated innovation (Kanter, 1988; Coombs & Gomez-

Mejia, 1991). Moreover, based on Coombs and Gomez-Mejia (1991), both the compensation system and how to allocate the reward across functional areas in a cross-functional team not only send powerful signals to employees as to the organization's goals, but also contribute to integrate the efforts of different functional areas. Given the importance of the human resources management practices in both strategic and tactical planning, it is valuable to understand how the effect of integration mode of conflict resolution on superordinate identity varies in the extent to which human resource management functions are applied in the new product development process.

***Moderating effect of participation in rewarding decision.***

Although a cross-functional new product team characterized by the integration mode of conflict resolution possesses the potential to lessen the adverse effect of functional identities by creating a new solution that satisfies the underlying needs of various parties, such potential can be better realized if team members are granted to participate in the team decision-making process and regard new product success as not only the organization's goal but also the organizational goal of themselves. As participation rate in rewarding decision increases, cross-functional new product teams with the integration mode of conflict resolution are expected to develop high superordinate identity.

High participation rate in rewarding decision, because it improves the internal pay equity and it emphasizes that rewards are based on the performance of a whole team rather than function-based, increases team members' ownership of new product success, which can motivate members with different backgrounds in a team to confront conflicts collaboratively (Song et al., 2000). As such, at high levels of participation in rewarding decision, the likelihood

of realizing the potential of integration mode of conflict resolution in creating superordinate identity is enhanced.

On the other hand, as a reward system overtly favors the technical function in a way that seems unfair to other functions, or a specific functional area keeps a high profile in reward decision-making process, because such internal pay inequity or internal inconsistency in compensation may de-motivate team members in different functional areas, the potential of integration mode of conflict resolution in creating superordinate identity might be suppressed. In other words, in cross-functional new product teams, the higher the level of participation in rewarding decision, the greater the effect of integration mode of conflict resolution on superordinate identity. Thus, this study postulates

*Proposition 8. The positive effect of integration mode of conflict resolution on superordinate identity in a cross-functional new product team will be enhanced as the level of team members' participation in rewarding decision increases.*

***Moderating effect of provision of risk-free reward.***

As previously noted, an important mechanism for the development of superordinate identity in a cross-functional team is a special team-based joint reward system characterized by provision of risk-free reward to team members who undertake creative and learning-oriented activities regardless of the immediate success or failure of the activities. When such an incentive system exists, this study expects that the effectiveness of integration mode of conflict resolution on superordinate identity can be enhanced progressively.

Developing integration mode of conflict resolution for a cross-functional team means the creation of a whole new solution that satisfies the diverse needs of all functions, thereby largely

facilitating the possibility of cross-functional integrating and the resulting superordinate identity. However, the underlying assumption in this argument is that the adverse interests exist within team members should be considered firstly. Given the propensity for failure in innovative process, team members' willingness to seek a new solution for resolving cross-functional conflict and achieving superordinate identity is to a large extent affected by whether the organization provides an environment that encourages risk-taking or not. The conventional practices that provide rewards to team members whose efforts yield new product success and punish them for the failure results not only are unfair to team members but also undermine the development of integration mode of conflict resolution.

By removing the disincentives and by actually providing incentives for engaging in innovative and learning-orientated activities, as suggested by Kanter (1988), Sarin and Mahajan (2001), and Chang et al. (2007), a special team-based joint reward system characterized by provision of risk-free reward to team members can improve team members' willingness to develop creative solutions to conflicts, thereby creating high superordinate identity. Thus, this study suggests

*Proposition 9. The positive effect of integration mode of conflict resolution on superordinate identity in a cross-functional new product team will be enhanced as provision of risk-free reward to team members exists.*

## **CONCLUSIONS AND IMPLICATIONS**

Cross-functional teams have become more popular in recent years because they improve coordination and integration, span organizational boundaries, and reduce the production cycle time in new product development. Previous studies have discovered a number of factors that

contribute to the effectiveness of cross-functional teams, one of which is superordinate identity. While, within the management literature, there has been a growing interest in the role of ‘superordinate identity’ in influencing new product performance in the context of cross-functional teams, we sense that there has been little or no empirical research incorporating both team-related factors and human and organizational factors in examining the extent to which superordinate identity may have contributed to new product performance. The present study aims to fill this gap by developing an integrated model that simultaneously captures the associations among the key constructs of integration mode of conflict resolution, superordinate identity and new product performance. Discretionary slack, encouragement to champion product leadership, participation in rewarding decision, and provision of risk-free reward are proposed as moderating constructs with regard to the various antecedents of superordinate identity. The proposed conceptual framework aims to describe (1) how the performance of new product development is influenced by superordinate identity, and (2) how superordinate identity is impacted by the integration mode of conflict resolution, leadership effectiveness, and the use of human resources. The relationships among these identified constructs have been hypothesized based on a review of literature. It is suggested that future studies should focus on testing the research propositions that has been proposed. Further studies might also look at the opportunity to refine and validate the proposed model.

The study has a theoretical as well as a practical dimension. It offers the prospect of enhancing current knowledge in the context of cross-functional new product development teams. The present study integrates both team-related factors and human and organizational related factors with a view to explaining the effectiveness of integration mode of cross-functional conflict resolution in creating superordinate identity which in turn enhances new

product performance. Moreover, the proposed conceptual model provides a solid foundation from which empirical studies might be designed to examine the moderating effects of leadership effectiveness and the use of human resources on the relationship between the integration mode of cross-functional conflict resolution and superordinate identity. The findings of the study may provide some useful guidelines for NPD project managers and firms to enhance new product performance through the creation of team-based superordinate identity. This is particularly important to cross-functional teams because the development of superordinate identity is offered as influential in increasing knowledge creation and transfer, creating a climate of trust, and overcoming spatial and organizational barriers in cross-functional teams. As part of the empirical study, this paper presents a conceptual model with a view to highlighting the antecedences and consequences of superordinate identity on new product success in the context of cross-functional new product development teams, and suggesting the necessity for examining the possible relationships between these identified constructs. Details of the research findings from a survey of NPD project managers will be reported in subsequent papers.

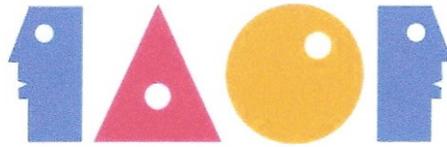
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## **USER SATISFACTION WITH MOBILE SERVICES IN PAKISTAN**

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### **ABSTRACT**

The aim of this research study is to find out the user's satisfaction with the Pakistani mobile phone Operators. Investments in Pakistan's mobile market have been enormous in the past few years. There are now six mobile operators operating in Pakistan. This paper discusses the relationship between user loyalty, corporate image, user perceived quality, user perceived value, user expectation and complaint handlings with user satisfaction. They are thought as driving force for achieving user satisfaction in Mobile Telephone marketing.

### **Keywords:**

Pakistan, Mobile, User Satisfaction, User Loyalty, User Perceived Quality, User Perceived Value, User Expectation.

## INTRODUCTION

Monopoly is the situation where the users are considered not to be well facilitated by the service provider. To remove the monopoly from telecom sector of Pakistan the government decided to deregulate and liberalize this sector. There has been incredible increase in the teledensity since 2000 due to large investment in the telecom industry and government strategies towards promoting liberalize culture in the respective sector. PTA has declared that number of mobile users has passed 70 million. Thus initiatives towards deregulation and liberalization of telecom sector attracted investors to invest in the telecom industry of Pakistan. Today there are six major operators namely Mobilink, Ufone, Telenor, Warid, China Mobile and Instaphone and there is a severe competition among these operators for mobile services in the country. Overall the service provided by these operators can be categorized as voice, data and video. These services can be in the form of voice calls, SMS, GPRS, mobile TV, mobile banking and many entertainment services.

Mobilink is considered to be the pioneer in mobile sector by launching GSM technology in Pakistan. It claims to have 28.57 million subscribers. They have well established nationwide infrastructure, excellent network and is in fact the largest cellular company in Pakistan. Ufone the subsidiary of PTCL is providing good quality services across Pakistan. They have introduced number of new services like GPRS, internet bill payment, web to SMS chat and mobile banking. It claims to have 15.42 million subscribers and coverage to over 100 key cities of the country. Telenor as emerging service provider in the industry is devoted to provide high quality services to their increasing number of users. Telenor always tries to facilitate its users by introducing new packages and services like Easy load package, mobile TV, high connectivity GPRS, unlimited validity of connection and many other services. They

are serving about 15.46 million users in Pakistan. Warid, a UAE Group started its operation on May 2005 in Pakistan. Warid has many features like low call rates, attractive packages, GPRS service and many more. Warid has about 11.86 million users in the country. China Mobile operator previously known as Paktel is China operated service provider. China Mobile is now attracting users by their user caring services and low call rates. They are claiming to have 3 million users in the country. Instaphone a small cellular company is providing good quality services. Although they have good network coverage and infrastructure and providing quality of services but have AMS network unlike their competitors who have GSM network.

Competition exists between these operators in retaining their existing users and to reach maximum number of new users. The result of this competition is a wide range of high quality services available with efficient, cost effective and competitive telecommunication services throughout Pakistan. To retain existing users, satisfaction plays an important role in the retention of existing customers in the telecom industry. To attain higher user satisfaction, operators are introducing advance services and new packages. The aim of this study is to find the user satisfaction with mobile service in Pakistan.

## **LITERATURE REVIEW**

Mobile carriers should understand the importance of user satisfaction and loyalty while making strategies for user retention. Mobile technology has provided a new means to access users. Mobile users are now able to communicate with each other by voice as well as data due to emerging technologies. The advancement in technology has forced mobile operators to provide users with new features in their connection in order to retain existing users. The relation between service quality and perceived value should be highly focused by the service provider in concern with user loyalty and satisfaction. User satisfaction is their overall

assessment after using a service for a period of time. Different factors have different impact on users. All these factors should be taken in to account while devising a strategy for user satisfaction. (Heejin 2006)

User loyalty is considered to be an important factor in telecom sector for preserving the service in long run. Switching cost, trust and user satisfaction are important agents for user loyalty where switching cost is observed to be high but in the case of low switching cost the agent are considered to be trust and user satisfaction for loyalty. Moreover switching cost has temperate effect on the relationship of loyalty with user satisfaction and loyalty. The result showed that switching cost is a quasi moderator with regard to user satisfaction and trust. (Gokhan 2005)

Firms should distinguish themselves with their competitors by providing value added services for building high user loyalty which is critical factor for measuring user satisfaction. Similarly users have pre-purchase expectations about a service, meeting those expectations with services increases user satisfaction. Handling user complaint is another factor that is very helpful in increasing user satisfaction and has negative impact on user satisfaction. Corporate image has significant impact on user loyalty although statistics does not support this relation. It is also observed that customer satisfaction is also dependent on perceived quality and has positive role towards the dependent. Similarly perceived value also have stronger link with user satisfaction therefore proper care should be taken while formulating any long term policy for user satisfaction. At last for building user loyalty, user satisfaction is a major determinant. (Serkan 2005)

In the business when discussing factors for service providers quality of service, user value and user satisfaction are becoming prominent. That is why high service quality should be

focused for greater user value to achieve higher user satisfaction and to gain exceptional competitive advantage. Keeping in view user satisfaction the operator should not ignore reliability and assurance because there is positive effect of reliability, assurance, and network quality and user value on their satisfaction. User perceived sacrifice have negative effect on user satisfaction thus service provider should try to reduce this factor. (Hing-Po 2002)

Mobile services have grown contrary to the expert's expectations. This growth is also responsible for the intense competition between service operators in the telecom industry. This competition is forcing the operators to adopt effective strategies in order to satisfy the users. Perceived quality reveals positive impact on one's view about quality of services and user satisfaction. The similar attitude is shown by the perceived value towards users' satisfaction and should be considered in developing a strategy by operators. Moreover satisfied users exhibit greater likelihood of repurchase of same service or product. In the same way when a user is highly satisfied with a service he does not take in consideration the price factor of the service, thus satisfaction brings with its price tolerance thus user satisfaction and price tolerance are directly related to each others.

Price tolerance and likelihood of repurchase are two apparent measure of user loyalty which has significant response towards user satisfaction. It was also noticed that users will submit less complains if they are more satisfied thus showing that users complain and user satisfaction has indirect relation or negative connection with each others. (Ofer Turel 2004)

## **RESEARCH METHODOLOGY**

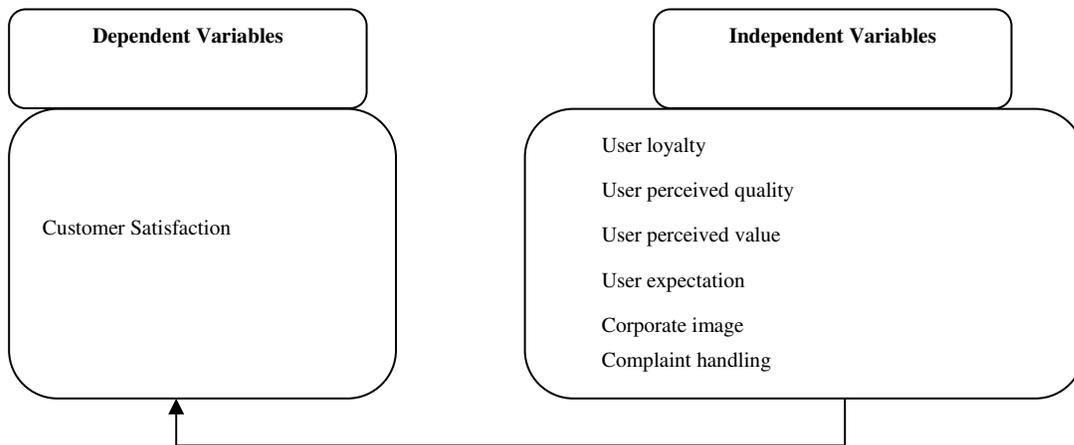
This research is based on the data taken from the mobile users in Pakistan. Simple sampling technique was used to make research process faster. To acquire data from the Mobile

users, questionnaires were distributed among different mobile users. This whole data collection process took thirty days and response rate was of 82 %.

### Variables

Variables are shown in Figure below. In this research, seven variables are considered for analysis. Out of these, six are independent variables (user loyalty, corporate image, user perceived quality, user perceived value, user expectation and complaint handlings) and one is dependent variable (user satisfaction). These independent variables are affecting user satisfaction.

Figure 1



User satisfaction depends on two things that is expectation before purchase and product performance after the purchase which directly effects the user expectations. So users were asked about their pre-purchase expectation and comparison with other service provider for the same expectation, their trust on service provider, reliability etc. As defined earlier user loyalty is directly affected by user satisfaction and user complaints (Fornell, 1992).

Under User loyalty they were asked about their preference, recommendation to other and their intention to use the same service in future. Corporate image is the overall concept of society towards the corporation or service provider. For its evaluation, users identified the stability, innovation and image in the society of the operator. Perceived quality is the limit up to which the product or service provide the necessary needs of users with more satisfaction value.

To determine about the service quality of an operator, users rated these companies for their billing system, coverage area, Value added services, messaging services and network coverage. User perceived value deals with perceived quality on price paid.

User perceived value was judged from the Users ideas about the pricing plan with respect to quality, superiority of overall pricing option by service providers. User expectations are their requirements for the quality and meeting expected needs from the service. To know about the expectations of the users, they were asked about their expectations for services, billing tariff.

User complaint handling is the degree up to which the service provider is caring user complaint. Only one question was asked under this topic that how much your service provider is caring about your complaints.

## **Questionnaire**

The data collection was achieved through questionnaires. Seven variables (user expectations, user loyalty, user perceived quality, user perceived value, user expectation, corporate image and complaint handling) are used to measure and explain user satisfaction.

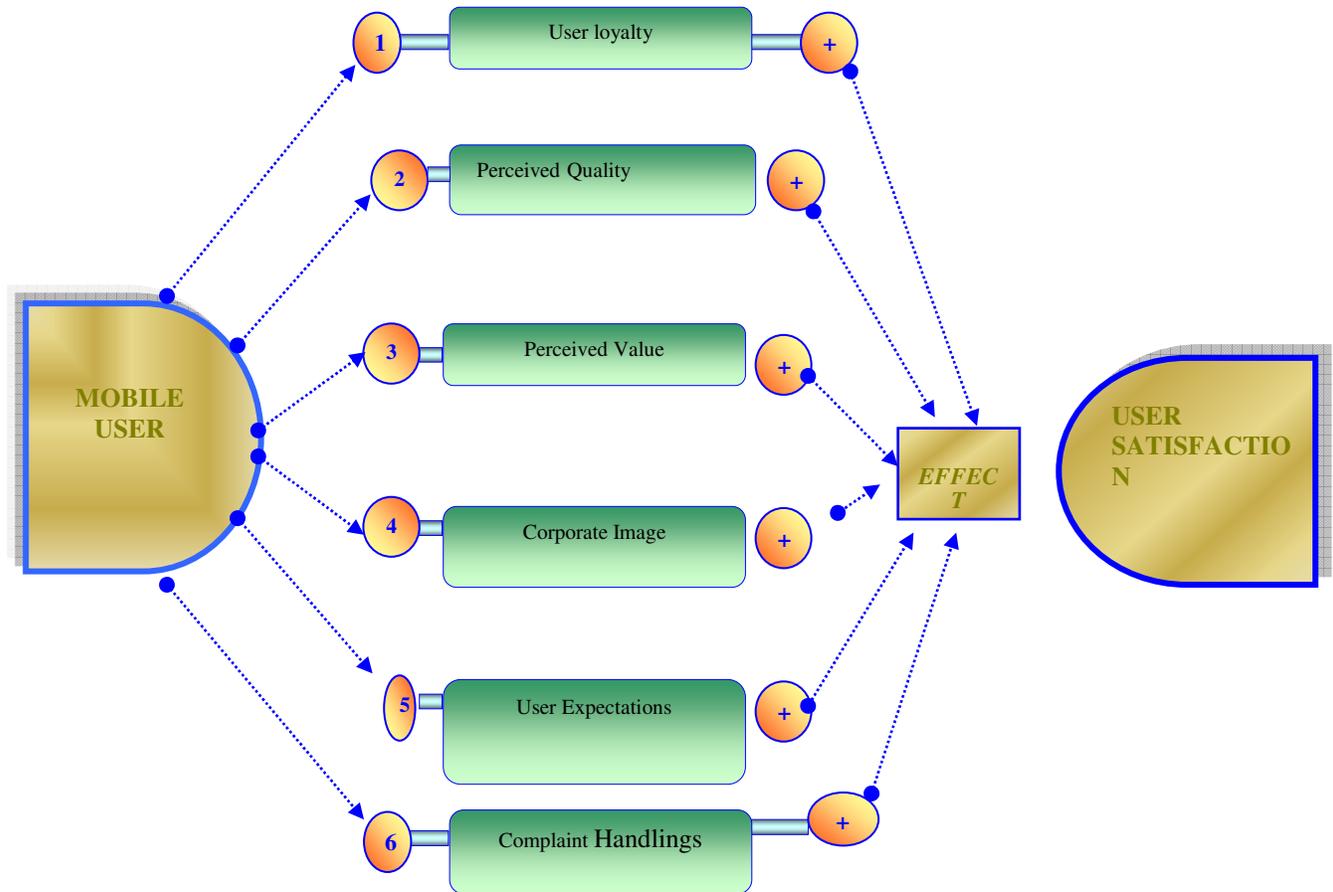
The questionnaire was developed depending upon the extensive literature review (Hirschman, 1970; Fornell and Wernerfelt, 1987 Peters, 1988; Reichheld and Sasser, 1990

Johnson et al., 2001 Phillips et al., 1983; Buzzell and Gale, 1987 Fullerton, 1998) on Likert scale.

**Research Model**

The research model is developed on the basis of previous research studies, we have included following variables (perceived quality, user expectation, user loyalty, corporate image, user perceived value and complaint handlings). Equation tested is following:

(Research Model)



Equation no.1

$$y = a + bX_1 + bX_2 + bX_3 + bX_4 + bX_5 + bX_6 + e$$

$$US = a + b(CL) + b(PQ) + b(PV) + b(CI) + b(CE) + b(CH) + e$$

Where as:

Y = US = User Satisfaction = Dependent variable

“a” is constant.

“e” is common error or other variable.

1. X1=UL= User Loyalty
2. X2=PQ= User Perceived Quality
3. X3=PV= User Perceived Value
4. X4=CI= Corporate Image
5. X5=UE= User Expectation
6. X6=CH= Complaint Handling

### **Hypotheses**

On the basis of extensive literature review hypotheses are developed for the study as follows:

**H1:** *There is a positive/significant relationship between the User loyalty and user satisfaction.*

**H2:** *There is a positive/significant relationship between the User perceived quality and user satisfaction.*

**H3:** *There is a positive/significant relationship between the User perceived value and user satisfaction.*

**H4:** *There is a positive/significant relationship between the corporate image and user satisfaction.*

**H5:** *There is a positive/significant relationship between the User expectations and user satisfaction.*

**H5:** *There is a positive/significant relationship between the complaint handling and user satisfaction.*

### **RESEARCH FINDINGS**

For finding the strength of the relationship between several variables, Pearson Product Moment Correlation Co-efficient is used, in this tool both variables are treated symmetrically, i.e. there is no distinction between dependent and independent variables. Two variables are said to be correlated if they tend to simultaneously vary in same direction. If both the variables tend to increase or decrease together, the correlation is said to be direct or positive. When one variable tends to increase and the other variable decreases, the correlation is said to be negative or inverse.

Table 1 is showing correlations for all the variables and Table 2 is indicating descriptive statistics comprised upon values of standard deviations, means, median, mode, minimum, maximum values and ranges. There is a high correlation among the independent and dependent variables.

According to Table 1 there is high correlation between the independent and dependent variables. We can also see that that the correlation between user satisfaction and user loyalty is 0.40 while the mean of user loyalty is 3.95 and standard deviation is 0.73. The correlation value indicates that both the variables are moving in same direction and the ratio is 0.40. This shows those users who are loyal to their operators are satisfied from them. Similarly 0.34 is the correlation between corporate image and user satisfaction which is positive which indicates corporate image in the society effect positively the satisfaction level of the users.

The mean of corporate image is 3.94 and the standard deviation is 0.74. The table shows that user satisfaction and user perceived value which have the mean value 3.56 and standard deviation 0.84, are positively correlated to each other because the correlation value

0.18 between these two variables is positive and highlighting that user will be more satisfied if they get more value with respect to price paid.

User perceived quality whose mean is 3.75 and standard deviation is 0.59 shows that both the variables are moving in same direction and the ratio is 0.12. This shows the positive behavior of these variables upon each other. So if users entertain more quality from their operator they will be satisfied and will recommend this operator to other users. Another important factor which can guide these operators to satisfy user is to fulfill the user expectations, which they have from an operator. According to our research users remain more careful about their expectation from operator as there are 0.18 positive correlations between user expectation and user satisfaction.

Table 1

	US	UL	CI	UPQ	UPV	UE	CH
User Satisfaction	1						
User loyalty	0.40	1					
Corporate Image	0.34	0.31	1				
User Perceived Value	0.18	0.20	0.22	1			
User Perceived Quality	0.12	0.23	0.14	0.25	1		
User Expectation	0.18	0.20	0.17	0.42	0.28	1	
Complaint Handling	0.26	0.19	0.30	0.10	-0.00	0.099	1

According to table 2 the mean of user expectation is 3.61 while the standard deviation is 0.74. According to the figures in table 1, users value their complaints very

much that is why there is positive correlation between user complaint handling and user satisfaction. The correlation value between these is 0.26. This shows that if operator reacts in efficient manner to solve the problem of user, it will satisfy the user and he will remain loyal to the operator. The mean of complaint handling is 3.79 while the standard deviation is 1.09.

Table 2

	US	UL	CI	UPQ	UPV	UE	UCH
Mean	3.63	3.60	3.95	3.75	3.56	3.62	3.74
SE	0.05	0.06	0.05	0.04	0.06	0.05	0.08
Median	3.80	3.67	4.00	3.80	3.50	3.67	4.00
Mode	3.60	3.67	3.67	4.00	3.50	4.00	4.00
SD	0.74	0.83	0.75	0.60	0.84	0.74	1.10
SV	0.55	0.69	0.56	0.36	0.71	0.55	1.20
Range	4	3.67	4	3.4	4	4	4
Minimum	1	1.33	1	1.6	1	1	1
Maximum	5	5	5	5	5	5	5

### Regression

In regression dependence of one variable that is random upon the other variable which is non random or fixed can be calculated. For finding the contribution of independent variable towards dependent variable, we use Multiple Regression.

Table 3 contains the regression outcomes for Pakistani user in telecom sector.

Table 3

User Perceived Value	0.04	0.99
User Expectation	0.05	0.43
Complaint Handling	0.09	0.03
	Coefficient	P-VALUE
Intercept	1.18	0.002
User Loyalty	0.26	2.53
Corporate Image	0.18	0.006
User Perceived Quality	0.05	0.55

This table shows that by increasing 1 unit of user loyalty will increase user satisfaction by 0.26 units which means this variable is having strong impact on user satisfaction. This result is significant at significance level of 2.53. According to the table 3, one unit increase in corporate image will produce 0.18 unit's increment in the user satisfaction showing strong impact of corporate image over user satisfaction at significance level of 2.53.

Similarly if user perceived value is increased by 1 unit it will show 0.04 unit increase in user satisfaction at 0.99. It shows that user perceived value has high impact on the user satisfaction. The table shows that by increasing 1 unit of user perceived quality, user satisfaction will increase by 0.05 showing strong impact of user perceived quality over user satisfaction which is significant at 0.55. Moreover 1 unit increase in user expectation will increase user satisfaction by 0.05 units showing high impact of user expectation over user satisfaction at 0.43. At last the table shows that by increasing 1 unit of complaint handling the user satisfaction will increase by 0.09 units, at 0.03. According to the regression technique there is strong positive relationship among effective user satisfaction, user loyalty, corporate image and user expectation, user perceived value, user perceived quality and complaint handling.

## **CONCLUSIONS**

There is an enormous increase in investments in Pakistan Mobile market. Now we have six mobile operators operating in Pakistan. These operators are introducing new services and low call rates packages to attract more users, as well as to retain them. Findings of this research paper are very informative for mobile operators. The results indicate that user loyalty; corporate image and user expectations have high impact on the user satisfaction.

According to this research these factors are the driving force for achieving user satisfaction in the Pakistani mobile telephone market. Operators need to deal with complaints lodged by the users and properly trained staff should be available to the users for their queries. The managers should focus on these factors to attain high user loyalty and user satisfaction which will lead to user retention.

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## **Hardware Layout of Meal Box Industry Health Independent Management**

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### **ABSTRACT**

The purpose of this study was to research the meal box industry health independent management and to develop the proposal for a HACCP food safety control system for the meal box industry. This would result in the establishment of associated hardware layout and software management. As the family structure has changed rapidly in Taiwan, most people eat out, often taking a meal box for lunch and dinner. Thus, the food sanitation control of the meal box was a very important subject under this investigation. The research subjects were eight meal box factories around the area of Kao-hsiung City, Kao-hsiung County, and Pin-tong County in southern Taiwan. Eight of them have been approved by a pilot certification system for food safety issued by the Department of Health, Executive Yuan, and ROC. Interviews and inspections of these factories were conducted. It was found that more than 94% of them have passed the regulation of *Food Sanitation Control Act*. Under our proposed method, based upon our research results, we can upgrade the professional know-how of managers in food supply of meal box factories, guide operators of food processing in establishing self-control systems, enhance sanitation self-control capabilities, and attain the goal of controlling meal box at the source of production. With the research result regarding hardware layout, the meal box suppliers can improve the current inefficient hardware layout or build a new more efficient production line with a better self-control system.

**Key Words:** HACCP (Hazard Analysis Critical Control Point), GHP (Good Hygiene Practice), Meal Box.

## INTRODUCTION

With the development of society and the transition of the family structure, the quality of living has continued to rise. People are no longer satisfied with their typical daily diet as a means to relieve their hunger. Rather, more focus has been put on health and nutrition; among the most important issues was the safety and quality of their food. The main cause of food poisoning is bacteria, such as vibrio enteritis, staphylococcus, and salmonella, which lead to discomfort. The nursery for this kind of bacteria is secondary contamination of heat treatment and cross- contamination caused by unclean equipment, utensils, pest, and misoperation (Ren, 2000).

The major buyers of the products of the meal box industry are primary and secondary schools and companies. The unclean equipment and utensils, as well as negligence during the procedure of processing, preservation, and transformation of food, often cause problems. Without self-discipline, efficient sanitation management systems and imperilment management systems, no companies can assure the quality and safety of food.

In 2000, the Department of Health issued the *Good Hygiene Practice (GHP)* as the common standard for the food industry based on *Article 1, Chapter 20 of Food Hygiene Control Law*. This led to the establishment of *Hazard Analysis Critical Control Point (HACCP)*, the quality assurance system. Compared with other statutes, *HACCP* was stricter, more cautious, and more practical. Better methods and procedures of food safety and product management resulted after comparing possessing procedure plans based on *GHP* regulations with the product plans based on *HACCP*.

The control of inefficiency reduced the possibility of potential cross-contamination during

the procedures of lunchbox. Cross-contamination might cause a massive scale of food poisoning, the impact which is beyond levels of estimation. The protection against cross-contamination caused by staff during logistics is difficult. The contamination of pristine work areas, unsmooth of staff streamline, and management's failure to comprehensively implement food safety procedures are the main reasons for this cross-contamination. These demonstrate the imperfection of hygiene management, reduced production efficiency, and result negatively on the products.

The inadequate use of space within lunchbox factories and the inappropriate arrangement of streamlining raise the cost, as well as obscures the hygiene safety control of the factories. The procedures of lunchbox production, from raw materials, cooking, packaging and transportation, are complicated, often leading to the cross-contamination. Inadequate supply control facilitates the rapid reproduction of microbe, even food poison. From 2001 to 2005, the number of cases of food poison caused by contamination and misplacement in Taiwan rose from 67 to 146. The number of cases of food poisoning in schools rose from 7 to 27 (Department of Health, 2003). All these data illustrate that the introduction of food safety control systems did not eliminate the possibility of food poison. The imperfect implementation of *HACCP* is the focus of this research.

### **Purpose of the Research**

The efficient establishment and implementation of a hygiene safety control model for the meal box industry relies primarily on the hardware layout and upon the management of software for improved assembling. The stipulation of procedures must conform to local situation and the determinations of control are subject to space of factories and actual implement. With the help of Plan, Do, Check and Action (PDCA, new problems appear so that

improvement can be reached giving birth to the well implemented food safety control system and formulation of suitable regulations for the lunchbox industry. The research focuses on the establishment of safety controls of the meal box industry with the emphasis of establishment of hardware.

## **LITERATURE REVIEW**

Chapter 20 of the *Food Hygiene Control Law* issued in Taiwan ordained that food producers of production, procession, preparation, package, transportation and stock, sellers as well as the locale of food additive, equipment and food guarantee systems, should abide to GHP enacted by the Central Government. The Central Government announced the sorts of food that should closely conform to regulations of food safety control. The regulation included articles on GHP and *HACCP*. Articles on GHP have been issued on 7th September, 2000. The stipulation of food safety control offers control and safety standards to food producers during production and logistics periods. Currently, Taiwan is making efforts aimed on entering WTO and catching up with the trends of future international business, so it is urgent to decide how to assure food safety during production, procession, transportation and sell periods so that to assure the health safety of customers.

HACCP food safety control systems have reached some achievements as the promotion world widely. Countries such as: Taiwan, America, Canada, British, Germany, France, Chile, Peru, Denmark, New Zealand, Australia, EU countries, Malaysia, Thailand, Japan, Cuba and Argentina have adopted this system. It is well known that *HACCP* has been used widely in food safety control, determining the best methods to assure food safety. The establishment of this system should consider not only the dynamic hardware equipment, but also the influencing factors of CCP validation and verification. From the customers' perspectives, this system aimed

to raise food safety so that there were more guarantees to meet international business standards.

As *HACCP* was widely adopted in many countries, in Taiwan only the meal box industry and some parts of the food and beverage service industry implemented this system. When efforts are made to enter WTO, more industries will need to adopt this system. Under this situation, further research is needed on the analysis of *HACCP*'s experience worldwide so that more industries will adopt this system. The literature review of Taiwan determined that only Chen (1997) introduced and analyzed the experience of *HACCP* in America, Britain, Canada, New Zealand, Australia, EU countries, Cuba, Thailand, and Malaysia.

The following are the introduction of international promotion of implement HACCP:

1. In 1973, the USA enforced the implement of *HACCP* in Low Acid Canned Food Production Standards;
2. The Ministry of Maritime Affairs and Fisheries of Canada enforced the implementation of *HACCP* in their aquatic products processing industry;
3. On April 1994, the Ministry of Fisheries of Chile brought *HACCP* into line with its Export Aquatic Product Hygiene Safety Control and announced the implementation of *HACCP* from March, 1997;
4. The amendment of law in Japan during May, 1995, brought *HACCP* into line with their new legal provisions of food control. It was named *Admitted Comprehensive Hygienic Requirements of Production* and was first implemented from dairy foods and meat industry. During the same year, the UK Ministry of Agriculture, Fisheries and Food (now DEFRA) amended *Food Safety Law* which stipulated that the producers of food must operate systems equal to *HACCP*. France announced many regulations related to food and hygiene control and issued the *Food Safety and Ban* law. At the same time

positively promoting the operation of *HACCP* and *ISO9000*;

5. Based on the order of President the USA Department of Agriculture issued the *New Food Safety Test Regulation*. From January 1998 to January 2000, promotions to implement the *HACCP* were carried out on the size of factories. Canada Department of Agriculture, in the same year, promoted the implement of *HACCP* in slaughtering, processing of meat and dairy food on the basis of Strengthen Food Safety Program;

6. The Federal Ministry of Health of Germany issued the National Food Regulation Rules on January 1997. During the first year of operation, inspection regulations of *HACCP* were carried out, the initial program was processing of dairy food and meat.

7. In December, 1997, the FDA of the USA enforced the *HACCP* in fisheries. On July 1993, the EU proclaimed that all fishery processing factories (including mother factory) had to adopt *HACCP*;

8. The WTO ordered that rules related to food must conform to regulations of AO/WHO Codex Alimentarius Commission. The new Codex recommended that governments should establish, based on *HACCP*, an international guided outline;

9. APEC made efforts to stipulation, for the aim of trade liberalization, a mutual certification system of food among countries on the basis of *HACCP*; 10. During the second FAO/WHO Global Forum of Food Safety Regulators held from 12<sup>th</sup> to 14<sup>th</sup>, October, 2004, the officers from Thailand proposed the encouragement and urged the implementation of *HACCP* in industry and business departments.

## **RESEARCH DESIGN**

The research focuses on eight selected lunchbox producers in Kaohsiung city, Kaohsiung County and Pingtung County, all of which have received the previous counseling

held by the Department of Health. The eight factories are named

A、B、C、D、E、F、G、and H separately for convenience of research.

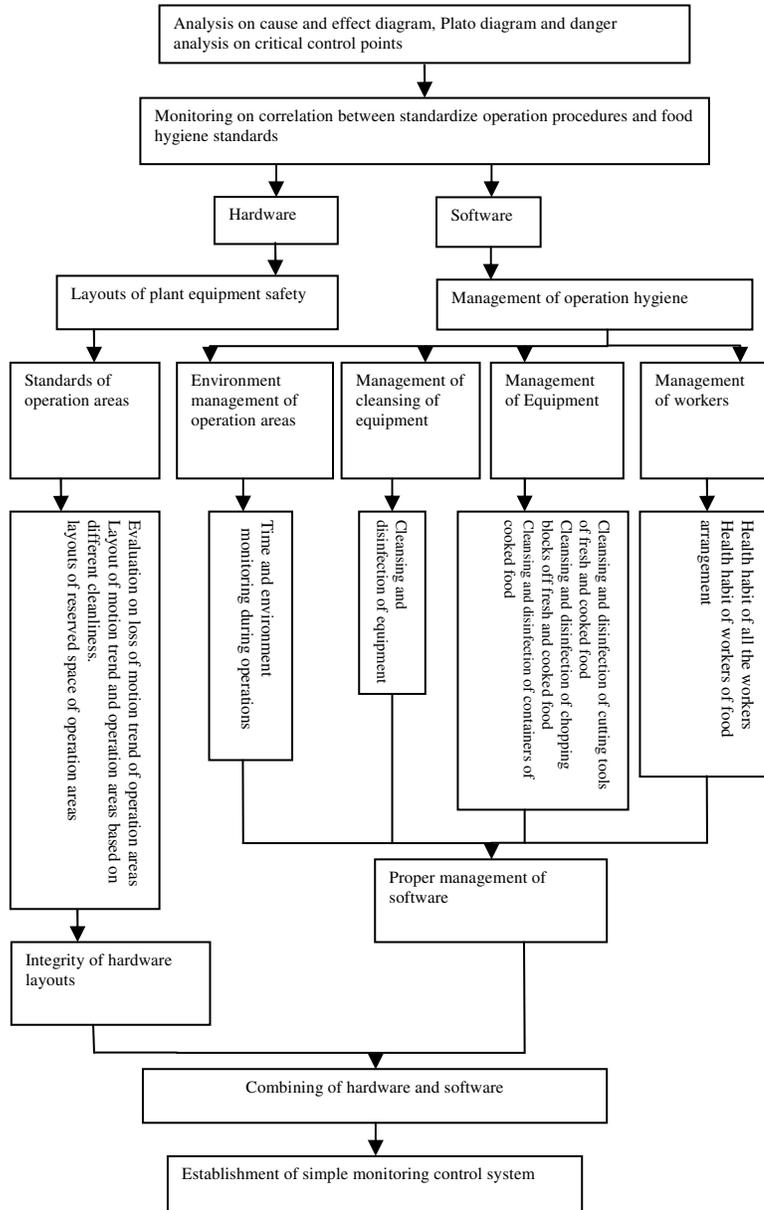
### **Content of Research**

The research focused on the following: (a) The design and analysis of a cause and effect diagram was used to research the reasons of potential problems. The diagram was the basis of GHP and the observation of filed operations; with the use of a fishbone diagram, one method of QC which included seven methods, to analyze the potential deficiency during processing in order to provide reference standards to hardware layout and management of software. Analysis of the Hardware plan included: 1. After the estimate and observation of eight lunchbox factories, figure out their advantages on hardware and make analysis on the weak points of streamlines, arrangement of workshops and environmental layouts of plant areas so that basic standards of food hygiene regulations are to be met; 2. Design different factories structures and plant simulated diagram and make analysis on advantages and layouts of motion trend and usage of space so that optimal arrangements of different factory structures and plant areas.

### *Research Frame*

The research and analysis on health safety independent management on meal box industry was initially based on observation according to GHP. Next was analysis of critical control point and a cause/effect diagram with the support of standard production procedures and monitoring correlation with food hygiene regulation, by the method of field observation, layout and establishment of applicability are made on the sub-perspectives of hardware: operations standards of working place, management of working place environment, management of cleanliness of equipment, management of plant and management of loss of workers. After the integration of hardware layout and proper software management, the

combined hardware and software design is reached and a simple execution monitoring management system was established.



- PCA detection of operation environment
- ATP detection of sanitary of equipment surface
- ATP detection of cleansing and disinfection of chopping blocks off fresh and cooked food
- ATP test on cooked food containers and detection test on amyllum and grease residues. Test on hand before operation and gloves after operation

## **CHARACTERISTICS AND ADVANTAGES OF IMPLEMENTING HACCP**

### **Characteristics and Advantages of HACCP**

The implementation of *HACCP* emphasizes process monitoring, rather than traditional management system of afterwards remedial, named product inspection. Thus, when applying *HACCP*, one must understand thoroughly and master the essence of potential dangers of production so that safety strategies can be formulated to assure the safety of products.

The model of *HACCP* relies on the appropriate judgment and the analysis of health ailments caused by food pollution. After understanding the possibility and potential danger, an accurate danger analysis can be conducted. Based on these analyses, dangers may be controlled or eliminated during each step of food production. Right judgment regarding location of critical control point of control and management are made, followed by the establishment of efficient monitoring methods of CCP. According to the order of seven principles, continuous fully monitored management was made. Due to the food safety reliance offered by *HACCP*, it can be used as the acknowledged international food management standard.

To standardize the order of foods, governments have made various laws and regulations. Just as different national conditions exist, so it is that food management standards are also different. Thus, disputes often occur in the international food business. As a result, cheap but good products from developed countries and products with relative lower quality than those of Taiwan are imported with the gradual loosening of trade. The importation of these two qualities of food has impacted food safety and the food industry. Therefore, the Department of Health, which in charge of Taiwan food safety, has already counseled producers to operate the preventive self-management system of HACCP. The ultimate purpose is to establish the compliance estimate system of hygiene and safety of food in Taiwan, to promote the mutual certification and

test system of food, to advance its function to reach the international standards for the convenience of international cooperation and exchange of safe and clean food products.

## **The Comparison of Hygiene Management of Traditional Food Factories and HACCP System**

### ***Traditional hygiene management system.***

The main management method was testing final products. This expensive method costs lots of time and man power. Before the results of tests can be reported, products may be consumed which may be harmful to public health. When the problems of food hygiene come out, products have to be recalled and treatments have to be operated which raise the cost of producers and negatively impacts a business' reputation. Though problems can be tested from final products, procedure and the sites of contamination cannot be judged. It is difficult for post remediation to prevent the same problems in produce procedures and to eliminate the dangers.

### ***HACCP management system.***

The *HACCP* Management System is a comprehensive management system. The test of final products can offer some support to affirmance. This system can not only save manpower and costs, but also optimize resource efficiency. It is very efficient in controlling and preventing food poison caused by microbiology contamination. The harm estimation analysis reveals that by clarifying important management procedures, the safety of the products can be ensured. This is also the early prevention management system which can efficiently prevent dangers caused by food. The *HACCP* self management system varies according to sorts and differences between hardware and software of food factories. Due to the assurance of food safety, it could be used as the standard for international mutual food certification.

The analysis of this research showed that *HACCP* is a self management system relying on

early prevention system, rather than the remedial measures of testing products, to assure the safety of food. There are three advantages to using *HACCP*: a) It can prevent from food contamination and food poison cases beforehand; b) It can make full use of manpower and resources and lower cost; c) It can assure the quality of safety and improve the management of food industry.

### ***Hardware Layout of Self-Management Systems of Producers of Meal Box Industry***

Based on GHP, food production sites at eight factories were studied. The loss was estimated by causality based on a fishbone diagram, one of seven methods of QC, as illustrated by diagram 2. The influences on product quality, of products in processing procedures, raw materials in procedures of preparation, packaging, and transportation were analyzed from hardware and software perspectives. The initial part was focused on the influences of the hardware.

### ***Estimate of Hardware Layout***

The estimate focused on the hardware layout of meal box factories so that the layout could meet basic requirements of operation standards and food safety standards. The important point of hardware layout was to design according to different arrangement of factories and plant areas, including layout of reserved space of different factories and plant areas. The comparisons of different space design of different factories, of motion trend arrangement, of evaluation on advantages and disadvantages of space around plant and of rational layouts of collocation of factories and plant lay the foundation of establishment of different optimal hardware layouts.

### ***Hardware Layout***

The research was conducted on factories which had received the early counseling and certification on food safety management system issued by the Department of Health. The

factories were identified as A, B, C, D, E, F, G and H. After the observation of production, operation space and equipment in site, and summarized the advantages and disadvantages of motion trend, different optimal arrangement models were established to meet different disadvantages and for the purpose of prevention. The hardware layouts included the followings: a) The scope of layouts involved food logistics factories; b) there were different plant structures, the key points in designs were divided into square, rectangle and multi-storey buildings; c) For the environment of plants is different, the design of reserved space are divided into peripheral design, triangle design, bilateral design and frontal space design; and d) The evaluation of advantages and disadvantages and operation practicality of in site should also include influences of men, atmosphere, logistics motion trend and peripheral environment based on different plant structures.

### **Establishment of Hardware Layouts**

#### ***Inner layouts of meal box factories.***

Meal box factories can be divided into the operation zone, the quasi-clean operation zone, the clean operation zone and the non-food product operation zone, based on cleanliness as the basic division of operation areas. There must be effective areas isolating different operation zones. Processing equipment is distributed to different operation zones according to different process procedures. The layouts of arrangement of basic equipments are as following: a) General operation zones: raw material storage, operation zones of raw material, cold storage, cleaning areas of inner packing vessels (the export processing area should be in control area.; b) Quasi-clean operation area: manufacturing areas, cooking areas and inner packing preparation area;

c) Clean operation area: packing area and temporary storage area; and d) Non-food operation area: quality test areas, locker rooms, hand washing and disinfection rooms, administration rooms and lavatory rooms.

### **Layout of Motion Trend of Meal Box Factories**

The standards of motion trend division are based on works of factories. People flow, air flow and water flow should be from clean operation zones to quasi-clean operation zones and finally to general operation zones. Logistics should be from transfer areas to general operation zones, to quasi-clean operation zones and finally to clean operation zones.

### **Differences of Hardware Layouts of Different Meal Box Factories**

#### ***The estimate of operation area and plant structure.***

Different factories have different layouts on operation zones and plant structures. After the observation of eight factories, there are seven factories (A, B, C, D, E, F, G, H) that have adopted rectangle operation zones and the plant structure. Plant F adopted a square operation zone. On equipment perspective, the essence of each factory is the same. The rectangle operation space was not fully used; it was a quasi-clean operation zones of B, C, took up more than 40% total space for the purpose of cooking. General operation space takes up about 20% for food processing area. The observation reveals that the daily productivity of two factories is more than 4000 meals. Different raw material in the pretreatment areas cannot be differentiated due to large amount of treatment on raw food material. Cross-contamination was easy to happen among different raw food material. Clean operation zones of G and H took up more than 40 percent of the total space for the purpose of package. The general operation zones and quasi-operation zones took up 30 percent of the total space for the pretreatment and cooking. The observation revealed that the daily productivity was approximately 3,000 meals. During the operation, the

raw food material was transferred to prevent cross-contamination, from general operation zones to quasi-clean operation zones. Due to limited space, different food materials were overlapped, leading to the increased possibility of cross-contamination. Operation zones of A and F were equally divided. The observation showed that the day productivity of these two factories were between 3,000 to 4,000 meals. There was no cross-contamination neither during logistics flow nor man flow. General operation zones of D and E took up more than 40 percent for the food processing zone. Observation showed that day productivities for these two factories were between 400 and 1,300 meals. Due to low daily productivity, no observations showed that there was no cross-contamination caused by logistics-flow and man-flow. Thus, it was difficult to make a judgment.

***Estimate of motion trend of operation.***

The layouts of man-flow of A, B, C, D, E, G and H showed that there were entrances and exits in each operation zones. But entrances and exits of motion trend were the same which meant there must have been a one-way control system so that the motion trend was carried out. The observation showed that it was comparatively easy to control motion trend in hygiene government and so that it met GHP standards and prevented cross-contamination. The layout of the man-flow of B and F showed that the motion trend was unsmooth as workers had to pass quasi-clean operation zones to arrive general operation zones.

Prevention, the one-way control, should also be utilized to avoid cross-contamination. As there were one-way control systems in different operation zones, workers of A, C and G had no freedom to go in and out. The transfer gates were, for the convenience of work, lifting gates. The lifting gates were used as walkways to different operation zones leading to cross-

contamination of man flow, logistics flow, and air flow. The transfer gates of B, D, E, F and H were designed as downwards doors or photoelectric sensor auto-doors so that there was limited freedom to come and go. This design separated man-flow, logistics flow, and air flow which also met GHP standards to reach the purpose of prevention of cross-contamination and implementation of one-way control.

The layouts of logistics motion trends revealed that all factories put general operation zones and test zones together. GHP standards on food production clearly stipulated that, to prevent cross-contamination, there must have been separation between the purchase time and the operation time. The observation showed that all factories violated the standards and there was no separation between purchase time and operation time. This resulted in potential dangers during purchase procedures. It was highly recommended, that to prevent cross-contamination, there should be separation areas between the general operational zones and the test areas. During the shipment, A's vehicles failed to reach buffer areas and clean areas, resulting in products that were exposed to outer place of factories. More labor was needed to meet transportation, productivity was lower and there was the possibility for cross-contamination. Vehicles of B, C, D, E, F, G and H reached buffer areas and clean areas during shipment. These factories reached the standards of GHP and prevented cross-contamination. Besides, layouts of air flow of each factory met standards of GHP. However, the observations showed that the doors of each factory were not always closed, leading to negative pressure environment of operation zones.

### ***Estimate of Difference of Hardware Layouts***

The comparison of different hardware layouts of factories showed that F made full use of operation space and the arrangement of equipment was appropriate without too much wasted

space. The design of walkways for airflow was in the shape of  $\Gamma$ . The entrances and exit doors were placed according to different cleanliness operation zones. The motion trend was comparatively more smooth and more feasibly. Walkways of  $\Gamma$  shape were easy for control. The entering of operation zones were omitted when the hygiene controllers wanted to monitor online production. Meanwhile, it helped to implement control and prevented cross- contamination. Layouts of man flow of C, D, E, G and H place entrances and exits in different operation zones. As these entrances and exits were the same, a one-way control door was needed to prevent cross-contamination. Observation showed that there was no cross-contamination from different operation zones when separate entrances and exits were used. Apart from that, the separation of facilitates the establishment and instilment of operator concepts. However, preventive one-way control and training was needed. The layouts of logistics of eight factories combined general operation zones with test zones. However, as the standards of GHP on food products clearly stipulated that to prevent cross-contamination, the purchase time and operation time must be separated. The observation showed that all factories did not carry out the separation of purchase time and operation time. There might have been bacteria or pests hidden in the outer package of raw food material. Bacteria might also have hidden in the raw food material itself which may cause the pollution of treated products, cross-contamination occurs. The failure of A's vessels to reach the buffer area or clean gate during shipment period caused the product to be exposed to outer places of the factories, more labor to meet transportation, low productivity and the impossibility of prevention of cross-contamination. Vehicles of B, C, D, E, F, G and H reached buffer areas and clean areas during shipment which prevented cross-contamination and increase daily productivity.

## **CONCLUSIONS AND RECOMMENDATIONS**

Using a cause and effect diagram, the research made an analysis on the loss of operation for both hardware and software. This aimed at the proposal of prevention measures which will result in the improvement of hardware and software. On the basis of GHP standards, the research established operation procedures and the relationship with GHP. The aim of this research was to offer reference to establishment layouts on introducing food safety control system in meal box industry.

Regarding the hardware layout perspective, rational layouts based on different plant structures and arrangements of factories were made. Also, these layouts could be used as the reference to the establishment of factories and improvements on hardware layouts. In the software layout perspectives, utilizing the ATP hygiene monitoring system, the first test was made on cleanliness, residue detection on amylum, and grease in order to determine the loss in operation of both authenticated and unauthenticated meal box factories. Based on the analysis of loss, improvements were offered and prevention measures were established. Furthermore, offering reference for practical operations, optimal factory inner hygiene management systems were established.

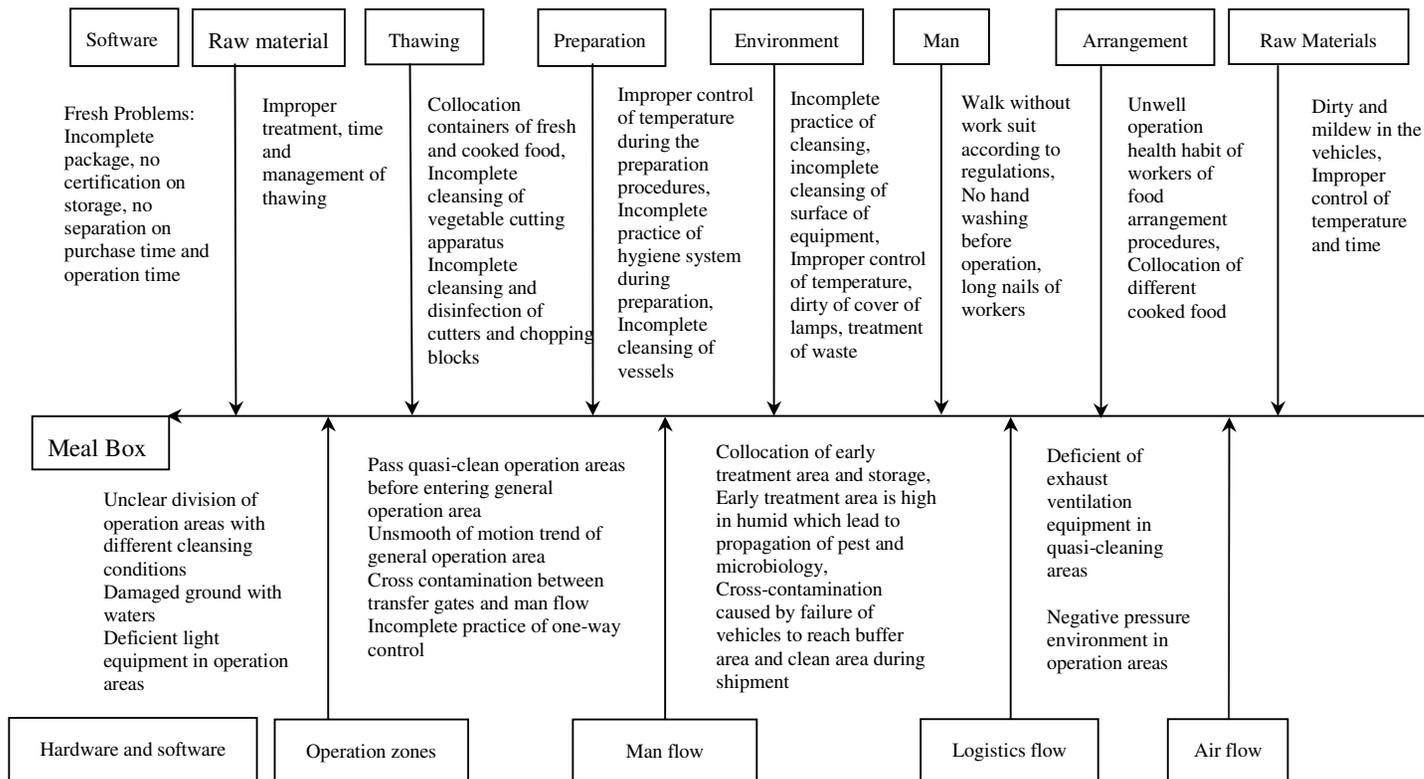


Figure 2. Cause and Effect Analysis of Procedures of Meal Box Industry

## **Management of Hardware Layouts**

(a) The layout of meal box factories in a square shape was a better utilization of space, motion trend (man, object, air and water flow), arrangements of equipment, and management control systems as compared to rectangle shaped and multi-storey shapes. It had the advantages on prevention food cross-contamination. However, training and one-way control systems needed to be completed.

(b) The utilization of reserved space around factories, compared with triangle shaped, bilateral shaped, and the former one, was better. It could be used together with other different meal box plant structures. To prevent cross-contamination it made up the disadvantages of unsmooth operation lines. For rectangle shaped plant structures, it was highly recommended to combine with those in a triangle shaped and frontal reserved. This made up the disadvantages of un-smoothness caused by the location of factories and other natural factors.

### ***Cause and Effect Analysis of Procedures of Meal Box Production***

The cause and effect analysis revealed the reasons for the occurrence of dangerous programs. The control measures should be made on the basis of SOP. For CCP, it must be established on the basis of SOP with the analysis of product danger caused by the procedures of making raw material into products. With rapid speed in testing, it could efficiently control danger. The analysis of loss in hardware is of eight factories revealed that the separation of

different operation zones was unclear, motion trend was unsmooth, and one-way control could be carried out. During processing procedure, equipment and different raw food material should be indicated, so that further tests and evaluations could be completed. This could be used as a reference governmental control of producers. Operation environment, plant, cleanliness of equipment, disinfection, prevention of bacteria vector should be further tested and their implement situation should be evaluated. This should also be provided to producers as the reference of control and government. Make more evaluation on cleanliness of hand, pollution of gloves, the wear of work suit, caps, masks and the nail cutting of operation workers and food arrangement workers should be offered as control standards to producers. Transportation vessels should be cleaned daily with chlorine water containing available chlorine content more than 200ppm to assure the cleanliness and prevent pollution caused by mildew.

### ***Control of Software***

(a) The data of cleanliness and bacteria number in the air of eight factories met the requirements of GMP. The entrances and exits of operation areas and transfer equipment should stay closed at all times to assure the cleanliness of environment of operation areas.

(b) The tests of equipment of entrances and exits of operation areas, named manual sensing equipment, cleansed three times showed that the detection value on cleanliness of all the equipment was bigger than 1, 500RLU. This meant that the equipment was hard to clean and

producers always forgot to clean it which caused the propagation of microbiology. Thus, it was highly recommended that to prevent cross-contamination, producers must use before and after produce procedures, and the use ethanol to strengthen the disinfection process. .

(c) There was 58 percent transfer equipment on different operation areas with detection value larger than 1,500RLU. This meant that it was easy to neglect cleansing. Thus, it was highly recommended that to prevent cross contamination, it should be cleansed and disinfected daily after operation. There were 68 percent transfer equipment between the quasi-cleaning area and the cleaning area with detection value on cleansing larger than 1,500RLU. That was obviously more than between the general operations area and the quasi-clean operation with detection value of cleansing bigger than 1,500RLU taking up 64 percent. This also meant that the possibility of cross- contamination on this point was comparatively high. Thus, it was recommended that to prevent food cross contamination, during the transfer of cooked food from one location to another, the dish should be covered.

(d) There was 32 percent food arrangement equipment with detection value of cleansing larger than 1,500RLU. This meant that the equipment had failed to be thoroughly cleansed and disinfected. It could be inferred that there was still water left and the food arrangement equipment was not thoroughly dried after its use, which lead to the propagation of microbiology

and mildew. It was highly recommended, to prevent the cross-contamination, that before use, it should be disinfected by ethanol.

(e) There were 65 percent cutters and chopping blocks of fresh food with detection value of cleansing larger than 1,500RLU. This meant that the cleansing and disinfection were not thoroughly cleansed. Thus, it was recommended that, to reach the aim of disinfection and dry, after the use of cutters and chopping blocks, they must be washed and placed on shelves or cleansing boxes for cleansing. Ethanol could be used when it was necessary to strengthen the effect of disinfection. Chopping blocks should be regularly disinfected with chlorine water containing available chlorine content more than 200 ppm.

(f) There were more than 46 percent cutters and chopping blocks of cooked food with detection value of cleansing bigger than 1,500 RLU, which was lower than those of fresh food. This meant that the separation of fresh and cooked food was well done by producers. However, there was a rising trend on numerical value on the cleansing of chopping blocks. This indicated that there was a need to strengthen the management of cleansing and disinfecting the meal box factories' chopper blocks.

(g) The containers of cooked food should be cleansed, disinfected, dried after use to prevent secondary contamination. Thus, it was highly recommend to practice disinfection

according to standards of GHP. There are 42 percent containers of cooked food with residue of grease, especially those containers in pore shape, containers for dishes, soup, and cooking spoons. The numerical value of residue of grease was larger than 63 percent. This meant they were hard to be cleansed. Thus, it was highly recommended, that to prevent cross contamination, more attention should be paid on container cleansing.

(h) Among workers who, before operation, washed their hands there were 39% workers with detection value of cleansing smaller than 1,500RLU; 22% workers with detection value of cleansing between 500 and 1, 500RLU; and 37% workers with detection value of cleansing bigger than 1, 500RLU. This indicated that not all the workers washed their hands or had long nails trimmed. Thus, it is highly recommended that regular training should be offered to widen workers' knowledge, and to improve their attitude and behaviors.

(i) For the cognition of the workers regarding food arrangement procedure, the detection value of cleansing of D's workers was obviously low. Those engaged in high pollution works washed and disinfected their hands and changed their gloves. This meant that to prevent cross-contamination, hygiene procedures should be carried out after high pollution tasks.

The primary point of self management system on hygiene of producers of meal box industry should be hardware layouts and hygiene control on software. Rational motion trend

should be the primary factors directly influencing the implement of self control hygiene system.

However, the knowledge and training of workers should be the most important factor influencing the implement of self control hygiene system. The stipulation of on site standards must be based on the actual practice of meal box produces. The situation is the same with the establishment of limits of control. By way of PDCA, hygiene quality could be raised reducing safety problems for the meal box industry. That would assure quality products and positively impact the business reputation of the industry.

The achievement of hardware layouts of this research offered references on the preparation and establishment of factories and the improvement of hardware layouts. It was helpful for the arrangement of motion trend and the operation of hygiene control. In the establishment of software control, after knowing and evaluating the loss of online operation of meal box producers, some controls beyond practice were determined for the purpose of real-time control.

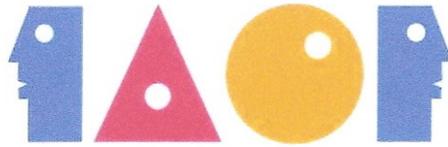
The research adopted ATP HQL to test the numerical value of cleansing, to estimate the corresponding number of bacterial in RLU, and to make limits on the scope of cleansing. This gives directions on future studies.

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**CONTEMPORARY HUMAN RESOURCE MANAGEMENT ISSUES AND CONCERNS  
IN THE HOTEL INDUSTRY: IDENTIFYING THE PRIORITIES**

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**ABSTRACT**

This article reports on a study which explored the views of managers in the hotel industry in Taiwan as to the most important issues in human resource management (HRM) in their industry. The results suggested that most participating hotels are focused on dealing with the day-to-day operational challenges, such as shortages of appropriately skilled staff and employee turnover. While they perceive these issues as significant and challenging, they were mostly inclined to view these as ‘facts of life’ in the industry, rather than offering more fundamental and strategic solutions for dealing with them. This study concludes that the current and emerging challenges facing the industry in Taiwan demand an approach to HRM which is far more strategic than the traditional focus on personnel administration; and that HRM has a key role to play in creating and sustaining competitive advantage in organizations. However, this will require a significant shift in the caliber of thinking about HRM at executive level.

**Keywords:** Human Resource Management, Hotel Industry, Taiwan

## **INTRODUCTION**

The importance of human resources to business success in any context has been widely recognized. Richard and Johnson (2001) are among the many who argue that human resource management strategies impact on an organization's overall effectiveness, and that the effective utilization of human resources can give an organization a competitive advantage. The importance of human resources is particularly significant in a 'people focused' industry, such as hospitality. Duncan (2005) suggests that there are eight main areas of challenge and concern in the global hospitality industry and that the most important of these concern people and employment.

Rather than adopting a 'single issue' perspective in the investigation, this study has attempted a broader perspective and intended to be more inclusive in the range of issues covered. This study explores the way managers are thinking about contemporary HRM issues and concerns in the context of the hotel industry in Taiwan. It provides insight which should be helpful for hoteliers, enabling them to compare their perspectives and opinions with the aggregated data and relevant literature. Hopefully, it will encourage them to consider more strategically and systematically the things they can do to more effectively position their HRM efforts.

### **HRM Issues In The Hotel Industry Globally**

Employee turnover has been one of the biggest concerns in the hotel industry for a long time (Hinkin & Tracey, 2000). The hotel industry globally suffers from high staff turnover levels, which is a pervasive and serious problem resulting in high direct expenditure as well as intangible costs (Cheng & Brown, 1998; Hinkin & Tracey, 2000). Hinkin and Tracey (2000) suggested the indirect costs related to turnover account for more than half of the total costs involved in turnover. Simons and Hinkin (2001) contended that employee turnover is more costly for luxury hotels than for lower budget hotels, due to the more sophisticated operating and training systems of the former.

There are many different factors that impact on turnover rates. Riegel (2002) argues that turnover is the consequence of a complicated series of dynamics, which include the obvious ones of job dissatisfaction and limited organizational commitment that influence employee attitudes and ultimately affect employee behavior. Mobley (1982) suggested that the reasons for turnover in general include dissatisfaction with work; availability of attractive alternatives; external factors like housing, transportation, or physical environment; and personal factors like illness or injury. Hinkin and Tracey (2000) added poor supervision, a poor working environment, and inadequate compensation to that list. They further suggested that some managers do not understand the relationship between employee retention and company profitability, and accept turnover as a necessary evil.

The issue of turnover has attracted many researchers' attention in different countries. Powell and Wood (1999) suggested one of the most significant problems in the hotel industry worldwide is 'brain drain', because the skills and qualifications gained in hotel sectors are easily transferable to others. Cheng and Brown (1998) explored the views of HR managers on the strategic management of employee turnover in medium-to-large hotels in Australia and Singapore. They suggested that the most effective mechanisms for minimizing turnover are initial recruitment and selection. They recommended a greater focus on internal recruitment and development, which create career path options, as a means to reduce staff turnover levels. They also noted induction and socialization that effectively acculturate newcomers into the organization; and training and development that demonstrates the willingness of an organization to invest in people which in turn lead to an increase in employees' commitment and job satisfaction.

At a more fundamental level, Iverson and Deery (1997) investigated 'turnover culture' in six five-star hotels in Melbourne, Australia and suggested that the hotel industry has actually created a turnover culture, where there is a normative belief in the legitimacy of relatively high labor turnover. This point has been subsequently endorsed by Hinkin and Tracey (2000). Iverson and Deery suggested a strategic switch to promoting a permanent employment culture and developing an internal labor market to reduce the growth of a turnover culture. They advocate

that managers need to improve communication channels and highlight the organization's aim for long-term employment during induction programmes, and also need to develop career path programmes in order to increase employee commitment and the retention of trained and qualified employees.

In the Asian context, Zhang and Wu (2004) noted that among human resource challenges facing China's hotel industry, high staff turnover rates constitute one of the key issues. Many employees regard hospitality work as a pass-through to a job in a higher level industry, instead of a life-time career commitment. Zhang and Wu suggested that low morale and motivation levels are critical contributory factors to high employee turnover and that developing effective retention strategies is imperative to solve this problem. One of the approaches they suggested is selecting a successor as each employee is promoted, as a way of encouraging both the organization and its staff to think longer-term, in terms of mutual commitment.

In Taiwan itself, Wu and Chen (2002) conducted research on the labor requirements of the hospitality industry and confirmed that the high turnover rate is one of the most difficult issues in human resource management in that context. They reported that the turnover problem in large hotels was much worse than in small hotels. Many hotels are planning to increase the number of people employed simply to cover the turnover situation.

Besides the turnover issue, service quality is another critical concern since hotels are a service-oriented industry. The delivery of hotel service to customers primarily involves personal contact and so the relationship between HRM effectiveness and customer service is likely to be very strong (Boella & Goss-Turner, 2005). Hoque (1999) argues that service quality focuses on the nature of the interaction between the individual employee and the customer at the point of service, in terms of politeness, and overall professionalism. Hoque also contends that service quality is the main factor in creating competitive advantage in the hotel industry, and that any hotel that does not endeavor to continually improve its service quality will lose ground.

Competitive advantage generated from internal sources includes such characteristics as value rareness, inimitability, and non-substitutability (Kim & Oh, 2004) , and the employee at the end of the service delivery system may well be the only differentiated and unique asset of a hotel organization which cannot be easily copied.

Hinkin and Tracey (2000) have suggested that there are in fact only two ways to compete and differentiate hospitality services. One is by competing on price and minimizing costs, which locks a hotel into a particular market segment. The other is to compete by providing exceptional service. They note that customer care is not a new concept in the service industry, but it is still a complex thing to control and sustain. In the face of the high level of turnover in the hotel industry, it is possible that some customers are served by staff who are relatively untrained, less

committed and less capable in their social skills. But dealing with this requires the use of quite systematic approaches to service quality management. Boella and Goss-Turner (2005) suggested that if an organization's first and foremost objective is to provide a service, a holistic approach to service quality management must be developed and employed, infiltrating all levels of the organization from the chief executive to the entry level employees. The employees must be selected, trained properly, and continually motivated to be committed to the service quality strategy as a part of the organization's business strategy.

Employee turnover and service quality have been identified as the major issues of HRM in the hotel industry globally. The main purpose of the study reported here was to investigate the major HRM issues and concerns in the hotel industry in Taiwan, and to compare them with those that are distinctive for the industry across the world.

## **METHODOLOGY**

Due to the limitations of time and cost, it was not possible to contact all the hotels in Taiwan. The major focus for this research was the chain hotels because they account for the largest market share of the lodging industry globally (Angelo & Vladimir, 2004) and dominate the four to five star hotel market (Timo & Davidson, 2005). Their economic impact, as a group, is therefore significant. At the time of writing, there were eight international hotel chains and nine domestic hotel chains, owning forty-six hotel properties in Taiwan.

The methodology used in this research was qualitative, using in-depth interviews. The characteristics of such qualitative research are exploratory and descriptive (Creswell, 2003), creating a data set that is not possible to obtain through written questionnaires and surveys. While there are few definitive rules for sample size in qualitative inquiry (Patton, 2002), it has been suggested that twelve to twenty examples are needed when trying to obtain the broadest range of information and perspectives on the subject of study (Kuzel, 1992). Twenty-eight hotels were approached and fourteen hotels participated in this research. The sample selected totaled 14 hotels, which represents 30.43 per cent of the total population of such hotels.

The respondents were asked three questions: What are the main human resource management issues confronting the hotel industry in Taiwan currently and for the foreseeable future? What are the human resource management issues which are most front-of-mind for your particular hotel? What are the drivers or causes of these human resource management issues? Findings from this study are presented together with interpretation and commentary offered to compare the themes raised in this study with those identified in the literature.

## **RESEARCH FINDINGS**

These three questions were asked separately but the findings are presented together because several issues were common to all and were identified as having cause and effect relationships. Five HRM issues are presented in order of the frequency with which they were

identified by fourteen participating hotels, namely shortage of suitable employees (100% of the respondents); shortcomings in approach to training and development (64% of the respondents); difficulties with internship employment (50% of the respondents); high levels of employee turnover (50% of the respondents); and the effective use of outsourcing, dispatching, flexible, and casual employment (50% of the respondents).

### *Shortage of Suitable Employees*

Respondents pointed out that as the overall average of education level has risen significantly in Taiwan in the last decade, it has resulted in more and more difficulty in recruiting entry level employees. In the past, it was common to receive many applicants for entry level positions which enabled hotels to select the best employees among the applicants. Currently, however, students with a bachelor degree are not enthusiastic to do the entry level jobs because they regard these service and housekeeping jobs as low level. Instead, this young generation tends to pursue high-tech or fashion industry jobs which are seen as leading to appealing careers.

The fact that the hotel industry has grown significantly in the past decade has exacerbated the problem of employee shortages. Among forty-six chain hotels, nearly fifty per cent of them were established within the last ten years. The speed of hotel establishments opened has also exceeded the speed of employee development. Once a new hotel establishment opened, many people have been 'job-hopping' to pursue a higher level position. In the long term, it is feared

that the demand for entry level employees will exceed the supply to the extent that this will cause a crisis in hotel operation and management.

At middle management levels, respondents believe that while there is not a shortage of people available to do those jobs, their qualifications, competences and capabilities have not kept up with the requirements of the positions they hold. Assistant Managers are promoted to be Managers, or Managers are promoted to be Directors simply because the vacancy needs to be filled, rather than because the person has the skills or qualifications needed. These managers have not accumulated sufficient training and experiences during their 'job-hopping', so that their management proficiency is very limited, ultimately resulting in a shortage of managerial skills in the hotel industry. Respondents predict that it will be more and more difficult and challenging to recruit and that 'grabbing' talented individuals will be characteristic of a very competitive demand situation.

#### *Shortcomings in Approaches to Training and Development*

Due to the shortage of appropriate people, hoteliers are often forced to recruit employees simply to fill in a vacancy without considering the background of the applicants. And while some employees may have a hospitality educational background, what is learned in education is too theoretical to be applied in a practical industry setting. Even when employees are from within the industry, they may not be well trained during the 'job-hopping' and their level of competence

may be limited. Each hotel also has different Standard Operating Procedures (SOP) which makes re-training necessary. These problems highlight the importance of providing sophisticated and efficient training and development programs.

However, some hoteliers do not see that as a problem, because they believe that knowledge and technical skills can be learned easily by orientation and on-the-job training. Their concern is with the personal characteristics, such as attitude and values. Respondents thought that it is difficult to develop positive values and work ethics in young people after entering the industry and these attributes needed to be obtained in school education. It seems that when they have the opportunity to hire trained staff, they are looking for education and preparation that will do more than simply focus on skills and knowledge. What they expect is that appropriate attitudes and values can be developed by hospitality education providers. This gap results in the waste of educational effort and resources and raises the question of 'are we teaching what we should?' (Collins, 2002)

#### *Difficulties with Internship Employment*

In order to provide a sufficient and suitable workforce for the tourism and hospitality industry in Taiwan, the government had promoted tourism and hospitality education and allowed many related programs to be established in the 1990s. The major characteristic of this educational system is focusing on training by establishing 'sandwich' courses that incorporate

periods of industrial placement and formalized coursework (Collins, 2002). Internships are beneficial for both students themselves and for the industry, because students have opportunities to work and gain practical experience while studying. Hospitality organizations can fulfill their social responsibility by providing the internship opportunities for students and solve problems in attracting entry level employees in the short term.

However, the educational experience provided to the hospitality industry appears not to have helped because respondents reported a significant gap between what students expect and their actual experience of the industry. It was observed that most hospitality students were not willing to commit themselves to the industry after they graduated. Students were said to choose hospitality programs for their major because they were attracted by the prospect of working in a luxurious and exciting environment. These students then received two or four years of higher level education in university, but before graduating were required to take internships in the hospitality industry. Most students were shocked suddenly when they found the reality was totally different to their expectation. They were not willing to enter the industry after graduation because they found the workplace to be undesirable. High work loads, shift work and unattractive payment levels made these young people want to escape from the hospitality industry.

In addition, hospitality organizations also suffer from the disadvantages of employing internship students. They need to provide training to internship students during a fixed period. These internship students 'come and go' every three months or six months so it is hard for hotels to develop career paths and contribute to employee development in the long-term. The training they provide to these internship students only meets the short-term demand and is wasted when these internship students are not willing to come back to the industry after they graduate.

#### *High Levels of Employee Turnover*

A high level of turnover was seen by most respondents as an unavoidable problem and a 'fact of life'. Many respondents thought that the characteristics of the hotel industry, such as high work loads, unattractive payment and just-in-time and seasonal variation demand for labor, are not contestable. These characteristics seem to be an original sin of the hotel industry, and leads to a 'turnover culture' in the hospitality industry. They believe it is very difficult to manage employee turnover because the nature of the hotel industry makes people avoid working in such an unfavorable environment. One of the respondents said that high levels of turnover were seen to be not only a normal trend in the hospitality industry but increasingly common for all industries because 'young people nowadays have no loyalty'.

However, high levels of turnover were not seen as necessarily being bad for hotels. This view, put by a number of respondents, suggests that enthusiasm is an important characteristic for hotel

employees. To some extent, high levels of turnover might be seen as positive because it removes de-motivated employees. One of the participating hotels had a turnover rate of less than 2% in 2005. However, this was thought to have limited career path opportunities, and that as a result long-term employees were not energetic. The low turnover rate also meant that the overall average of employees' age was higher (28% of employees were between 40 and 49; 38% of employees were between 50 and 59). The respondent from this hotel suggested that older employees resulted in a lack of innovation, creation, and infusion of fresh ideas into the organization.

#### *The Effective Use of Outsourcing, Dispatching, Flexible, And Casual Employment*

Most of the hotels outsourced non-core employee functions, including security and public area cleaning. Some hotels outsourced part of housekeeping, and food and beverage operation as well, which in the past have been seen as core functions in the hotel. At the time of this research being conducted, two of the participating hotels are negotiating with 'dispatching companies'. They are expecting that the problem of seasonal employee shortages can be solved by dispatching companies. They also expect that dispatching companies can provide stable and skilled casual employees during the peak seasons.

However, the outsourcing of hotel functions is still developing and has not matured yet in Taiwan. Hotel employers need to carefully consider the advantages and disadvantages in

outsourcing hotel functions. In terms of advantages, personnel costs can be decreased because the hotel employers do not need to fund labor insurance, retirement, and health insurance fees for those workers. In terms of disadvantages, service quality and customer security might be affected. There is much room for improvement in outsourcing or dispatching but it is seen as an inevitable trend in the hotel industry.

Casual or part-time workers are employed for particular occasions (such as banquets, conventions) or in peak seasons. These casual workers are employed on a 'come and go' basis and have no contract or formal agreement with the hotel. Hotels enjoy the flexibility of casual workers; however, the service quality can be compromised since these casual workers generally do not have the opportunity to be well trained. One of the respondents said that casual workers are the last choice for hotels because they are seen as fire-fighters. What casual workers provide is service quantity not service quality. It seems that hotels themselves are ambivalent about these workers.

## **DISCUSSION AND RECOMMENDATIONS**

On the basis of these in-depth interviews, it was possible to make a comparison between the issues identified by writers and researchers, and those identified by people actually working in the industry. It can be argued that the issues of skill shortages, shortcomings in training and development, and difficulties with internship employment are all linked to the issues of customer

service quality raised in the literature. In theory, employing interns provides a solution to the shortage of employees to some extent because internship provides a stable employment source for hotels in recruiting at entry level. Internship students are able to integrate theoretical knowledge with practical experiences through experimental learning, while the industry has opportunities to employ interns to meet both seasonal and long-term needs.

However, if the hotel industry cannot utilize internships strategically, the benefits of this win-win situation will not exist in the long-term. Some interviewees regard internships as cheap labor and one of the interviewees is even proud of their financial performance by employing internships. Some hotels regard internships as a supportive workforce for seasonal variations, rather than a long-term investment, because they think these interns will leave at the end of the internship period. It seems that these hoteliers do not understand that these internships could be a potential asset in the organization. It is suggested that hoteliers need to develop a sense of belonging for their interns and raise their interest to come back to work in the hotel. Hoteliers should provide a career vision for these internships that the hotel industry is worthy of commitment. They should also differentiate career planning development to identify these interns as superior to others who have no internship experience. This approach not only provides an incentive and motivation for these interns remaining employed after they graduate, but also contributes to human capital accumulation for the organizations.

The training and development resources provided by the hotels will not be wasted if these interns are willing to come back to the hotel industry. Garavan (1997) is one of those who has articulated how training and development can be used to reinforce certain behaviors and attitudes which contribute to effective service. Many service encounters occur during the frequent day-to-day interactions in a hotel that ultimately determine the level of service delivery quality. Hotels are not simply in the business of selling accommodation, food and beverages but rather, in the business of providing people with memorable experiences of service. Employees themselves are the personification of the service organization and customers' overall impression of an organization is often generated from contact with first-line employees.

The high level of turnover is a significant problem in the hotel industry that has attracted many researchers' attention (Cheng & Brown, 1998; Deery, 2002; Hinkin & Tracey, 2000; Iverson & Deery, 1997; Riegel, 2002; Simons & Hinkin, 2001). However, most participants in this study seemed to accept Hoque's (1999) view that the high level of turnover is a 'fact of life' and a normal and acceptable phenomenon in the hospitality industry (Iverson & Deery, 1997). In the fact, turnover still can be improved by better management, as long as human resource managers can see it as an opportunity, not just an inevitable problem.

Some researchers have suggested that specific HRM practices can enhance employee satisfaction which in turns reduces the turnover rate. Empowerment is one of the effective

approaches recommended by many researchers (Bowen & Ford, 2004; Enz & Siguaw, 2000a, 2000b; Lashley, 1999). They suggested that it is important to empower the employees who provide services by focusing on customers' needs. Service encounters are the main activity in a customer service industry and employees may encounter many different unique situations which can not be covered by the organizational policies and procedures (Bowen & Ford, 2004). If organizations are able to empower their employees, then they are able to exercise discretion in delivering customer service and do whatever is necessary to satisfy customers' needs (Enz & Siguaw, 2000a; Lashley, 1999). It has been argued that empowered employees also tend to have a strong sense of control and personal worth because they can take responsibility for the service encounter and have the power to effect customer satisfaction (Lashley, 1999). At another level, it has been suggested that empowered employees are motivated by doing meaningful work that ultimately enhances their job satisfaction and reduces the turnover rate (Bowen & Ford, 2004).

Not surprisingly, acceptance of a turnover culture sits side by side with practices which are easier to implement: outsourcing, dispatching, flexible employment, and casual employment. Kalleberg (2000) has seen flexible employment as a way of being responsive to sweeping social and economic changes. Global economic turbulence increases competition and uncertainty which forces organizations to be much more flexible in employee resourcing and responding to customers. Compared to most other industries, the fluctuation of workforce demand is more

significant in the hotel industry. Human resource managers understandably seize approaches which give them the flexibility to deploy employees in response to the variation, and to recruit a 'just-in-time' workforce in the peak seasons or during periods of commercial or institutionalized seasonality. Flexible employment practices enable organizations to not only cut direct and indirect labor costs but also provide flexibility for both employers and employees. Employers can adapt to variations in the demand and increase flexible workers on an as-needed basis while providing opportunities for people who are glad to take flexible or casual work.

While flexible employment may be convenient for all parties, it does raise some key issues of employee management. Different work arrangements may lead to different levels of recognition, commitment, attachment, and obligation between employers and employees. As well as the benefits, hoteliers should consider the side effects of flexible employment. One of the possible negative aspects is that dispatching workers have a limited relationship with hotels in which they will work resulting in low trust and low commitment. These might, in turn, lead to conflict between direct-hire and dispatching workers, and between management and employees (Kalleberg, 2000). Another possibility is that it is more expensive to manage the outsourcing activity than originally expected, so that the goal of cost saving is not achieved (Albertson, 2000).

The trend towards flexible working has become unstoppable in such a fluctuating environment (Purcell & Purcell, 1998), and dispatching is one of the arrangements which is likely to be a permanent dynamic of the hotel industry in the future. While becoming more popular in Taiwan, but there is no regulation of the process at the time of writing. It has been argued that it is imperative to regulate dispatching employment, because of the complex triangular employment relationship between dispatching company, dispatched worker, and the firm to which they have been dispatched (Kalleberg, 2000; Purcell & Purcell, 1998). The issue of control and supervision of dispatching workers is ambiguous because the dispatching company is the employer while the firm dispatched to supervise the employees. This complicated issue can not be covered by traditional employment law which recognizes only two parties: employer and employee. It highlights the urgency and imperative to clarify the obligation and responsibility between three parties.

## **CONCLUSIONS**

Given that the hotel industry in Taiwan already has suffered from significant shortages of suitable employees, it can be predicted that serious competition for employees is probable and the problem will become even more severe when new entries enter the market. Human resource managers should be long-term oriented and proactive, and utilize internships strategically because effectively handled internship student employment has the potential to make a much

more useful contribution to dealing with the pervasive issue of employee shortages. They need to consider how they can make internships more attractive and more effective as a way of attracting and keeping suitable staff.

Although empowerment is recommended by many researchers to reduce the turnover rate, it seems that this approach has not been widely taken up because the term 'empowerment' was not used by the participants at all in this study. Given the possible benefits in terms of service quality, customer and staff satisfaction, and turnover, there is much to be gained from considering empowerment options. Although a teething period is unavoidable in starting a new management approach, hoteliers should not be too conservative to attempt it. Sufficient communication and facilitation skills training are important to minimize the possible negative effects.

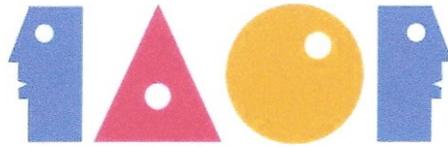
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## **IMPACT OF CUSTOMER RELATIONSHIP MANAGEMENT (CRM) IN THE IRAN BANKING SECTOR**

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### **ABSTRACT**

The banking industry has reduced structural barriers of competition in domestic markets by abolishing interest rates ceilings on deposits and lending by financial intermediaries in the world. Iran also has not been exceptional in this case. According to the government's policy, the interest rate is going down by 9%. Earlier it used to be 22% presently these are: 15%. The introduction of technology-based solutions like CRM has differentiated companies from their customers' point of view.

CRM is a strategy where banks to build and manage long-term relationships with their customers. Researchers have shown that CRM implementation can provide better customer service, as well as improvement and management of customer expectations and loyalty (Cho et al., 2001; Reich held, 1996; Reichheld & Sassari, 1990; Romano, 2001; Winer, 2001). In this paper we explained the CRM philosophy and it's role in banking system, and have proposed a model of E-CRM for Iran's banking sector by taking into consideration their competitive environment.

**KEY WORDS:** CRM, E-BANKING, SERVICE QUALITY, INTERNET BANKING.

## INTRODUCTION

The 80s and 90s were marked by an unprecedented development in information and communication technologies. This movement was motivated, in particular, by the need of companies to remain competitive in markets characterized by an increase in customer numbers and in the supply of services (Venkatraman, 1994). The introduction of technology-based solutions therefore came about as a way of differentiating companies from their customers' point of view. This evolution contributed towards a change in many companies' strategies and, in particular, the relations they establish with customers (Ricard *et al*, 2001).

Several industry groups have estimated that billions of dollars are being spent on CRM annually. Gartner research suggests that there was a reduction in CRM spending between 1999 and 2003 (Rigby & Ledingham, 2004), but most estimate an increase in CRM spending. Current spending on CRM-related projects is estimated around \$10 to \$15 billion and experts predict future growth in CRM spending to reach \$75 billion and beyond over the next several years (Chatham, 2002; Tiazkun, 1999; Winer, 2001).

In this movement, banking industry has reduced structural barriers of competition in domestic markets by abolishing interest rates ceilings on deposits and lending by financial intermediaries in the world. Iran also has not been exception. According the Government's

decision, the interest rate is going down to be around 9% .Earlier it was 22% and presently its 15%.

Today's banking is not merely a function of accepting deposits, lending and money transmission, the banks have now diversified into insurance, brokering, advisory services, merchant banking, factoring and almost every legitimate financial activities. In order to survive in the present world of competition, banks' marketing strategy needs to be formulated in such a way as to woo the customers. Hence, positive customer perception has become a major thrust area for banks to increase market share that is created by CRM. This has increased the importance of identifying marketing assets in which to invest and of understanding how the assets provide potential for sustained profits in the long run (Rust, Lemon, and Zeithmal 2004). Customers are considered as a critical element of a firm's marketing assets, and the effective management of customer assets is expected to affect firm profits directly (Bolton, Lemon and Verhoef 2004).

While addressing the issue of customer relationships, one should not forget that the banks are evolving, re-designing and delivering the best possible products and services which will strengthen the bond between them and their customers. In this context, the banks have to transform themselves into customer-centric service centers rather than transaction-processing centers or centers of interest-based services.

The CRM is a challenge, particularly in the context of Iranian banks. It does not offer a magical solution or a talisman to provide solutions to all their problems at a stroke. On the other hand, if it is developed and implemented in a proper way, it can fetch remarkable results in terms of performance and profits. For example, a 5% increase in customer retention may increase the profitability by 35% in banking business, 50% in insurance and brokerage and 125% in the consumer credit card market. Therefore, banks are now stressing on retaining customers through CRM. It does not matter whether a customer is valuable or non-valuable in terms of his financial worth. Even a common man is an important customer for a bank. But what really matter is the kind of relationship that is forged by the banks. A good relationship with them will certainly enhance the bank's image and goodwill. It even increases the bank's market share.

### **WHAT IS CRM?**

CRM is the aligning of business strategy with the corporate culture of the organization, along with customer information and a supporting information technology of the customer interactions that promote a mutually beneficial relationship between the customer and the enterprise. Primarily, CRM is a business strategy, but it is a business strategy enabled by the advances in technology. According to (Cunningham et. al, 2004), CRM is a strategy that integrates the concepts of knowledge management, Data mining, and Data Warehousing in order

to support the organization's decision-making process to retain long term and profitable relationships with its customer.

CRM also involves the deployment of strategies, processes, and technologies to strengthen a firm's relationship with customers throughout their life-cycle from marketing and sales, to post-sales service. The motivation for CRM stems from companies' desire to increase their revenues and profitability through improved customer satisfaction and retention (Reichheld, 1996; Reichheld& Sassar, 1990; Winer, 2001).

In this era, Internet technology has transformed CRM into Electronic-CRM (E-CRM), because companies and banks can use Internet technologies to capture new customers, track their preferences and online behaviors, and customize support and services. CRM also is a strategy for banks to build and manage long-term relationships with their customers. Researchers have shown that CRM implementation can provide better customer service, as well as improvement and management of customer expectations and loyalty (Cho et al., 2001; Reichheld, 1996; Reichheld& Sassar, 1990; Romano, 2001; Winer, 2001). CRM then, complements a firm's capability to present products, quality, and services to its customer (Chen& Sukpani, 1998). By implementing CRM solutions, many firms expect to improve profitability by gaining customer loyalty, customizing offering, and lowering costs.

In CRM, Business culture should shift from product-focus to customer-focus, sales and marketing can focus on retention and increase of share of customers instead of acquisition and market share. In CRM, Customer service can identify and take advantage of cross-sell and up-sell opportunities. However, customers information does not freely flow across the enterprise, to obtain the vision of CRM, information must move freely. This requires integration, today's banking world should employ, E-Banking, to reach the larger section of customer share, and retaining. In order to understand the significance of E-Banking in the banking sector, we will briefly explain this.

## **WHAT IS E-BANKING?**

### ***Banking:***

To understand E-Banking, we should know. What is the meaning of Banking? Banking means the acceptance, for the purpose of lending or investment, of deposits of money from the public, repayable on demand or otherwise, and withdraw able by cheque, draft, order or otherwise. The term banking company means any company that transacts the business of banking. In addition, the banking industry performs various functions. Some of the functions are: accepting deposits from public/others (Deposits), Lending money to public(Loans), Transferring money from one place to another (Remittances), Acting as trustees, Acting as intermediaries, Keeping valuables in safe custody, Collection business and Government business.

### ***E-Banking:***

A combination of the two words, Electronic technology and banking, is a process by which a customer performs banking transactions electronically without visiting a brick-and-mortar institution. It involves an extensive use of Information technology that eliminates the need for direct recourse to the bank by the customer. The emergence of E-banking has enabled the banks to offer real-time transactions and integrate all customer related functions. Now a day's banks are utilizing the new technology to provide better technology and convenient access to its customers.

Suganthi et al. (2001) conducted the review of Malaysian banking sites and revealed that there are various psychological and behavioral issues as trust, security of internet transactions, reluctance of change and preference for human interface which appear to impede the growth of internet banking. Amin Sulaiman et al (2005) concluded that the adopters perceive E-banking to be an easy and convenient way and carry out their E-banking transactions either from their homes or offices, also, the age, income and job positions held influenced E-banking adoption. Higher adoption was seen amongst younger persons, persons with high salaries and those holding higher positions.

### ***Modes of E-Banking***

Technology has enabled banks to overcome the barrier of time and space in extending their services to customers and Quality of service is seen more than ever as a key differentiator in the marketplace. One question relates to whether automated, telephone and Internet banking represent positive change are delivering enhanced service quality. There is danger that some customers will go elsewhere if they lose human interaction from their current service provider (Gerson, 1998).

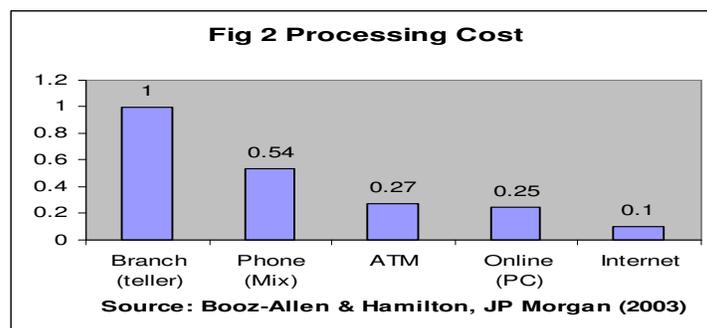
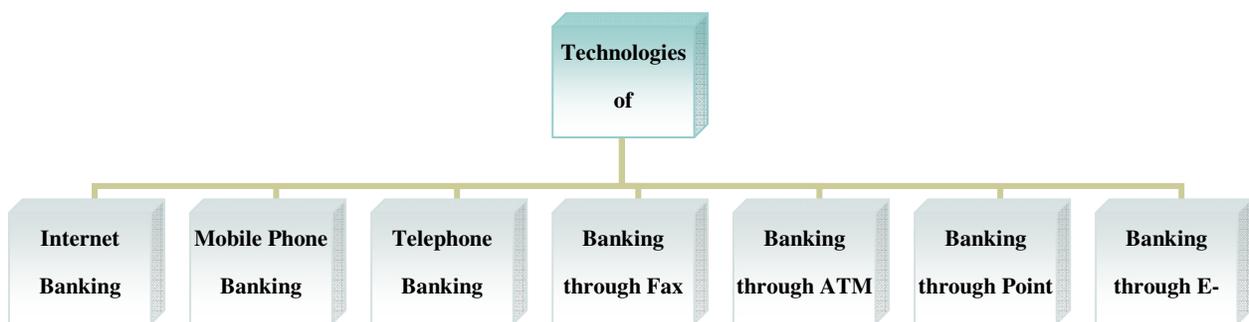
Only improved service provision, with the right mix of human input and technology, will retain customers in the longer term. We shown technologies of E-Banking as figure No 1 below, and then will explain some of them in detail.

### ***Internet Banking:***

The introduction of Internet has brought the concept of ‘Anytime Anywhere Banking’. Internet banking or online banking refers to the conduct of financial transactions by the customers with the help of a secured website operated by the bank. Thus, most of the banks nowadays have websites, which not only provide banking-related information but also facilitate online transactions, such as bank account inquiry, payment of utility bills, credit card bill payment, status inquiry and online shopping. Internet banking and associated transactions are much cheaper compared to rendering services through physical branches (i.e., brick and mortar

form). Figure 2 shows the cost of processing transaction through Internet in comparison to other means.

**FIGURE 1: MODES OF E-BANKING**



In Internet or online banking, information is transmitted and received in electronic form since Internet is a network of very large number of computers. Based on interviews from four

banks in Hong Kong noted that basic transactions and securities trading are the most popular types of operations that customers carry out on Internet banking.

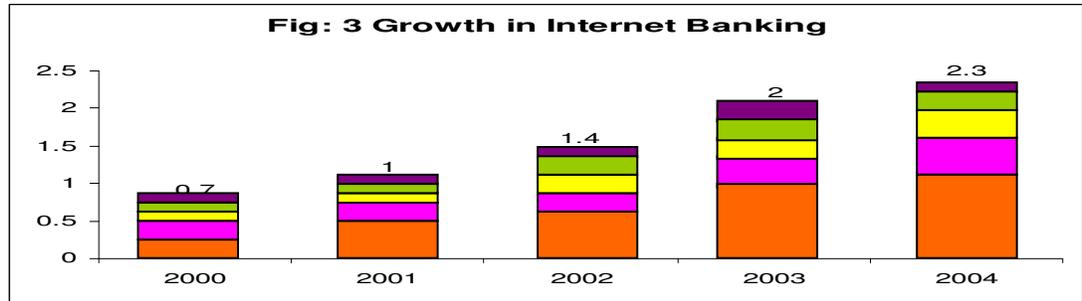
The banks have been riding high on the technological wave of Internet banking and at the same time discouraging physical banking transactions by levying additional charges at physical branches. Thus, due to investment in technology and its adoption by different banks, growth has been witnessed in the field of Internet banking as depicted in Figure no 3 in different parts of the world.

#### ***Digital Products of E-Banking:***

Indeed, Internet banking has become a business necessity, rather than a means for banks to gain a strategic (Scott, 2002). Internet banking would enhance the quality as a digital product/service and thus the instrument should in principle be applicable to it. With Internet banking, the following typical secure Internet banking services are provided for account holders, as see in the figure No 4. Items may be added or subtracted from this list. Depending on the bank being used.

#### ***Telephone Banking:***

Facilities allow non-cash transactions to be carried out (over the telephone), which would have required a visit to a branch earlier (Prendergast and Marr, 1994), similarly, Internet banking allows customer to perform tasks at a time and in a place convenient to them.

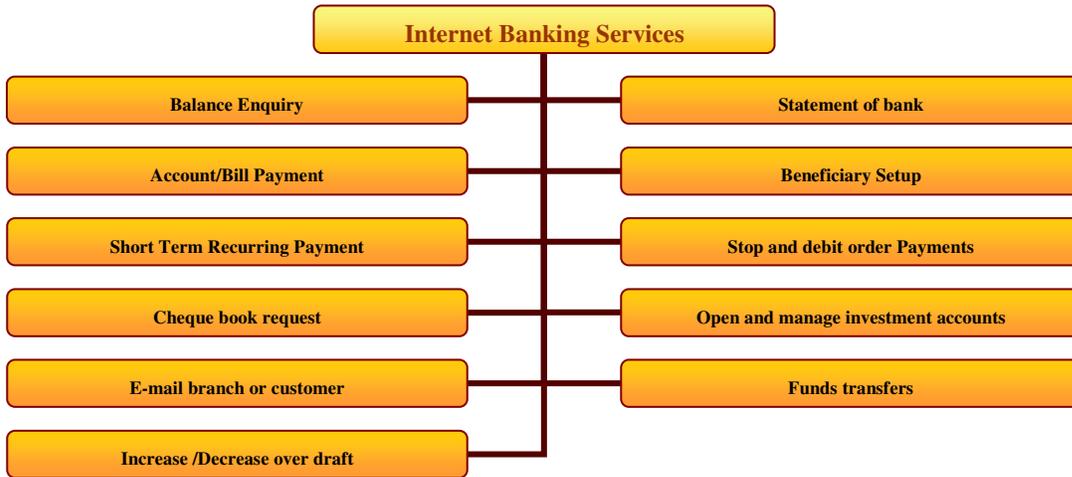


<b>Rest of the World</b>	1.0	1.7	3.1	5.1	6.1
<b>Asia- Pacific (exc Japan)</b>	2.4	4.4	6.8	9.8	13.8
<b>Japan</b>	2.5	6.5	11.9	19.6	21.8
<b>US</b>	9.9	14.7	17.1	20.4	22.8
<b>Western Europe</b>	18.6	28.0	37.8	47.7	57.9

*Source: International Data Corporation, [www.epaynews.com](http://www.epaynews.com)*

Dabholkar (1996) suggests that direct contact with such technology also gives customers a feeling of greater control. Most telephone banking uses an automated phone answering system with phone keypad response or voice recognition capability. With the obvious exception of cash withdrawals and deposits, it offers virtually all the features of an **Automated Teller Machine**(ATM): account balance information and list of latest transactions, **electronic bill payments, funds transfers** between a customer's **accounts**, etc. Usually, customers can also speak to a live representative located in a **call centre** or a **branch**, although this feature is not guaranteed to be offered 24/7. In addition to the self-service transactions listed earlier, telephone banking.

**FIG:4 INTERNET BANKING SERVICES**



representatives are usually trained to do what was traditionally available only at the branch: **loan** applications, **investment** purchases and redemptions, **cheque book** orders, **debit card** replacements, change of address, etc.

***Mobile Banking:***

In the simplest form, mobile banking services enable users to receive information on their account balances via SMS. Some new soft ware enabled mobile phone to use some banking services such as fund transfers between accounts, stock trading, and confirmation of direct payments via the phone’s micro browser. Several European banks have introduced successful mobile financial services for these smart phones, where as some U.S. banks have recently closed their mobile banks due to lack of users, All amount of transfer funds through mobile phone by emigrant foreign workers was 268 billion \$ in 2006 .

So, customer can track their account and credit card transactions and transfer funds between accounts. Further more, they can pay bills and trade equities using a menu-based interface. Banks are one the key players that want to preserve their position as a central payment and banking services provider in the financial market.

### ***ATM:***

Automated Teller Machine is a computerized telecommunications device that provides the **customers** of a **financial institution** with access to **financial transactions** in a public space without the need for a human **clerk** or **bank teller**. On most modern ATMs, the customer is identified by inserting a plastic **ATM card** with a **magnetic stripe** or a plastic **smartcard** with a chip, that contains a unique card number and some security information, such as an expiration date or **CVC** (CVV). **Security** is provided by the customer entering a **personal identification number** (PIN). Using an ATM, customers can access their bank **accounts** in order to make **cash** withdrawals (or **credit card** cash advances) and check their account balances.

### **CRM IN E-BANKING**

Discussion has recently arisen on the strategic benefits of adopting the relationship approach in the banking sector (Bennett and Durkin, 2002). It is essential for the banks to know its customers well, building a strong, trusting relationship with them – which is particularly important in the financial services sector due to the complexity of many of its products (Diacon

and Ennew, 1996; Bejou *et al*, 1998), commitment, honesty, cooperation between the institution and its customers (Tyler and Stanley, 1999; Rexha *et al*, 2003), as well as customer satisfaction.

The use of CRM in banking has gained importance with the aggressive strategies for customer acquisition and retention being employed by the banks in today's competitive milieu. It is also a business strategy that aims to understand, anticipate and manage the needs of an organization's current and potential customers. It is a strategic, process, organizational and technical change, whereby a company seeks to better manage its own enterprise around customer behaviors. Simply put, it involves six major drivers:

*Targeting customers*

*Consistent interface with customers*

*Prospecting by identifying the 'best' prospective customers*

*Acquisition by attracting them to become customers*

*Cross-Sell/Up-Sell and build Loyalty by doing more and the right kind of business with them.*

*Retention by keeping them as long as possible, that is, wins back and save your customers.*

## CUSTOMER PERCEPTION & SATISFACTION

In the literature on service marketing, **perception** is defined as the consumer's belief concerning the service received or experienced. Customer perception has been regarded as an indicator of the marketing effectiveness of the firm, many companies now identification of customer's expectation and actual delivery of services are essential elements of marketing strategy. So companies must create positive attitude towards the identification of needs and wants of the target customers, it is a fact that achieving and maintaining of positive customer perception even at higher cost would not be costlier than cost of negative customer perception.

But **Satisfaction** is" a customer's emotional response to his or her evaluation of the perceived discrepancy between his or her prior experience with and expectations of product and organization and the actual experienced performance as perceived after interacting with organization and consuming the product ".(Vara, 2002.p.5).(Satisfaction= Perception \_ Expectation). Customer satisfaction is an important factor to the success of businesses. In the mass consumption era, one of the aspects that will make a customer choose certain products or companies over others will be the level of customer satisfaction and support before and after the sales services provided. In the financial service industry this is a major oversight since the banking industry relies on customer satisfaction for most of their business transactions, and

provides a service and not a tangible product. The only thing customers have to gauge their expectations about these service offerings is customer care (Allen, 2000).

A review of articles on the financial services industry revealed that corporations know what the consumers are looking for and that value is measured through quality (Kerber, 2000). The threat of increased competition, slower growth rates, and price pressures induced many organizations to focus on customer satisfaction (Kerber, 2000). Parasuraman, Zeithaml, and Berry (1985) have concluded that service quality can be described based on ten dimensions. Attempts to measure these ten dimensions, however, reveal that customers can only distinguish among five of the 10 dimensions. The five dimensions of service quality that customers distinguish among are:

**Tangibles:** Appearance of physical facilities, equipment, personnel, and communications materials.

**Reliability:** Ability to perform the promised service dependably and accurately.

**Responsiveness:** Willingness to help customers and provide prompt service.

**Assurance**

**Empathy:** Making the effort to know customers and their needs.

Therefore, a company's ultimate aim in today's highly competitive environment is to reduce the number of complaints to zero. The banking industry is no exception. A lot of

empirical studies were conducted over the past few years on the basis of measurement of service quality of banks. The SERVQUAL model developed by Parasuraman, et al. (1985) is widely used to measure the quality of service by different service-providers like bank, hospital, travel agency and so on. The model provides for five dimensions as cited above. Gani and Bhat (2003) conducted a comparative study on service quality in five commercial banks of India, covering public, private and foreign sectors using SERVQUAL model and concluded that service quality of foreign banks was comparatively much better than that of Indian banks and suggested heavy investment by Indian banks in tangibility dimension to improve the quality of service to the customers.

### **THE BANKING SECTOR OF IRAN IN A GLANCE (CUSTOMER-ORIENTATION)**

The basic purpose of the Iranian banking system is to serve around 70 million people, making profit is secondary goal. All banks in Iran are under the control of central bank of Iran Islamic. Iran Islamic bank is responsible for regulating and implementing of the country credit & monetary policies.

Some information about Iranian banks related to this textual are as following in Table No 1.

**Table 1: Part of E-Banking Equipments in Iran till end of 2007**

Banking Card	POS	ATM	Branches	Banks			
				Electronic	Private	Specialized	Government
25,871,666	1,40,000	9000	16,9810	2	6	4	7
				2	17		

We can divide all the banks customers in two categories.

- 1- Non- profitable Customers
- 2- Profit Customers

1- Non-Profit Customers: Non profit customers can be further subdivided in two groups

as shown below:

**A:** *All the government's and company's employees, those who get salary through banking system.*

**B:** All amount of owners in Iran including (landed property, vehicle,) those, who pay bills like (electricity, water,) through banking system (around 112.000.000 bills monthly).this category includes majority of customers. Banks can't give good services to them, because they are non-profit customer and engage employees in their work. For this reason such category causes decline in the service qualities of the banks.

## **2-Profit customer:**

Profitable customers are those who pay bank for their services or from whom bank make profits from. These are those customers on whom banks tries to focus on, because they are the real customers. Banks make money from them by providing services like bank deposit, fix deposit, providing loans, credit services, transfer of funds, etc. people in this category are much less as compare to the first category.

Iranian economy is a highly liquid, large amount of money flow in and out of the country and within the country which is mostly done through banks. People prefer to deposit their money in banks despite of low return (as interest) because of the low risk involved and liquidity of their fund. And the other hand, according the above information in table No 1, we understood that banking facilities and devices are very less for this section of customers. And banks are going to increase all of them b 2010.

## **E-CRM SOLUTION FOR BANKING SECTOR IN IRAN AND ITS PRINCIPLE**

E-CRM solutions are especially valuable to banks that face the following situation:

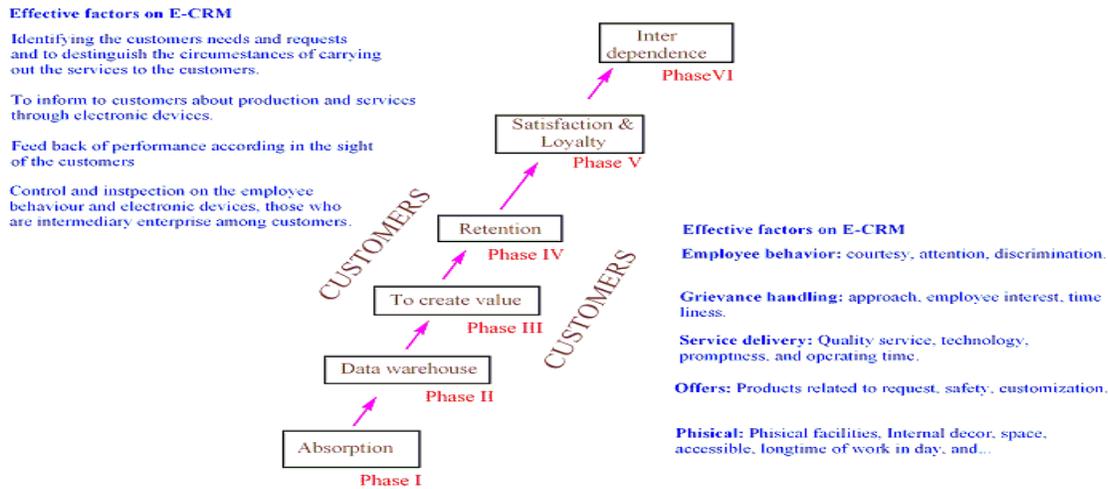
1. Bank is driven by mission-critical customer service requirements.
2. Current costs for E-CRM run high.
3. Large volumes of information are distributed.
4. A complete customer care solution is needed.

5. Customer data warehouse is very important (safety, access able, processing,)

E-CRM solutions can be deployed and managed to provide increased revenues and decreased costs for banks while improving customer service. E-CRM goals can be achieved through E-Banking devices, like: Internet banking, banking based on mobile phone, banking based on telephone and so on. The competition has been increasing with entrance of private banks in Iran banking sector. In particular, all of the government's banks which, are under the control of government's rule. they have to follow and on the other hand they have to have profits to survive. Therefore profitable customer (second category) is the only hope for government's banks.

From this view, to setting of a comprehensive E-CRM strategy and a strong implementing of , it can increase number of customers, make bank's trust worthy and customer's loyal. E-CRM solution can be visualized in six stages by ten main principles, as given in Figure no 5.

**Fig 5: Set up the Strategy related to customers**



As observed:

**At the first stage** of model, is to absorb the customers. This stage is related to set of strategic planning according to the customers, and also to case of physical items like physical facilities, internal decor and so on.

**At the second stage**, to establish data warehouse , this stage is related to identify customer’s request and needs, and also to serve them we need some personal and financial information about customers to offer products, safety and customized services.

**At the third stage** is creating value for customers. This stage is very important from the customer’s point of view. Banks try to create value to their customers, but the customers should know about these facilities , services, through existence E-banking system. and also to service delivery with quality, promptness and operating time through this modern technology and

electronic devices with their expenditure (cost). and then the customers , benchmarking (to assay) before each enterprise.

**At The fourth stage** customer retention: to take feed back of performance according to the customer's view point about their service's quality, grievance handling approach, employee interest, all of this items cause to create customer retention.

**At The fifth stage** is satisfaction and loyalty of customers. The key role in this stage are E-banking system equipments and employee behavior, courtesy, attention and discrimination and then enterprise should do two important work:

1- control of employee behavior.

2- 2: control of E-devices.

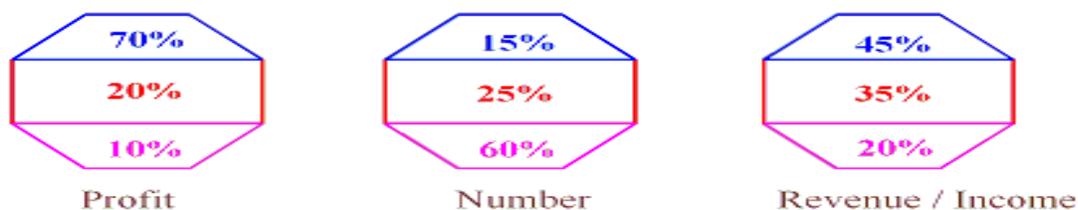
**And last stage is the interdependence**, From the beginning of bank's activities, it has feeling of dependence on customer till this stage but at this stage customers have feeling dependence on bank because they trust on bank now, also satisfied and have become a loyal customer, so they can really upon the E-banking system for all of their financial transaction. this is the reason why this stage is called stage of 'Interdependence stage'.

## **CONCLUSIONS**

With adding private banking and probably to admit Iran as a member of World Trade Organization (WTO) and with the confirmation to establish a foreign banks in Iran ( First branch

of foreign bank opened on 27-may-2008), all banks are suppose to set up big plans and strategies for their survival and customer retention. To remedy, they can employ, technologies, techniques and strategies which focus on customer-orientation. According to the managers of famous banks, 35% of profit belongs to 5% of customers. It means all of customers don't create similar profit for the banks. According to other research as shown in below figure No 6.

**Fig 6: The Customer's Profitable and Classification**



As observed, an enterprise is confronted with different and vast spectrum of customers. Upper surface of this figure shows, only 15% of customers have role in 45% of commercial revenue and 70% enterprise's profit belong to this amount. so must to keep more customer-share, set up aggressive strategy. So customer-share must be retained with all of the powers. This is one side and other side is non-profit customers. Large percentage of such customers are those, who have much amount transfer funds with banks, but they are not much beneficial , and minimum of their work is 112.000.000 bills to pay monthly, that huge people come to bank. It means they engage most of banking employee.

Bank should keep high level of service quality for their profit-customer. They can do this, but when people don't come physically to the bank to do some work like to pay bills or transfer funds and so on. To solve this big problem, Banks should increase amount of ATM, POS , bank's cards, E-branches and then they can keep and increase level of service quality. And the important point is CRM that can arrange all of these together, according to the model have shown in the text. It must not forget that, customer is one of the strategic assets of bank and may be for short duration and temporary, but with the implementation of E-CRM properly and perfectly, the customer will become the long time bank strategic assets and permanent customer. At the first, CRM surrounds customers and then try to gain loyalty of the customers by using every opportunity to reach closer till reach the stage of dependence.

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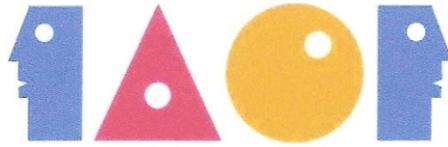
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**A REFINED AND INTEGRATED KANO MODEL AND THE  
IMPLEMENTATION OF QUALITY FUNCTION DEPLOYMENT -  
RESEARCH ON THE LIBRARY OF A VOCATIONAL AND  
TECHNICAL SCHOOL IN SOUTHERN TAIWAN**

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**ABSTRACT**

The recent education thought is the idea *Pursuing improvement and improving quality*. The main purposes of universities and colleges libraries are to facilitate education, research and service to improve the general research and development ability. Thus, the ways that libraries offer more efficient service have significant influences on rising reputation and maintaining sustainable development.

The evaluation on the achievements of libraries is major on reader service aiming at improving service quality. By the combined methods of integrated Kano model and Quality Function Deployment (QFD), the research focuses on the service quality of a library of a vocational and technical school in Southern Taiwan. The results show that finances, plenty of staff and professional ability and technology are the key quality technologies carried out beforehand to improve service quality of the library of the vocational and technical school. Besides, the difference index shows that the greatest differences between importance and satisfaction are in the following perspectives: good application environment (for example: atmosphere, cleanliness and quiet), easy to be operated and offer query function on personal records of lending and convenience for obtaining books from shelves. The improvements of service quality should underline these three aspects from the perspective of differences between importance and satisfaction.

**Keywords:** Refined Kano Model, service quality of a library, quality function deployment

## **INTRODUCTION**

### **Motive and Research Gaps**

The main statistical data (Ministry of Education, 2009) of the Ministry of Education in Taiwan show that the number of students of vocational schools is decreasing every year. Influenced by international financial crisis, the dropout tendency of university is extended to vocational schools. There are 1500 students who do not register during the first three days of a new semester (Su, 2009). The decreasing number of students makes the completion among universities and colleges more fiercely. Thus, ways of maintaining education quality and improving completion ability becomes one of the most important research issues of universities.

The recent education thought is the idea Pursuing improvement and improving quality, which is also the common purpose of each university. The education reform is becoming one of the most important programs of Taiwan government, one consensus reached between people and government. Among reform measures, the improvement and assurance of education quality is one of the popular concerns of the mass and the key point of education reform. Thus, the research on one education quality improvement strategy based on thoughtful consideration and operation should be the key points of efforts made by educators. Therefore, the literature background and motif of this essay is to figure out the demands of students on library and the methods for improvement.

The major function of university libraries, to support education, research and offer service to promote the general research and development ability of universities have great impact on the rising of academic reputation and the sustainable development. Besides, the research of Liu (2007), universities should pay attention on the abundance of collection, one aspect of One-dimensional attribute. Now, libraries are facing the challenges of internal and external shocks in the E-generation. As the guidance for customers becoming the new tendency of the service industry, more attention should be paid in rising service quality, collection of data and the improvement of quality of staff. Thus, reader service is the main content of evaluation on achievements of libraries (Huang, 2002). With the influence of underlining service quality and customer satisfaction trend, libraries should take following things into consideration: how to create competitive advantages and to establish business philosophy based on readers to improve service quality.

Based on questionnaires, the essay makes research on the needs of service objects of libraries. By ways of refined integrated Kano model and QFD, the analysis on the general service quality is made so that improvement priority on service can be leveled with further establishment of service quality evaluation mode and lays foundation for rising service quality of school libraries. The research questions are as followings:

- (1) What are the demands on library service quality of students of this vocational and technical school?
- (2) What are the characteristics of the refined Kano model of service project of the library?
- (3) What is the priority of the improvement of service quality of the library?
- (4) What are the key technologies of the service quality of the library?

## **LITERATURE REVIEW**

### **Concepts of Service Quality**

Gronroos (1984) stated Service quality come to exist after the comparison between customers' beforehand expectations and afterwards perceptions. Customers always have some degree of expectations as well as perception before and after receiving service. There is a perceptual gap between the comparisons of two data, named total perceived quality. If expectations meet perception, the value of total perceived quality is high and vice versa.

Lewis and Booms (1983) said Service quality depends on the satisfaction degree of customers' expectation to the service.

Parasuraman, Zeithaml and Berry (1985) consider service as a dynamic process, holding that service quality is the difference between customers' expectations and the perception on service. When the latter one is bigger or equal to the former one, the service is good and vice versa.

Overall, service quality is the customers' perception on the service provided in relation to the quality that was expected. During this dynamic process, when expectation is met, the service is good and vice versa.

### **Dimensions of Service Quality**

According to Juran et al. (1974), the influences of service quality on customers are classified into five dimensions: 1. insight quality: this refers to invisible quality. The quality of service totally relies on the inner operation of the service staff due to its invisibility, for example, the maintenance of various kinds of equipment. (2) Hardware quality: this refers to the visible quality. The quality can be perceived immediately on the service due to its visibility. Hardware quality has close relationship with the products of manufacturing industry. For example, customer can see and feel the quality and effects of various kinds of equipments. (3) Software quality: this refers to the perceivable software quality. Though, both of software quality and hardware quality can be perceived, the former one refers to concrete products; while the latter one refers to operation, for example, whether the service staff can rightly meet customers' demands. (4) Service time quality: this refers to the rapidity of service, for example, the queuing time in shopping, waiting time for waiters, waiting time of patients for doctors, response time on customers' complains and the waiting time for repairmen. All these reflect the quality of service time quality. (5) Psychological quality: this refers to the politeness and geniality of service

providers on customers so that the comfortable environment can be established for customers, for example, the etiquette and professional dedication.

As for library service, Shi and Levy (2005) hold that service should include concrete equipment, attitudes and abilities of staff. Xie Baonuan (1998) holds that there are four influencing factors including entity environment, collection, service staff and communication.

Qu Taikui (2003) holds that it should include service, simple use of searing system, book reservation, searching equipment, technologic equipment, environment, service and publication.

Chen Yuhong (2002) holds that it should include service, environment, personnel and management, collection, administration and utilization education.

The study is based on opinions of Martensen and Gronholdt (2003), Shi and Levy (2005), Xie Baonuan (1998), Qu Taikui (2003) and Chen Yuhong (2002). Service quality, including 3 dimensions equipment, environment and service, are sub-categorized into 34 categories on the basis of researches of scholars such as: Chen Meiwen (2004), Huang Lichun (2002), Chen Yuhong (2002), Huang Mianmian (2006), Yuan Zheyu (2003) and so on when analyze service quality.

### **Kano's Two-dimensional Quality Model**

General quality holds that the sufficiency of the quality elements means satisfaction and inadequacy means dissatisfaction. However, the two-dimensional quality holds that not all

quality elements are like this. The sufficiency of quality elements does not ensure satisfaction.

Sometimes, it may cause dissatisfaction and indifferent. The following parts introduce theories related to two-dimensional quality model:

### ***Noriaki Kano's two-dimensional quality model***

Based on Herzberg's (1987) study, Fumio Takahashi and Noriaki Kano introduced M-H theory (Motivator-Hygiene theory) into quality field and renamed it as the M-H Characteristics of Quality. However, the name is not well accepted and he had to rename it as Attractive quality and Must-be quality. Noriaki, Nobuhiko Seraku, Fumio Takahashi and Shinichi Tsuji (1984) formally proposed two-dimensional quality models and empirical studies. It is firstly used in the development of manufacturing industry and the quality is categorized into five dimensions:

(1) Attractive quality element: Satisfaction is reached when the element is sufficient; while, the inadequacy of the element may also be accepted without quality element of dissatisfaction.

(2) One-dimensional quality element: satisfaction is reached when the element is sufficient; while, the inadequacy of the element cause dissatisfaction.

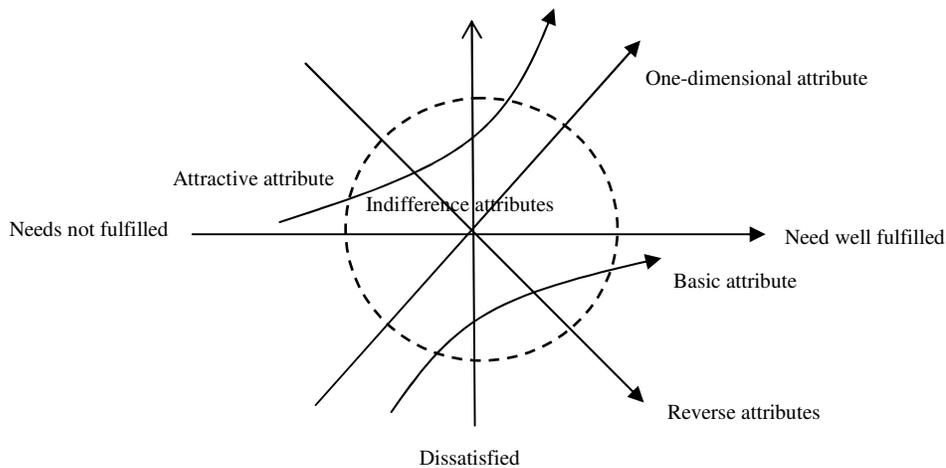
(3) must-be quality element: The element is taken for granted without better satisfaction; while the inadequacy of the element causes the dissatisfaction.

(4) Indifferent quality element: The sufficiency and inadequacy of the element lead to neither satisfaction nor dissatisfaction.

(5) Reverse quality element: The sufficiency of the element causes dissatisfaction; while the inadequacy of the element gives birth to satisfaction.

The Figure 1 demonstrates Kano's two-dimensional quality model. The vertical axis illustrates state of customers' satisfaction, and the transverse axis illustrates the sufficiency of quality elements. The straight line through the origin is the one-dimensional quality. This means that the sufficiency of the element gives birth to satisfaction and vice versa. The reverse quality is also one straight line through the origin with the opposite direction to that of the one-dimensional quality. The attractive quality and the must-be quality are represented by arcs with one above the transverse axis and one below it. This means that the possession of the attractive quality or not do not cause dissatisfaction. The possession of must-be quality closely relates to dissatisfaction category. The indifferent quality is the straight line corresponds to the transverse axis, which means that neither of the sufficiency nor inadequacy of the element causes satisfaction or dissatisfaction. *Refined Kano model.*

Yang (2005) redefined the model as refined Kano model. This model can guide companies to make right plan. The procedures of category of this model are initially based on Kano's two-dimensional quality category model followed by attractive quality, one-dimensional quality, must-be quality and indifferent quality subject to mean value of importance degree. Then the



*Figure 1.* Kano's two-dimensional quality model  
 Source: Yang Ching-Chow (1993)

four qualities are sub-categorized into eight quality models with the detail definition as the followings:

(1) Attractive quality: this is dividing into high attractive quality and low attractive quality. If the mean value of one certain attractive quality is higher than the total mean value, this means that the element possesses high attractive quality and vice versa. High attractive quality is the best weapon for companies to attract customers. Low attractive quality has little attraction to customers and should be discarded from the cost perspective.

(2) One-dimensional quality: one dimensional quality is divided into high value-added quality and low value-added quality. If the mean value of certain one-dimensional quality is higher than

the total mean value, this means that the element possesses high value-added quality and vice versa. High value-added quality has more contribution on customers and helps to increase revenue. Thus, companies should make efforts on offering this kind of quality to customers. Low value-added quality has little contribution on customer. But companies cannot neglect this quality. Rather, companies should avoid of lacking in service quality leading to dissatisfaction.

(3) must-be quality: this is divided into key quality attributes and needed quality attributes. If the mean value of certain must-be quality is higher than the total mean value, this means that the attribute is the key quality attribute and vice versa. Key quality attributes are necessary quality. Companies should fully offer this kind of service to customers and meet customers' demands. Needed quality attributes are the basic quality that companies should reach to avoid customers' dissatisfaction quality.

(4) Indifferent quality element: this is divided into potential quality and non-disturbance quality. If the mean value of certain indifferent quality is higher than the total mean value, it is the potential quality. If the mean value of certain indifferent quality is lower than the total mean value, it is the tolerable quality. The potential qualities gradually become the attractive qualities to customers. Companies may take these qualities as strategies into consideration for future service providing to attract customers. Non-disturbance quality can be omitted from cost

perspective. By curved lines, Figure 2 demonstrates the categorization methods of integrated Kano model of quality attributes.

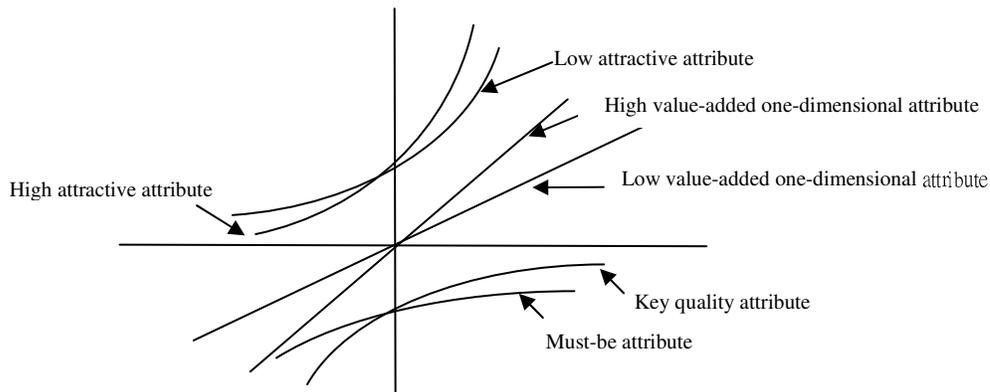


Figure 2. Refined Kano quality model  
Source: Yang Ching-Chow (2005)

### ***Categorization of two-dimensional quality model***

The summarization of above researches shows that library service quality may not all belong to sufficient provide category, that is, high satisfaction level. Due to limit improvement funds, the improvement is more effective if it focuses on prioritization reform attributes and improvement of key technologies. Thus, the research on the cooperation usage of refined Kano model and QFD on library service quality is very important.

### **Quality Function Deployment**

Quality Function Deployment; QFD is started from the quality tactics of the manufacturing industry and most service industries recently used this tactics to improve service quality. The

following explanation is the definition, benefit and executive procedure of Quality Function

Deployment; QFD.

**Concept of QFD**

Shigeru Mizuno (1987) defined QFD as “step-by-step deployment of a job function or operation that embodies quality, into their details through systematization of targets and means.”

Bossert (1991) holds that QFD provides structure methods to facilitate the establishment of process of a company. This process may help to understand customers’ requirements. Lai

Shunzhen (2001) holds that QFD is used to meet customers’ requirement. By way of Step-by-step guide, it develops customers’ expectation qualities and translates them into operational quality program to understand prior qualities.

Overall, this research holds that QFD is systematized methods which reflect customers’ requirements and translate them into production plans and service strategies.

		Inadequacy of Attributes				
		Like	Granted	Indifferent	Tolerable	Dislike
Sufficiency of Attributes	Like	Null Quality	Attribute Quality	Attribute Quality	Attribute Quality	One-dimensional Quality
	Granted	Reverse Quality	Indifferent Quality	Indifferent Quality	Indifferent Quality	Must-be Quality
	Indifferent	Reverse Quality	Indifferent Quality	Indifferent Quality	Indifferent Quality	Must-be Quality
	Tolerable	Reverse Quality	Indifferent Quality	Indifferent Quality	Indifferent Quality	Must-be Quality
	Dislike	Reverse Quality	Reverse Quality	Reverse Quality	Reverse Quality	Null Quality

**Effects of QFD**

On the basis of Liu Yuanchao (1995) and Lai Shunzhen (2001), the effects of QFD

including:

(1) It reduces time and energy on design period and design changing period; (2) It reduces time and energy during design period and design changing period; (3) It reduces amendment time and waste on cost; (4) It establishes sequences and information deployment method; (5) It reduce the development cycle; (6) It reduces the Start-Up-Cost substantially; (7) It reduces alternation in design; (8) It decreases the possibilities of fastidious and demanding but inept in design; (9) It establishes team-work environment; (10) It helps reach common decision; (11) It keeps written data.

### ***Execution of QFD***

Execution of QFD is the construction procedure of House of Quality (FOQ). Subject or different objects and purposes, there are different procedures. The procedures include three layers: service plans, component plans and operation plans. The basic frame of FOQ includes: (1) customers' requirements; (2) analysis of engineering; (3) analysis of competition; (4) evaluation of technologies; (5) Interrelationship matrix (Brown, 1991), as shown in Figure 3.

Yoji Akao (1994) apply QFD into service industry, as shown in Figure 4. The procedures are as followings: (1) Demanded quality deployment chart is drawn based on questionnaire and topics in focus. Evaluation of quality importance is made according to occurrence frequency;

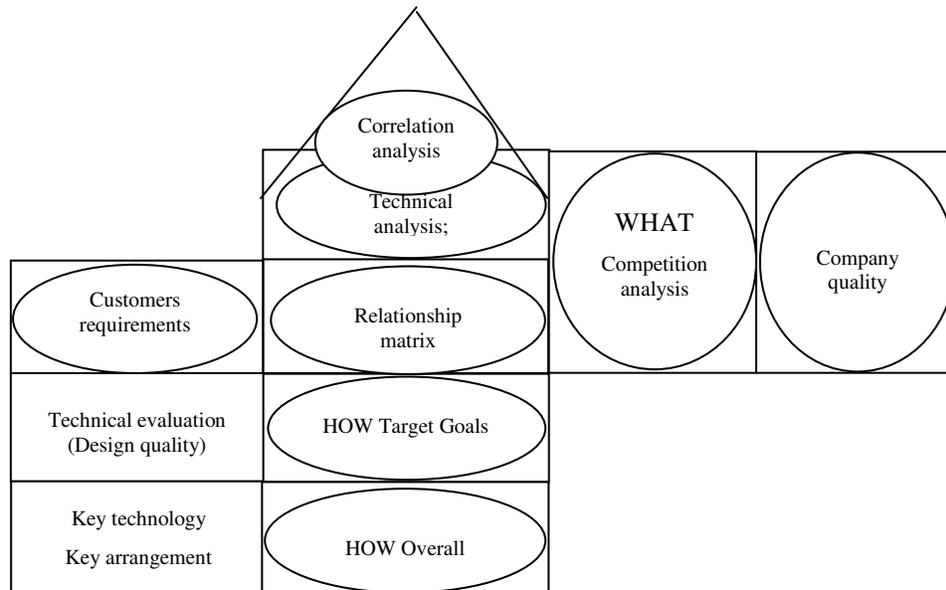


Figure 3. Frame of house of quality (Source: Brown, 1991)

(2) Quality deployment chart is made according to demanded characteristics deployment chart; (3) Quality matrix is made on the use of both demanded quality deployment chart and quality deployment chart; (4) Based on importance value of requirement quality characteristics and correlation between requirements and needs, importance value of each characteristics is rated; (5) Based on service mechanism, process deployment chart is made; (6) On the reference of process deployment charts and quality deployment chart, quality process deployment matrix (B) is made; (7) Calculation importance value of various processes from importance of quality characteristic

values and correlations between characteristics and processes; (8) Decide motifs of process during process procedure, draw matrix (C) together with process deployment chart and calculate importance value of motifs; (9) Based on processes of matrix (B) and (C) and the significant value of motifs, by way of Plato picture or QA charts, QC application charts of different tradeoffs are made together with the implement of comprehensive quality assurance activities.

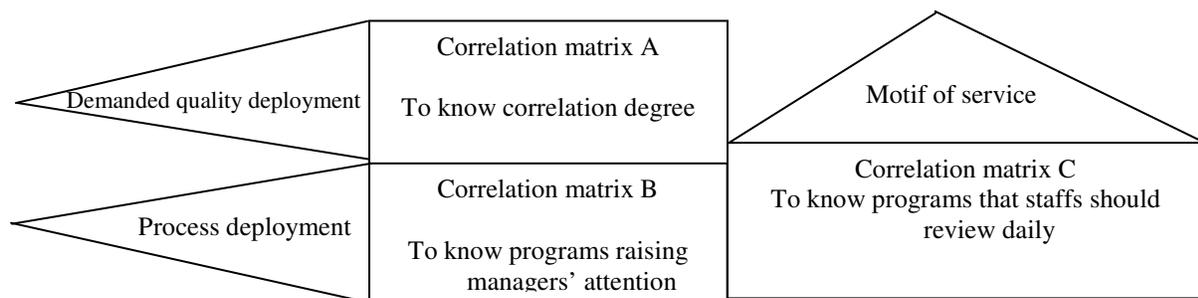


Figure 4. Quality deployment chart

Source: Yoji Akao (1994), translated by Chen Yaomao, Quality Function Deployment

## METHODOLOGY

### Research Frame

Based on the research purpose and literature review, the research frame is shown by Figure 5 aiming to understand customers' satisfaction degree on library service quality, to establish requirement quality of library service quality of the vocational and technical schools and get the priority of improvement of library service quality and conduction key technologies.

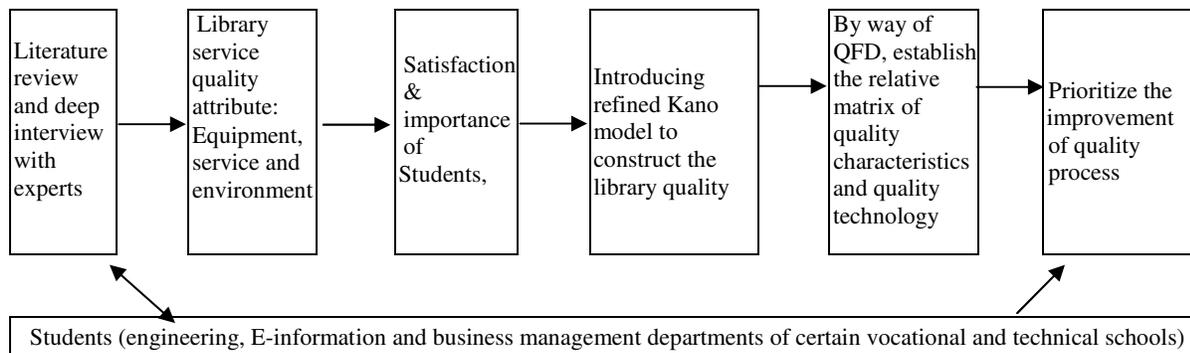


Figure 5. Research frame (Source: Compiled by the Research)

## Research Procedures

This research adopts integrated refined Kano model and QFD, with attribute categorization and adjustment of weighting, in order to facilitate the establishment of sequence of quality enhancement and the selection of key technologies. The research steps, demonstrated by Figure 6, are as followings: the 1st step is the establishment of measure standards for service quality. The questionnaire are designed on the basis of literature review and then dispatched to collect students' opinions on library service quality. The 2nd step is to evaluate importance and satisfaction value. The analysis is based on results of questionnaires. The 3rd step is to categorize according to refined Kano model. The categorization of results of questionnaires is based on Kano's two-dimensional categorization. Then, comparison of importance value of programs and general mean value is made for the purpose of categorization based on Kano's two-dimensional categorization. The 4th step is to adjust comparison value. According to refined Kano model to categorize quality attributes and pick out high attractive qualities, high added-value qualities, low added-value qualities, key quality attributes, must-be quality attributes and so on. These attributes are re-prioritized and sequenced as 6, 5, 4, 3, 2 and 1. The 5th step is to calculate adjusted priority. The 6th step is to re-sequence the elements. The 7th step is to establish the priority of quality enhancement With

results shown. by House of Quality, priority of quality enhancement and the key technologies of improvement of conduction of processes.

### Design and Objects of Questionnaires

Study objects of the essay are random-selected students of one vocational and technical school in Southern Taiwan. Totally, there are 1,000 students involved in the research. The method adopted is questionnaire and the tool for collecting data is Questionnaires of Vocational and Technical School Students on School Library Service Quality.

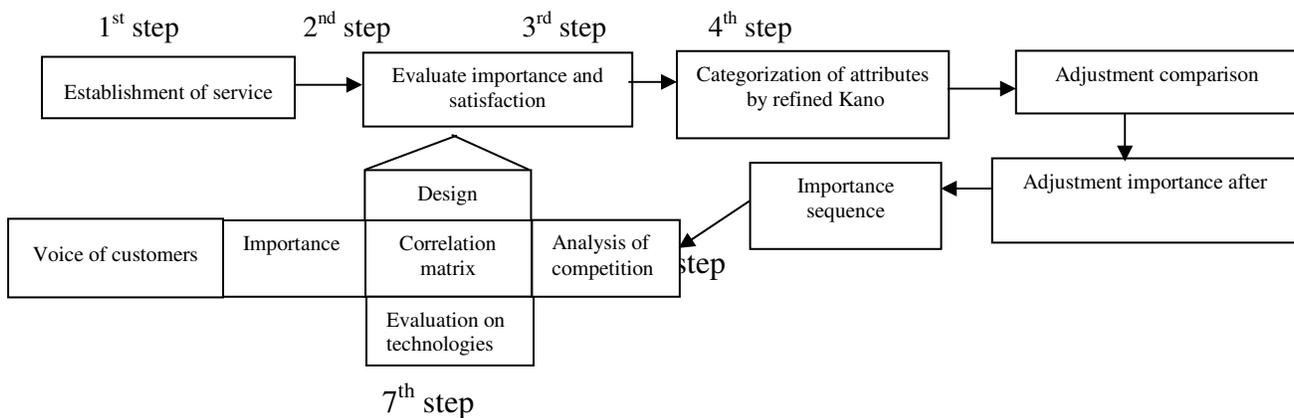


Figure 6. Research procedures (Source: Compiled by the Research)

The design and the modification of Questionnaires of Vocational and Technical School Students on School Library Service Quality makes reference to Shi and Levy(2005), Xie Boanuan(1998), Yu Taikui (2003), related studies and the interview opinions of experts. There are 4 kinds of questionnaires including importance value, satisfaction value, already done and undone respectively. Library service quality is divided into different dimensions such as equipment, service, and environment and so on with 34 sub-categories.

Basic data include gender, grades, and length of schooling, groups and different willingness of entering higher schools. The score system is divided into 5 degree as dislike, tolerance, indifference, granted and like subject to the fulfillment of library quality attributes or not. Scores of 1, 2, 3, 4 and 5 are rated according to personal perception. Another questionnaire is based on the questions the same with the former questionnaire. The interviewees' attitudes on the importance and satisfaction of accommodation qualities are divided into two categories with 5 alternatives respectively, named: extremely unimportant, unimportant, so-so, important and extremely important as well as extremely dissatisfaction, dissatisfaction, so-so, satisfaction and extremely satisfaction. Scores of 1, 2, 3, 4 and 5 are given according to interviewees' personal perceptions.

### **Quality Function Deployment, QFD**

The research makes reference on researches of Lai Shunzhen (2001), Guo Junting (2003) and Zhang Xuhua (2006). The research of QFD must use the following methods elaborated below.

#### ***Location of demanded quality***

The quality attributes rely on literature review omitted elaboration here. During the produce of quality deployment charts, the research makes use of refined Kano model to save man power, raise accuracy and precisely obtain psychosocial location of quality demands of customers (students) so that the establishment of quality standards and layout characteristic service. After classification of quality elements, according to refined Kano model definition, low-attractive

quality may be discarded from cost perspective. Those belong to non-disturbance quality, whether to be offered or not, cannot raise quality. Thus, low-attractive quality and non-disturbance quality should not be taken into consideration.

### ***Establishment of engineering quality elements***

The establishment of engineering quality dimensions makes reference on studies on measure of service quality of Parasuraman et al. (1985; 1988) and Juran (1986) together with the deep interview with school's administration staff. Firstly, general environment, hardware equipment, administration and operation procedures, service and the network structures are established. Then, the general environment dimensional deployment is subdivided into the appropriateness of library location, safety of library design, disabled equipment environment, landscaping and cleanliness. Hardware equipment dimensional deployment can be sub-categorized as providing of computer equipment, study rooms, research rooms, leisure equipment and copiers. Administration and operation dimensional deployment is divided into library regulations, appropriateness of management, simplicity of lending and borrowing procedures, sufficient staff and funds, simplicity and rapidity of data searching methods, contingency response ability and in-service training education. Staff service dimensional deployment can be sub-categorized into professional ability and skills, genialness of service attitudes, service response ability, cooperation of service, and

communication skills. Network dimensional deployment can be sub-categorized into clarity, accuracy, on-line answer and on-line borrowing and lending projects.

### ***Weighting priority of service quality elements***

(1) Difference index: The new evaluation value is got from the subtraction 3 respectively from original importance and satisfaction values. After the transfer, the quality enhancement index is got from multiplying importance and satisfaction values and new sequence is reached based on re-evaluation. The subtraction of importance rate and satisfaction rate is difference index. The smaller is the index, the earlier is enhancement of quality. When difference index is the same, the smaller is the index of enhancement of quality, the more priority should be given.

(2) Original priority weighting ( $Z_i$ ,  $i$  is No.  $i$  quality attribute): Based on difference index, the smaller the index is, the more prior the enhancement should be given and sequence is established according to this rule; (3) Priority weighting ( $X_i$ ,  $i$  is No.  $i$  quality attribute): Priority weighting is got from re-arrangement of the sequence of original priority weighting; (4) Standardized weighting: the sum of the division of priority weighting and original priority weighting is standardized weighting. ( $Y_i = X_i / \sum_{i=1}^n X_i$ ,  $i$  is No.  $i$  quality attribute,  $n$  is the number of entities of quality attributes.)

### ***Relation between quality elements and quality technologies***

Discussion is made with relative personnel and schools administrative staff on the correlation between quality elements and quality technologies. In the relation matrix, 5 represents the highest relation, 3 means moderate relation and 1 means low relation.

### ***Quality technologies weighting***

(1) Quality technologies absolute value ( $W_i$ ): technology absolute value of each technology is the sum of results of multiplying standardized weighting of each element and quality weighting refined Kano model, that is  $W_i = \sum_{i=1}^n Y_i * T_i * S_i$ .  $T_i$  is No.  $i$ 's quality attributes weighting.  $S_i$  is the relation between No.  $i$ 's quality attribute and quality technology. 6 means high attractive quality weighting, 4 represents high added-value weighting, 3 means low added-value element weighting, 2 represents key quality element attribute weighting, demanded quality attribute weighting is represented by 1. The regulation makes reference to researches of Zhang Xuhua (2006). During the research, attractive quality, one-dimensional quality and granted quality weighting is respectively represented by 4, 2 and 1. Refined Kano model holds that high quality attributes are with more values among attractive element and low attractive quality may be discarded from cost perspectives. Thus, the research does not include low attractive quality weightings. (2) Quality technology relative weighting  $U_i$ : this refers to the total sum of division of quality technologies absolute value and quality technologies absolute value, that is,  $U_i =$

$W_i / \sum_{i=1}^n w_i$ . The sequence based on this weighting value is the priority of technology conduction

enhancement.

## **ANALYSIS OF DATA AND RESEARCH RESULTS**

### **Research Objects and Obtain of Sample**

The research object is the vocational and technical school in Southern Taiwan, from 12<sup>th</sup> May to 12<sup>th</sup> June. The questionnaires are dispatched into students of Engineering Department, E-information Department and Business Management Department. There are 1,000 questionnaires dispatched and 639 pieces return. The return rate is 63.9%. After data sorting, there are 476 pieces of valid samples and validity rate is 74.49%.

### **Projects Analysis**

The research adopts analysis methods on the basis of Qiu Haozheng (2003). Firstly, sum of all the questionnaires is reached. Based on values sequenced from high to low values, questionnaires with values below 27% are classified into low score category. Questionnaires with values above 73% are classified into high score category. Then, t-test is carried out on results of each question of tested bodies of these two categories. After analysis of data, it is figured out that there are 136 questions possessing discrimination degree. All the questions can discriminate response degrees of different tested bodies and the continuity of contents.

### ***Validity analysis***

The questionnaires of library service quality dimensions used in this research are on the basis of summarization of literature, such as Shi and Levy (2005) and other relative experts.

Questions are based on contents proposed by Huang Mianmian (2006) and other scholars together with experts' interviewing opinions. As the contents of literature review have been tested by academic filed and possess content validity, thus, questionnaires on library service of the essay are designed based on synthesis of Kano's two-dimensional model and scale opinions with contents validity in discussing characteristics of students' demands on library service. Thus, the questionnaires possess certain content validity.

### ***Reliability analysis***

From Table 2, it can be found out that when library service quality with fulfilled attributes and non-fulfilled attributes, importance value and satisfaction value, from 3 dimensions of equipment, service and environment, possess high reliability(values of Cronbach  $\alpha > 0.7$ ) . Thus, contents of the scale table are high in consistency and possess inner reliability consistent index

The results show that when attributes is fulfilled and not fulfilled, among 136 importance and satisfaction question entities, all the scale coefficient  $\alpha > 0.7$ . Therefore, all the questions in the research possess discrimination degree and can discriminate different responses of tested bodies.

Table 2 Excerpt table of Scale Reliability on Library Service Quality Programs

Source: Compiled by the Research

Sub-scale tables	Number of questions	Cronbach $\alpha$ value			
		Attributes fulfilled	Attributes not fulfilled	Importance value	Satisfaction value
Equipment	7	0.8067	0.8338	0.7831	0.8089
Service	24	0.8587	0.9227	0.8403	0.8212
Environment	3	0.7145	0.8337	0.7238	0.7005
Total scale tables	34	0.8997	0.9441	0.8864	0.8796

### Kano's Two-dimensional Quality Total Analysis

The library service quality attributes are categorized based on Kano's two-dimensional model. Select quality attributes with relative more repetitions under conditions of fulfilled attributes and non-fulfilled attributes. On the basis of categorization of attributes in Table 1, Figure 7 is got with each quality attribute.

The research finds out that among 34 library service quality attributes, one-dimensional qualities include 5 entities such as convenience of book arrangement. These library service qualities are worth the attention of school broad. Thus, schools should give priority to these quality attributes for enhancement. Those belong to must-be quality attributes include 20 entities. These are must-be qualities of school library service. They should not be neglected due to the possession leading to no higher satisfaction. Those belong to indifferent qualities include 9 entities such as visual collection. These can be discarded from the cost perspectives.

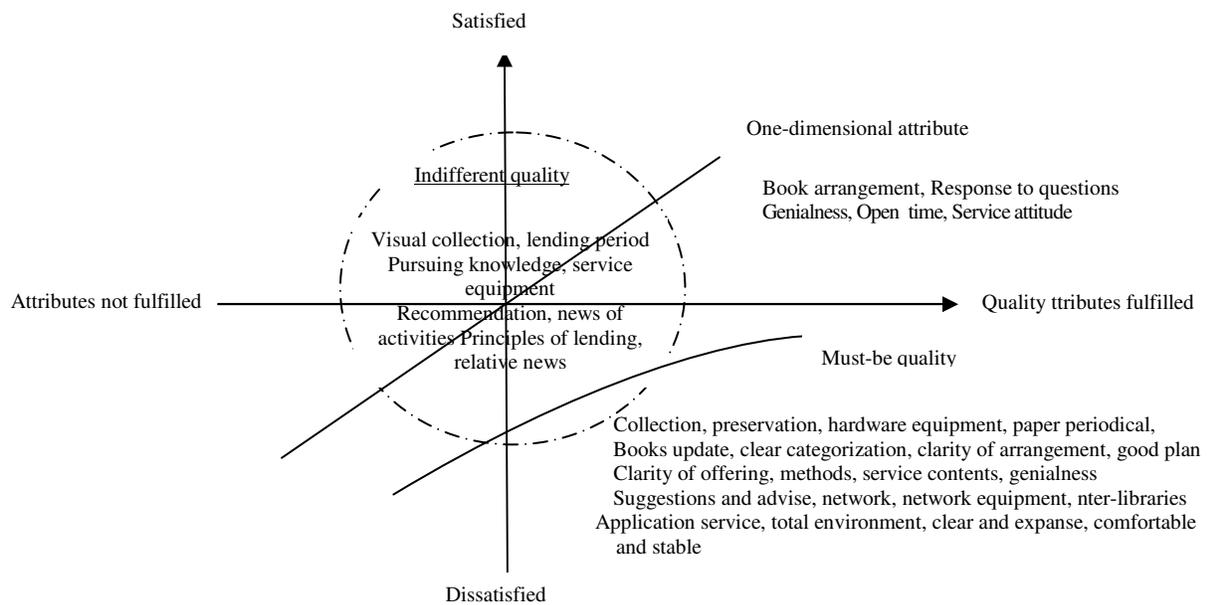


Figure 7. Refined Kano model analysis (Source: Compiled by the research)

### Refined Kano Model Analysis

According to Table 3's refined Kano model analysis, it is found out that there are 5 entities possess high value-added, that is, 7, 15, 17, 18 and 23. They have great contribution to universities and raise the achievements of school library service quality. Thus, schools should try their best to offer these services. There are 11 entities belonging to key quality attributes, they are 2, 3, 5, 8, 10, 13, 16, 19 and 32-34. Schools should offer these services to meet students' demands from students' perspectives. There are 8 entities belonging to Must-be quality attributes, they are 4, 9, 11, 12, 14, 20, 24 and 31. Schools should offer these attributes to some degree to prevent students' dissatisfaction quality. There are 2 entities belonging to potential qualities, they are 25 and 28. They are becoming attractive attributes. Schools should offer these attributes in the future as strategy weapons to attract students. There are 7 entities belonging to non-disturbance qualities, they are 6, 21, 22, 26, 27, 29 and 30. Schools have no need to offer these quality attributes from cost perspective.

## **Quality Function Deployment, QFD Analysis**

### ***Importance, Satisfaction and difference index analysis***

On the importance sequence of library service quality, open time and convenience of library resources are in the first place, followed by genialness and book update. On the satisfaction sequence, book update is in the first place, followed by genialness and the quick response to questions. Detail information offers in Table 4.

### ***Relative analysis of attributes and quality technologies***

Combined the first three elements in high value-added sequence, importance demanded quality sequence and different index needed improved, focusing on these elements' quality function deployment, the technology quality attributes needed established are introduced into HOQ matrix. After the multiple of standardized scale and the relation between quality attributes and quality technology, with the scale of refined Kano model qualities, first three quality technologies needed prior improved are picked out. They are funds and sufficient of staff in administration and function procedure dimension and the professional ability and technology in staff service dimension according to the sequence shown in Table 5.

Table 3. Refined Kano Model Analysis

Dimensions	Projects	Mean value of importance	Mean value of satisfaction	Kano attributes	Refined Kano attributes
Equipment	1. Collection	4.111	3.826	Must-be attribute	Demanded quality attribute
	2. Preservation well	4.244	3.971	Must-be attribute	Key quality attribute
Service	3. Hardware Equipment	4.214	4.038	Must-be attribute	Key quality attribute
	4. Paper periodical	4.139	4.048	Must-be attribute	Demanded quality attribute
	5 Book update	4.290	4.155	Must-be attribute	Key quality attribute
	6. Visual collection	4.065	3.889	Indifferent attribute	Non-disturbance quality attribute
	7. Arrangement convenience	4.218	3.880	One—dimensional attribute	High value-added quality attribute
	8. Clear categorization	4.225	4.099	Must-be attribute	Key quality attribute
	9 Clear mark	4.130	4.002	Must-be attribute	Demanded quality attribute
	10. Good planning	4.231	3.979	Must-be attribute	Key quality attribute
	11. Clear offerings	4.090	3.914	Must-be attribute	Demanded quality attribute
	12 Ways	4.111	3.924	Must-be attribute	Demanded quality attribute
	13. Service contents	4.229	4.032	Must-be attribute	Key quality attribute
	14. Genial teaching	4.132	3.970	Must-be attribute	Demanded quality attribute
	15. Responses	4.176	4.109	One—dimensional attribute	High value-added quality attribute
	16. Suggestions and advices	4.225	4.069	Must-be attribute	Key quality attribute
	17. Genialness	4.216	4.099	One—dimensional attribute	High value-added quality attribute
	18. Open time	4.351	3.994	One—dimensional attribute	High value-added quality attribute
	19. Network	4.185	3.863	Must-be attribute	High value-added quality attribute
	20. On-line renew	4.113	3.874	Must-be attribute	Key quality attribute
	21. Period of lending	4.050	3.866	Indifferent attribute	Demanded quality attribute
	22. Pursuing knowledge	4.055	3.933	Indifferent attribute	Non-disturbance quality attribute
	23. Service attitude	4.294	4.126	One—dimensional attribute	High value-added quality attribute
	24. Inter-library	4.151	3.916	Must-be attribute	Demanded quality attribute
	25. Service Equipment	4.174	3.924	Indifferent attribute	Potential quality attribute
	26. Readers recommendation	4.004	3.859	Indifferent attribute	Non-disturbance quality attribute
	27. Activity news	4.061	3.880	Indifferent attribute	Non-disturbance quality attribute
	28. Lending records	4.214	3.980	Indifferent attribute	Potential quality attribute
	29. Relative information	4.145	3.965	Indifferent attribute	Non-disturbance quality attribute
	30. Collection	3.960	3.853	Indifferent attribute	Non-disturbance quality attribute
	31. Service	4.065	3.889	Must-be attribute	Demanded quality attribute
	Environment	32. Overall environment	4.273	3.909	Must-be attribute
33. Clear and expanse		4.221	4.019	Must-be attribute	Key quality attribute
34. Comfortable and stable		4.242	3.994	Must-be attribute	Key quality attribute
	Mean	4.165	3.968		

Table 4. Analysis Table of Importance, Satisfaction and Different index of Service Quality

Quality attribute dimension	Quality attribute	Service importance			Service satisfaction			Enhancement index	Difference index
		Before convert	After convert	Rate	Before convert	After convert	Rate		
Equipment	Collection	4.11	1.11	24	3.8256	0.8256	33	0.9164	-9
	Preservation well	4.2437	1.2437	5	3.9706	0.9706	16	1.2071	-11
	Hardware equipment	4.2143	1.2143	13	4.0378	1.0378	8	1.2602	5
	Paper periodical	4.1387	1.1387	19	4.0483	1.0483	7	1.1937	12
	Book update	4.2899	1.2899	3	4.1555	1.1555	1	1.4905	2
	Visual collection	4.0651	1.0651	26	3.8887	0.8887	25	0.9466	1
	Convenience arrangement	4.2185	1.2185	11	3.8803	0.8803	27	1.0726	-16
	Clear categorization	4.2248	1.2248	9	4.0987	1.0987	5	1.3457	4
	Clear mark	4.1303	1.1303	21	4.0021	1.0021	11	1.1327	10
	Good planning	4.2311	1.2311	7	3.9790	0.9790	14	1.2052	-7
Service	Clear offerings	4.0903	1.0903	25	3.9139	0.9139	22	0.9964	3
	Ways	4.1113	1.1113	23	3.9244	0.9244	19	1.0273	4
	Service contents	4.2290	1.2290	8	4.0315	1.0315	9	1.2677	-1
	Genial teaching	4.1324	1.1324	20	3.9685	0.9685	17	1.0967	3
	Responses	4.1765	1.1765	15	4.1092	1.1092	3	1.305	12
	Suggestions and advises	4.2248	1.2248	9	4.0693	1.0693	6	1.3097	3
	Genialness	4.2164	1.2164	12	4.0987	1.0987	4	1.3365	8
	Open tim	4.3508	1.3508	1	3.9937	0.9937	13	1.3423	-12
	Networ	4.1849	1.1849	14	3.8634	0.8634	30	1.0230	-16
	On-line renew	4.1134	1.1134	22	3.8739	0.8739	28	0.9730	-6
	Period of lending	4.0504	1.0504	30	3.8655	0.8655	29	0.9091	1
	Pursuing knowledge	4.0546	1.0546	29	3.9328	0.9328	18	0.9837	11
	Service attitude	4.2941	1.2941	2	4.1261	1.1261	2	1.4573	0
	Inter-library	4.1513	1.1513	17	3.9160	0.9160	21	1.0546	-4
	Service Equipment	4.1744	1.1744	16	3.9244	0.9244	20	1.0856	-4
	Readers recommendation	4.0042	1.0042	31	3.8592	0.8592	31	0.8628	0
	Activity news	4.0609	1.0609	28	3.8803	0.8803	26	0.9339	2
	Lending records	4.2143	1.2143	13	3.9958	0.9958	12	1.2092	1
	Relative information	4.1450	1.1450	18	3.9748	0.9748	15	1.1161	3
	Collection	3.9601	0.9601	32	3.8529	0.8529	32	0.8189	0
Service	4.0651	1.0651	27	3.8887	0.8887	24	0.9466	3	
Environment	Overall environment	4.2731	1.2731	4	3.9095	0.9095	23	1.1579	-19
	Clear and expanse	4.2206	1.2206	10	4.0189	1.0189	10	1.2437	0
	Comfortable and stable	4.2416	1.2416	6	3.9937	0.9937	13	1.2338	-7

Source: Compiled by the research



quality subject to students' needs. For example, pick out high value-added quality with great contributions such as convenience of arrangement, quick response, functions of website and genial to readers, open time, convenience of resources, genialness. Key quality attributes must offer sufficiently, such as: ample and well-preserved of data-base with simple research and usage, sufficient software and hardware equipment for research, rapid update of books, clear mark of projects of each stair, dynamic planning well with clear mark, acquaintance with service and procedures as well as operation of equipment, appropriate response on suggestions and advises, personal lending records on the net with easy operation, good overall environment (such as: atmosphere, cleanliness and quietly), appropriate of location with bright and expanse space and comfortable and stable of desks and chairs. Quality attributes must reach certain must-be level, such as: collections, fresh and timeliness of magazines and visual equipment, ample collection of paper periodicals and magazines, clear mark of service in each stair, clear operation information on equipment with operation manual with pictures, offer information actively by use of different methods (such as: e-mail, website of library), genial teaching on usage of library resources and equipment, on-line booking, renew, notice for arrival and expiration of books, inter-library service (such as: borrowing books and copies from other libraries ) and implement service quality research. Potential qualities such as: service equipment (such as: copiers and scanning machine) and accuracy of lending and borrowing records. These attributes is becoming

attractive attributes and administration office may take these into consideration for further strategy weapons to attract customers. Non-disturbance attributes such as: ample of visual collections (such as: DVD, VCD and video tapes), reasonable on lending numbers and periods, location for knowledge as well as relax and leisure place, receive readers' recommendation, handle art activity news, relative information on update library data and introducing meeting of library usage. These entities may be discarded from cost perspectives.

On library service demanded quality perspective, the followings are comparatively most important 2 entities on the basis of research objects: rapidity of book update together with ample and well preserved data base without trouble in searching and usage in structure dimension, open time and convenience for library resources together with genialness in service dimension, good overall environment (such as: atmosphere, cleanliness and quietly) together with comfortable and stable of desks and chairs in environment dimension. Among all these things, the most important entities are open time and convenience for library resources, genialness and rapidity of book update.

### ***Satisfaction on demanded quality***

The mean satisfaction value of research objects on library service quality of a certain vocational and technical schools in Southern Taiwan is 3.968, which means there is still space for improvement. Among quality attributes, comparatively satisfactions are rapidity of book

update, genialness, and quick response to questions. Comparatively dissatisfaction entities are: book collection, fresh and timeliness of magazines and visual equipment, introducing meeting on usage of library resources and acceptance of readers' recommendation. As introducing meeting on usage of library resources and acceptance of readers' recommendation belonging to non-disturbance quality, while book collection, fresh and timeliness of magazines and visual equipment belonging to must-be quality needs, When improvement is on the comparatively dissatisfaction entities, book collection, fresh and timeliness of magazines and visual equipment should reach certain degree to solve the dissatisfaction on service quality and it facilitates to enrich the efforts if improvement standards rely on satisfaction.

### ***Different index perspectives***

As the first three entities shown by different index are: good overall environment (such as: atmosphere, cleanliness and quietly), on-line personal lending and borrowing records with simple and clear operation and convenience for arrangement. There are great gaps between importance and satisfaction in the values of these three entities. If gaps between importance and satisfaction are taken into consideration in deciding the prior enhancement qualities, these three entities should be in priority place.

### ***Sequence on quality technology conduction***

The research uses integrated and refined Kano model and QFD analysis to figure out the priority in conduction key quality technologies when improving library service quality of this vocational and technical school. The priority is given to entities of funds, sufficient of staff and professional ability and skills.

### **Contribution of the Research**

After empirical studies, categorizations of refined Kano's two-dimensional quality model in library service quality are known. Satisfaction and dissatisfaction on each service quality is clarified. Procedure importance sequence is figured out after understanding priority of conduction on service quality so that reduce the time and energy in improvement planning and save waste of resources.

### **Suggestions for Further Studies**

- (1) Focusing on importance of engineering technologies offered by research results, further research analysis with administration and planning implement steps should be carried out for the convenience of implement of administration.
- (2) Satisfaction research after improvement: focusing on the improved service quality, satisfaction research may be carried out in order to know the effectiveness of improvement

measures in enhancement of library service quality with the purpose of fully usage schools' resources.

(3) Sample selection: due to limited man power and material, the tested bodies are restricted to students of a certain vocational and technical schools in Southern Taiwan. For better understanding on the whole situation of library service quality of vocational and technical schools in Taiwan, taking geographical difference into consideration, it is highly recommended to adopt stratified sampling method which classifies the area into 4 sub-categories: Northern part, Middle part, Southern part and Eastern part of Taiwan. Results based on the samples from 4 areas are more convincing and practical.

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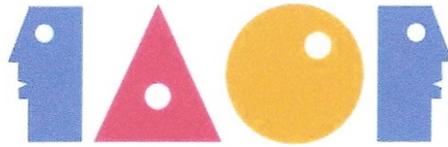
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## **THE IMPACT OF VOCATIONAL EDUCATION ON HUMAN RESOURCE DEVELOPMENT IN CHINA**

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### **ABSTRACT**

This study analyzes the impact of China's vocational education on the human resource development, mainly from the aspects of sociology, economics and pedagogy. Including the method of triangular corroboration analysis as well as interview on the spot and telephone interview, this study has also carried out case studies on three areas with better vocational education records and three areas with worse records, and in doing so, the conclusion has been drawn. These six areas served as examples for mutual comparison to analyze the condition of vocational education and its impact on the human resource development. As a result of these

analyses, The Impacts of Vocational Education on Human Resource Development in China was further studied and findings were discussed.

**Key Words:** Vocational Education, Human Recourse Development, Planned Economy, Market Economy, WTO.

## **INTRODUCTION**

China has adopted the policy of reform and opening up for more than 20 years, and during this period of time, vocational education has made progress in both theory and practice. Dic (2002) stated that various vocational schools and training programs have taken significant actions. Vocational education, which has become an important component of China's educational enterprise, has pushed the progress of technology and rapid development of national economy. This has helped to improve the quality of Chinese professional workers. A large number of laborers have been trained and talent for Chinese modern socialist construction has been applied, but the reform and development of vocational education still faces difficult problems. Some places have not yet noticed the importance of vocational education. Input is far from enough and this has limited the building of a solid base and good conditions. Guo (2000) said that the system of governance and schooling and teaching quality cannot meet the demands of economic construction and social development. Jiang (2002) said that the regulation of careers has not been effectively implemented and this has resulted in the frustration and lack of

enthusiasm among trainees. Huang (2001) said that the number of different vocational schools in urban and rural areas is not balanced. In order to address these problems, the Chinese State Department issued a document in August, 2002, which intended to promote vocational education from all aspects of educational governance, including financial budgets and promotional publicizing.

Li (2007) pointed out that in June, 1996, the Chinese State Department stated that China should promote higher education through various positive means, and by 2010, the enrollment rate of higher education should be improved from 9% to 15% of the same population. On the other hand, Mao (2007) stated that the sustainable developments of talent are often neglected, and this development can only be accomplished by a more effective system of vocational education. Shiue (2001) said that since social competition comes down to talent competition, it is easy to understand that human resource development also comes down to development of talent. Chinese governmental institutions and departments have always attached importance to the cultivation of talent, and they are cognizant of the important role education has played in the construction of society and economy. Sang (2003) indicated that the adjustment of economic structure happens faster and spreads to the whole world more quickly. Wang (2002) stated that technology has become the key element that decides the future of enterprises. The imperative

demands of the cultivation of people with innovative abilities determine the distinct status of vocational education in the national economy of China.

Jau and Lee (2005) pointed out that after entering the World Trade Organization (WTO) that China faced many challenges trying to enter successfully into the international economical arena. The education received by the Chinese people varies from one region of the country to another, especially in vocational education. It is far behind human resource developments; however, if this condition is changed, China will be able to meet all knowledge and technology challenges. Thus, Cano-Garcia and Hughes (2000) indicated that the improvement of vocational education in China and the improvement of the educational level of the social laborers are quite essential to the globalization of the economy, technology and the pools of skilled workers.

### ***Relevant Issues of Vocational Education in China***

According to the Vocational Law set in 1996 of the People's Republic of China, vocational education is an important part of the country's education program, and Yang, Zhang and Zhang. (2004) pointed out that a significant means to accelerate the development of economy and society while enhancing labor employment. Every country has its different statements on this issue. Currently, the most acceptable one was given by UNESCO (United Nations Educational, Scientific and Cultural Organization) in 1998. It says that "vocational or

technical education is designed to guide students to master the practical skills, specialized knowledge and cognition in certain specialized professions or trades as needed in specific areas.

### ***Development of Vocational Education since the Reform and Opening-up***

Aidan and Brannick (2003) stated that according to the prior accumulation of human capital theory, only when the level of exploitation of human resource is superiorly collocated with that of the material capital can it boost productivity. Only when the inner qualities of laborers respond to the outside environment can they encourage economic development. Jiang (2007) indicated that in China's current population resources, manpower resource is much more abundant than talent resource, which is the real pressure on the development of knowledge economy. Carnevale and Desrochers (2002) stated that to improve the social adaptability of sustaining education, education location must be directed to the civil vocational education of all the society, i.e. popular education.

Xia (2005) said that vocational education plays an active and important role in the economic development and social progress. Therefore, it leads to a kind of factual social demand for middling (defined as middle level or middle quality) vocational education. Jiao (2003) pointed out that in recent years; thirty percent of the new employees accepted by enterprises in Shanghai came directly from middling vocational school graduates. Yang, (2007) stated that according to surveys conducted by some enterprises, ninety-five percent of middling vocational school graduates are evaluated as satisfactory and very satisfactory. Sixty-six percent play a rather important role in society. Lee (2007) said that according to the survey conducted by

Beijing Meters and Instruments Technical School, 37.5% of the total employees in high-tech corporations in Zhongguan Village in Beijing are from such middling vocational schools and 90% of the 600 employees of Pingdu Refrigerator Factory, Haier Group in Shandong province, graduated from middling vocational schools.

### ***Challenges Facing China's Vocational Education***

China's top vocational education is still restricted to the junior college education level. Jou (2001) stated that this is abnormal because the dynamics of the senior vocational education are not fundamentally different from those of any other countries. In Chinese society, there are many needs for college-level talents with applied techniques. (Guo, 2000). After the entrance to WTO, international competition was destined to demand a rapid advancement of enterprise management and technique. Thus, the imminence of improving the education level of talents with applied techniques will be accelerating. Yang and Yang (2001) said that the senior Chinese vocational and technical education level surely needs to be improved. In recent years, China's vocational and technical educational development has been facing hyper-normal challenges. Banke, Charnes, & Cooper (2004) indicated that its preponderance has been beyond the prediction of vocational educational experts. The main reason for this challenge is the variation of the exterior environment for China's economic development, i.e. the process of economic globalization and its impact on China's educational policy selection. At present, the concern is

that on one hand, some officials have partial opinions about middling vocational education. On the other hand, there appears to be an obvious fickle psychology within middling vocational education. Luo (2006) stated that educators are anxious to upgrade and reform and are concentrating on the proportion of students entering schools of a higher grade, but they are attending only to the quality of source students while neglecting the employment rate and attaching importance to economic benefit and belittling the quality of education. Charne, Cooper, & Rhodes (2002) said that in 1999, among the 47 most important countries and districts all over the world, China's position in scientific and technological competition fell from 13 to 25, according to the international competitive power report issued by the world's Management and Development Research Institute in Lausanne, Switzerland. The number of people undertaking scientific research and development is at the top of the list, but the availability of qualified engineers is lower than ever.

Due to historical events, the minority dominant areas do not have the necessary social conditions for the development of vocational education. Fare, Geoskopf & Weber (2004) stated that though many vocational and technical education schools have been set up, they only meet the needs of a planned economy. They are unable to push the development of society, economy and culture in the minority assembled areas.

## **Demand for Vocational Education from China's Market Economy**

Yang (2002) stated that in China there is a lack of successors to highly skilled workers, embodied by the senile age structure and especially by the outdated structures of expertise and technical skills. It is easy to predict the market demand tendency for skilled workers. Thus, Doyle & Green (2003) said that it is quite difficult for those farmers with only junior high school education to obtain jobs in the cities. He predicted that even if these farmers do get a job in some enterprises, it will still be difficult for them to further develop, and this may have negative effects on the social public security.

After entry into the WTO, China made further adjustments to the structure of economy, industry, trade, and even education. In the short run, it will bring the industrial economy, beginning with an elementary market, into the track of a highly worldwide competitive knowledge economy. This will have a strong impact upon the old ideas, old systems, irregular school-running behaviors, and lagging management modes of teaching. Zhang (2005) pointed out that this impact will require that the educational system be more open to the market, demand more entities to run schools, and further develop the local-run education and schools jointly with international cooperation. Therefore, Jiang (2005) mentioned that it is necessary to compel schoolmasters to step from behind the back stage to the front stage and run schools independently, in order to meet the market demands at home and abroad. China's entry into

WTO intensified the competition in the labor exchange market and the system, management, service, and thinking mode of the territorial labor market adopted the market principle (Chu and Shr, 2001).

After China's entry into WTO, the education market in China became like a huge piece of cake which was coveted by more foreign multinational corporations and educational agencies. Therefore, in face of the new challenge, there must be a rapid response to prepare and build up the market consciousness. Urgent tasks are in front of the Chinese educational administrative departments and schools (Li, 2007). Facing the increase of foreign agencies in China's education market and determining how to compete with them will become the mission of China's educational reform.

### ***Prospects for the Development of Vocational Education in China***

Viewed from the outside, China's vocational education faces difficulties due to many traditional factors in the practical development needed for success. Zhou (2002) stated that middling vocational education faces double layers of difficulties in order to adapt to the conversion of a studying society. It is important to let go of the old conservatism of technology and tools and commit to the ongoing higher education development and non-vocational high school education reform.

Viewed from the inside, Zhang (2001) stated that the reform in technological colleges and the rise of professional degree education originated from the thought of seeking truth from facts. Lee (2007) pointed out that reformers are concerned with the standards of vocational and practical modern talents and while the reform on non-vocational high school education should not move away from vocation and technique, but instead draw on the lessons from vocational education. In such a situation, Zhao (2007) said that if the vocational education falls back and consolidates itself, it might be on the road to draining the pond to get all the fish. If the government and the public can maintain the line of thought and keep forging ahead to bring the advantages of vocational education into full play to achieve characteristic innovations under new circumstances, expanding it from both directions (one to upgrade to higher vocational education and another to borrow ideas from non-vocational high school education), it is very likely for China to create a new situation for the development of vocational education (Li, 2007).

The entry into WTO would have a positive and facilitating effect on the updating of China's educational concepts, the consummation of educational system, and the content enrichment of education, the application of new techniques, the improvement of educational administrative level, and the exchange of teachers. Thus, Dic (2002) stated that higher vocational education should enthusiastically introduce foreign advanced courses, textbooks, teaching methods, and teaching technology to shorten the distance from them, and thus, speed up the

development. Liu (2000) pointed out that modern society's demand for people's working capability is changing. It is inadequate to just improve professional skills at a post. What is most important is the ability to meet an emergency, existence, and development. Meng (2001) stated that to acquire further understanding about the objectives of vocational education becomes essential, not simply to aim at a certain post, but to expand it to the whole career of the laborer. As a result, the nature of vocational education will change into lifelong education rather than the end of education.

## **METHODOLOGY**

The research of the pedagogical scholars can perhaps follow the wrong path and compare vocational education with higher education so that vocational education will always seem like a low-level education and reflect no national power. The result is that vocational education would appear to be a secondary, not a primary education for the people.

The government has become aware of the importance of vocational education, but does not know how to improve it. There are many questions. Where should improvement start? How much manpower, money and material should be devoted? How will it be reflected in society? How should the government handle all of these kinds of problems? All of these questions should be investigated because the outdated methods of the fifties do not function anymore.

This study involves comparisons of vocational education in developed districts and in backward districts. It used qualitative analysis to discover the similarities and differences in the districts where vocational education exists and districts where no vocational education systems exist.

### **Sampling**

The six regional areas of China, chosen for the conduction of interviews and case studies included: (a) Shanghai Huangpu District, a developed region with commercial characteristics; (b) Juye County of Shandong Province, a developed region with agriculture as its primary industry; (c) Changdao County of Shandong Province, a developed region with fishing as its primary industry; (d) Dongxiang County of Gansu Province, an economically and socially depressed region with minorities constituting the majority of the population; (e) Zhangjiachuan County of Gansu Province, a backward region with animal husbandry as its primary industry; and (f) Jinzhai County of Anhui Province, a backward region with agriculture as its primary industry.

### **Data Collection**

This study selected some objects, for instance, that included different kinds of schools and enterprise employees and then explored the inner connections and uncertain factors between vocational education and economic development through investigations and case studies.

## **Analysis of Data**

This study conducted the following steps:

1. First, it compared vocational education in developed districts and backward districts.

This involved longitudinal and transverse comparisons. Longitudinal comparison chiefly centered on the analysis of the status quo and the future development tendency of vocational experience in a certain region. Transverse comparison mainly referred to the comparison among economically developed regions and backward regions.

2. Second, it used qualitative analysis to discover the similarities and differences in the

districts where there existed vocational education and those where there did not. For carrying out the qualitative analysis, the following were put into practice in order:

- (a) Emphasis was placed on the interdisciplinary study, such as organically connect

manpower, economy, and education, in order to give prominence to the interdisciplinary characteristic of research.

- (b) Some objects were selected such as different kinds of schools and enterprise

employees. Then the inner connections and uncertain factors between vocational education and economic development were explored through investigations and case studies.

(c) When collecting data, triangular corroboration analysis, an effective method for qualitative research, was used. Data was gathered by various sources or methods and the coherence of data and truth for evaluating data and accuracy of outcome were strictly kept confidential.

3. Third, an analysis figured out the laws and methods of change and development and summarized the development of local vocational education, cultural level and manpower educational level since 1978, the beginning of the reform and the opening up of China. On this basis, the study investigated correlation among education, the economy, and population, in order to determine the inter-restrictions among them. Finally, suggestions were constructively made on vocational educational development, economic development programs, and economic growth patterns.

## **DISCUSSION AND CONCLUSIONS**

China boasts a vast territory with distinct differences among districts. Such great regional diversity has given rise to different styles and patterns among different districts as far as the developmental rules of vocational education and its relation with the human resource development are concerned.

According to the different degrees of human resource development in China, two types of areas can be distinguished--developed regions and backward ones. The features of the developed

areas are a well developed economy, a high level of development, man-power resources, a large number of colleges, universities and academic research institutions, and a comparatively perfect system of vocational education.

These advantages make possible the synchronized development of industry, education and research. For these areas, knowledge should carry out a major function in promoting and guiding the development of industrial economy and transforming the traditional agriculture into a modern technical industry, i.e. bio-chemical medicine, life-sciences, network information and so forth.

Some regions such as Juye and Changdao of Shandong Province recently became prosperous with the execution of the reform and opening-up policy. Shandong is a coastal province. Juye is located in the south of Shandong Province with a population of around 910,000; Changdao is also located on an island of Shandong Province with a population of 46,000. It has industrial foundations of ordinary level, and therefore, as a newly developed region, it is somewhat weak and cannot withstand the fierce competition brought about by entering the WTO. In these areas, there are limited vocational education systems and certain research facilities, but the foundations are not as solid as those of Shanghai. Therefore, the market economy must be used to transform the traditional industries in such areas. In the areas with better conditions, the industries related to human resource, such as software industry,

consultation industry, medicine, communication, etc. can be chosen for development and used to adjust the original industrial structure vigorously. Some of backward regions, especially old and barren areas, such as Zhangjiachuan and Dongxiang of Gansu Province, do not have solid economic foundations. Gansu is a west province. Dongxiang is located in the central part of Gansu Province with a population of 260,000; Zhangjiachuan is located in the southeast of Gansu Province with a population of 300,000.

As for these areas, the infrastructure facilities must be strengthened and the strategy of “laying a good foundation and progressing with leaps and bounds” should be used. The development of information, internet, traffic and natural resources should be quickened. In the long run, in these areas, the most important priority is to improve the quality of human life. As long as human resource is developed, knowledge economy will develop subsequently. Knowledge should be put into full use in order to promote local economic development. At present, these areas should learn lessons and experiences from the town and township enterprises of the coastal areas and properly develop the industries employing the local natural resources.

Meanwhile, with agricultural development, the information from Internet sources should be employed to gain the latest technologic knowledge for the purpose of inspiring the development of high-quality, efficient agriculture and side industries. The agricultural and side industrial productions with their natural advantages should be rapidly introduced all over the

country and even abroad. At the same time, this would promote the investment in education and the improvement of human quality in these areas. Vocational education should be developed as knowledge can lead the regional economy to further development. Chen (2002) said that the natural resources in these areas should be protected while being developed. The tourism of natural scenery and human resources can be developed first by means of inter-regional cooperation and joint development which would lead to the development of the economy, the cultivation of regional intellectuals and the promotion of the qualities of the human resources. Jau and Lee (2005) pointed out that after China entered WTO, the social economy entered into the period of transformation which is represented in two ways. First, a transformation of economic system is moving from the traditional planned economy to the market economy. Second, the transformation of the world economy is moving from an industry economy to a knowledge economy.

These two major economic transformations could lead to the imbalance of economic development among regions in the initial periods, but finally they will eliminate the regional differences. With the establishment and perfection of both the national market economy system and the enterprise competition system, the economic groups will surely make trans-regional investment. In such an investment, the cost difference of resources, manpower and capital would be used to pursue benefit, efficiency, and comparatively high ROI (return on investment), and the

kind of investment finally will bring along the development of the regional economy. By this means, the difference among regional economies will be gradually reduced. Along with this complicated economic activity and the constant change of knowledge and skills, vocational education can affect and prompt the human resource development in accordance with the basic developing rules.

The development of the market economy in China has brought about not only an unprecedented opportunity, but also a challenge for the development of vocational education. In order to establish the market economy system, the planned economy system should be discarded and large-scale and substantial adjustment should also be made to the current industrial structure and employment structure resulting in the necessary changes of the employment types and professional demand types in the employment market. Nevertheless, most of the current labor forces in China were trained according to the requirements of the planned economy system, so now they must be retrained to meet the demands of the changing markets. Vocational education in China will be in great demand because it will provide retraining for several hundred million strong labor forces, as well as foster the new labor force. In the meantime, it is also confronted with the great challenge and impact from the transformation of economic structure, which is represented by the following five aspects.

### **1. Influence of the Industrial Structure**

The planned economy has played a leading role in China for a long time, and the outstanding feature of its industrial structure layout is the large proportion of labor force and agriculture versus the relatively small proportion of service industry. According to *The World Development Report in 1990* by the World Bank, the proportion of the service industry in the Gross National Product (GNP) in China is one of the lowest among all the countries in the world. The corresponding employment structure has formed according to this type of industrial structure. Until 1991, the arrangement of labor force demand kept its original order of agriculture followed by hi-tech industries and service industry. However, since 1991 and in view of the economic development trend, the labor force has been and will continue to be gradually transformed from agriculture to hi-tech industries and the service industry.

From relevant forecasts and analyses from 2000 to 2020, the industrial structure of China is arranged in the order of hi-tech industry, service industry and agriculture according to their respective proportion in GNP and the employment proportion of the labor force. In 2000, the proportion of agriculture declined from 28.4% in 1990 to 20.64% in 2000 and is expected to further decline to 12.78% in 2020. The proportion of hi-tech industry shows a slight increase from 43.6% of the GNP in 1990 to 48.80% in 2000 with a projected increase to 47.22% in 2020. The proportion of service industry has increased rapidly from 28.0% in 1990 to 30.56% in 2000 is projected to be 40.00% in 2020. In 2020, the characteristics of the Chinese industrial economy

are comparable with those countries in which the average GNP is from 1500 to about 2000 dollars. The proportion of the service industry in China will still be small approximately 8% lower the current proportion of the labor force, however, the proportion of hi-tech industry will maintain an exorbitant rate approximately 10% higher than the current proportion of the labor force.

The labor force structure will be facing enormous adjustments. In order to be prepared for these adjustments, vocational education needs to put the emphasis on training talents for hi-tech industry and service industry. The urban vocational education model has been initiated in accordance with the structure layout for the stabilization of hi-tech industry and the development of service industry. In Shanghai, for example, the impact is continuous and the development of the market economy and the transformation of industrial structure have put forward new requirements for vocational education. Thus, only through continuous adaptation to the changes of the market economy can vocational education in Shanghai survive and develop.

Concurrent with the labor force transfers among the industry sectors, large-scale occupation transformation will appear and the substitution process of high-quality talents for low-quality labor force will be expedited. The change in demand for laborers' knowledge and skill will be a new challenge for the contents and methods of vocational education. In Shanghai, however, the proportion of higher vocational education is too small, while that of middle

vocational education is too high, which conflicts with the demand structure of the higher industrial structure and laborers' advanced skills. In view of the present structure of vocational education, the cultivation scale for high-level and professional talents is rather small, and cannot meet the needs of the developing mainstay industry and new high-tech fields. Shanghai is in urgent need for the transformation of a set of vocation-specialized schools into higher vocational school.

The current decline of rural vocational education is also the result of the impact from the adjustment of industrial structure. More and more of the rural surplus labor force floats to the cities and then gradually infiltrates into the urban hi-tech industry. The development of rural middle vocational education that enables the country to face hi-tech and service industry is a necessity. Only then can the rural surplus labor force be trained to become a considerable labor force resource.

## **2. Contributions of Vocational Education to Human Resource Development**

Vocational education transforms the simple labor force that gives priority to physical labor and using experience and skills to the complex type that is engaged in higher order skills and mainly uses technology and knowledge. Furthermore, it could transform the potential for productivity to practical and direct productivity, consequently enhancing the knowledge base in the labor force, changing the form of the labor force and adding a strong stamina to it. Vocational

education provides knowledge and skills that enable one to adapt better to the human resource development. When such knowledge and skills are applied in the production process, they can improve the productivity and prompt economic development. A complete vocational experience system, which must ensure the trained talents to merge with the occupation structure and economic structure in society, has to pay attention to the quality and quantity of talents and give regard to whether they can find employment.

### **3. Impact of Labor Force Market**

In the early days of the reform and opening up in China, hundreds of thousands of workers rushed into Hainan to pursue business. After the establishment of the labor force market, people strived for justice, freedom and competition in order to make the best use of their talents. According to the feedback information from the labor force market in recent years, however, both sides of supply and demand in the labor force market have not achieved satisfactory results yet. Most people, especially those laid-off workers, had great difficulty in finding a job through the labor force market. The reasons for this are as follows:

(1) After the adjustment of the industrial structure, many new vocations were short on laborers with the needed talents and skills, but the applicants were unfamiliar with the new occupations, so they could not pass the interview.

(2) Many on-the-job personnel looked for new development opportunities in the labor force

market, but usually they couldn't find ideal posts.

(3) Due to the influence of the traditional employment concept, people bore such high expectations toward employment that they often missed good opportunities for themselves.

(4) Because many laid-off workers only have a single skill, they could not meet the requirements of a new occupation, which makes it difficult for them to apply for a new or different job.

One of the important reasons for these kinds of phenomena is that in the market economy system, the employment structure is highly concentrated on low-level industries, which leads to low productivity and laborers' quality. Now that high-level talents are more and more needed by the society, the competition focus in the labor force market is turning to those high-level talents. Wu (2002) said that the standard of many employment units has made some job-hunters flinch. The relatively low quality of talents is an important reason for the low production rate of a trained labor force. Undoubtedly, it is vocational education that will assume the responsibility to improve the laborers' quality. How to improve their quality and what the requirements of occupations and skill for laborers are have pushed new demands for vocational education.

#### **4. Impact of Hi-tech Industry**

China's hi-tech industries are divided into three levels. First is the research and development of hi-tech, including the research in six fields: biology, information, energy,

material, laser, and automation. Second is the industrialization of hi-tech, including the implementation of China Torch Program and the establishment of hi-tech industry development zones. Third is the infiltration and expansion of hi-tech into traditional industries to transform the industrial structure and improve the whole level of manufacturing.

### **5. Impact of Specialized Scientific and Technical Personnel.**

One of the criteria for measuring hi-tech enterprises is the proportion of specialized scientific and technical personnel. The scientific research and the technological development levels in Shanghai always take the lead in the country, but compared with the advanced level of the world, the scientific research gap is about 15 years behind. Additionally, manufacturing techniques are about 20 years behind and the lag for the hi-tech industrialization is even longer. The current proportion of hi-tech industry in terms of the value of industrial output in Shanghai is about 3% to 4% as compared to Japan at 35%, the United States at 30%, and Germany, the United Kingdom and France at 20%.

At present, the hi-tech industries are on the road to needed development. Because the technological production is not perfect and because the outflow of hi-tech as well as hi-tech personnel is moving abroad, the hi-tech industrialization is now confronted with a potential crisis.

In general, vocational education schools in China have the common desire to develop to a higher

level and many schools have attempted to handle the production of the senior professional titles. Compared with the common higher schools, vocational schools have the special advantage that they can train the personnel directly according to the supply and demand conditions of the market and the demand of the hi-tech industries. The objective of vocational education is to improve the laborers' working capabilities, management skills moral standards. This would be beneficial for both the individually owned enterprise and collectively owned ones.

#### *Long-Term Development Goals*

Vocational education aims at training specialized technical personnel who can directly undertake production operations and business management for all types of industries. Therefore, it features a direct service to the economy. Compared with general education, the link between vocational education and productivity, production structure, and human resource development, is closer and more direct.

The results are in accordance with what was expected in the beginning of the study. High-quality workers are needed for every profession. In the transforming process, the modern enterprises are now confronted with the challenge from the hi-tech information era, as well as the development and perfection of the market economy system. In order to achieve a viable and dominant position during the market competition, Chen (2001) said that it is necessary for the modern enterprises to improve the quality of products and service which depends upon the

improvement of the employees' quality and their work techniques. From this point, it is believed that it is more urgent to enhance the teaching quality and the large-scale benefit of professional experience. In view of the development of vocational education, people won't be able to get used to the fast-changing social and economic situations if they receive the continuous education. Therefore, continuous education and life long vocational education will gradually improve the economic development and the social development of both the people and the country. In this sense, vocational education becomes the channel for the exploitation of the human resources.

Liao (2002) indicated that the rapid development of township enterprises in China has completely changed the destitute and underdeveloped state of the rural areas. Lan (2002) stated that with the improvement of the peasants' living standards and the enhancement of rural economic strength, rural funds begin to flow into the service industry and tourism which guide rural vocational education in transforming to the service industry and tourism. Hu (2006) indicated that in Juye County in Shangdong Province, it could be seen that new industries have proposed demands for the laborers' knowledge and skill, and also brought forward new challenges for the contents and methods of vocational education. Vocational technical training is no longer confined to the normal vocational experience structure and the informal vocational technical training has also emerged in large numbers. Vocational education that only depends on special schools has been insufficient. The ability and experience of laborers, such as the ability to

solve questions, to acquire and make use of information and to learn scientific and technical knowledge, etc., need to be fostered through life long education in working places and certain cultural atmosphere. Such a trend has become more and more evident.

## **RECOMMENDATIONS FOR FUTURE RESEARCH**

Limited by conditions such as the inconvenient travel in the country, which involves a wide range geographically and large population ratios, this study has met a great deal of difficulties in the investigation process. The adjustment of the rural industrial structure has moved forward the demand for the laborers' knowledge and skills, which indeed is also a very important link in vocational education of China. As a result, for the rural vocational education that prompts the agricultural science and technology, it would be of great research value to seek a new breakthrough in the strategic choice of the agricultural development.

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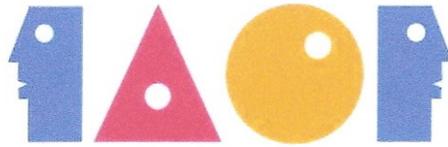
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## **DESIGN AND IMPLEMENTATION OF AN INTELLIGENT MOBILE INFORMATION SYSTEM FOR CAMPUS SAFETY MANAGEMENT**

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### **ABSTRACT**

If information technology can be utilized for campus safety, it would be helpful for school staff to monitor all situations in schools. This study is based on campus safety management and is aimed at establishing an intelligent mobile information system in colleges. This will facilitate the installation of video recorders in the rush areas (at the entrance and exit of the campus) and other places on campuses. This study adopts the Windows Media Player with the RTP/RTSP protocol in order to embed the mobile information system into the users' machines (personal digital assistants or smart phones), and provides a solution (including hardware solutions) to promote campus safety management. The system developed benefit school staff and students.

**Keywords:** Campus Safety; Intelligent System; Mobile; RTP/RTSP

### **INTRODUCTION**

Recently, the mobile telecommunication industry has experienced significant advances, and it will continue to evolve in the near future (Barco, Lázaro, Díez, & Wille, 2008) The success of wireless and mobile communications in the 21st century has resulted in a large variety of

wireless technologies such as second-, third-, and fourth-generation cellular, satellite, Wi-Fi, Bluetooth, and WiMAX (IEEE 802.16) services. IEEE 802.16 is designed to support high capacities, high data rates, and multimedia services. The aim of IEEE 802.16 is to fill the gap between the high data rates of wireless local area networks (WLANs) and the high mobility of cellular wide area networks (WANs) (Kim, Kim, Um, Son, & Choi, 2008). Chen (2008) combines the swarm intelligence and Web Services to transform a conventional library system into an intelligent library system having high integrity, usability, correctness, and reliability software for readers. Chen and Chen (2007) built the intelligent system and developed a knowledge base of the computer-parts.

Technological developments in content-based analysis of digital video information are undergoing much progress, with ideas for fully automatic systems now being proposed and demonstrated (Hyowon, Alan, Noel, & Barry, 2006). In the near future, several radio access technologies will coexist in Beyond 3G mobile networks (B3G) and they will be eventually transformed into one seamless global communication infrastructure. Self-managing systems (i.e. those that self-configure, self-protect, self-heal and self-optimize) are the solution to tackle the high complexity inherent to these networks (Barco et al., 2008). Digital representations are widely used for audiovisual content, enabling the creation of large online repositories of video, allowing access such as video on demand (Justin & Timothy, 2006). Digital artifacts created via

transformational technologies often embody implicit knowledge that must be correctly interpreted to successfully act upon the artifacts (Leonardi & Bailey, 2008). With continued advances in communication network technology and sensing technology, there is astounding growth in the amount of data produced and made available through cyberspace (Keke & Ling, 2006). An additional major benefit is if a partial prototype implementation can be automatically generated from a given software architecture design (Yujian, Zhijiang, & Xudong, 2007).

At present, for campus safety in schools, digital monitors and IP-Cams are connected to form an imaging system; thus, an image information system network is established. Such networks help school staff monitor the situations at schools. The staff can select images that they want to view; simultaneously, they can view the general images of the campus, corner areas, entrance of the school and areas around the information system.

## **LITERATURE REVIEW**

### **For Mobile Communication**

Wireless communication research is evolving toward integration, inter-working, and convergence of wireless systems, which will yield several concepts of simultaneous use (Ferreira, Serrador, & Correia, 2006). Malek and Frank (2006) have focused on determining a near-optimal collision-free path because of its importance in robot motion planning, intelligent transportation systems, and any autonomous mobile navigation system. Yang, Ping, Zheng, Xu,

Yinong, and Xiaosheng (2006). have presented a perspective on the future vision of mobile communications and services, which is referred to as mobile ubiquitous service environments, and Dixit (2006) identified the key barriers to achieving true network convergence. The influence of the provision of security is evaluated in the protocols and applications/scenarios where sensors can be used (Roman, Alcaraz, & Lopez, 2007), and more than 80,000 scalar multiplications per second are performed to enhance security in wireless mobile applications (Sakiyama, Batina, Preneel, & Verbauwhede, 2007). A distributed channel assignment protocol based on a cross-layer approach has been proposed, and it has been shown that the proposed protocol can substantially increase throughput and reduce delay in wireless ad hoc networks (Gong, Midkiff, & Mao, 2007). Pavlou (2007) documented a historic evolution, highlighted important design choices, and explained the hows and whys behind the various frameworks and technologies.

Sánchez, Sáenz, and Baloian (2007). presented a model to design and implement mobile applications to support the displacement and dynamic decision making of users with visual disabilities, and the problem of scheduling packets for downlink transmissions in the time slots of a frame is addressed in such a way that the quality-of-service requirements are fulfilled (Ciaschetti, Corsini, Detti, & Giambene, 2007). A spanning tree is based on the auto configuration of mobile ad hoc networks and a novel approach for efficient distributed address

auto configuration (Longjiang, Yunze, & Xiaoming, 2007). Fingerprint technicians' occupationally defined values and norms have played an important role in structuring their existing work practices, as well as the tension produced by organizationally mandated efforts to restructure the logic of their expertise-based hierarchies (Davis & Hufnagel, 2007). Pavlou, Huigang, and Yajiong (2007) build upon the principal–agent perspective to propose a set of four uncertainty mitigating factors—trust, Web site informativeness, product diagnosticity, and social presence.

An interface between the applications and the underlying transport network has been defined that offers the dynamic and efficient management of network resources based on a policy-based resource control engine (Rothenberg & Roos, 2008). Gao and Zhang (2008) have proposed an effective technique to determine the number and distribution of equilibria and a new supervised linear feature extraction technique for multiclass classification problems particularly suited to the nearest-neighbor classifier technique (Masip & Vitria, 2008). Two connectionist schemes, namely, (1) detection of bad/derogatory groups of features online and (2) the elimination of the effect of these bad features while performing function approximations or classification tasks (Chakraborty & Pal, 2008). Payne (2008) examines the Web service paradigm from an open multiagent system perspective and contrasts the formally grounded knowledge-centric view of agents with a pragmatic declarative bottom-up approach adopted by Web services.

The architecture modeling system can identify different elements and styles in a variety of buildings (Liu, Zhang, & Pan, 2008); location-based spatial queries having certain unique characteristics can be revealed, which traditional spatial query processing systems employed in centralized databases do not address (Ku, Zimmermann, & Wang, 2008). Medium access control protocols have quality-of-service support topology independent link activation transmission scheduling—for mobile code-division multiple-access ad hoc networks (Y. S. Su, S. L. Su, & Li, 2008). Flesca, Furfaro, and Mascian (2008) investigated the minimization problem for a wide fragment of XPath (namely  $X P^{\text{seq}};$ ), where the use of the most common operators (child, descendant, wildcard, and branching) is allowed with some syntactic restrictions; a novel approach is developed for static index pruning that considers the locality of occurrences of words in the text (Moura, Santos, Araujo, Silva, Calado, & Nascimento, 2008), and more nuanced understanding of consumer channel choices is developed (Vivek & Elena, 2008). The context-aware query processing system enhances the semantic content of Web queries using two complementary knowledge sources: lexicons and ontologies (Storey, Jones, Sugumaran, & Puro, 2008).

### **For Monitoring System**

Tan, Lam, and Lau (2008). investigated the performance of those 3G networks in terms of their data throughput, latency, video and voice calls handling capacities, and their ability to

provide service guarantees to different traffic classes under saturated and lightly-loaded network conditions.

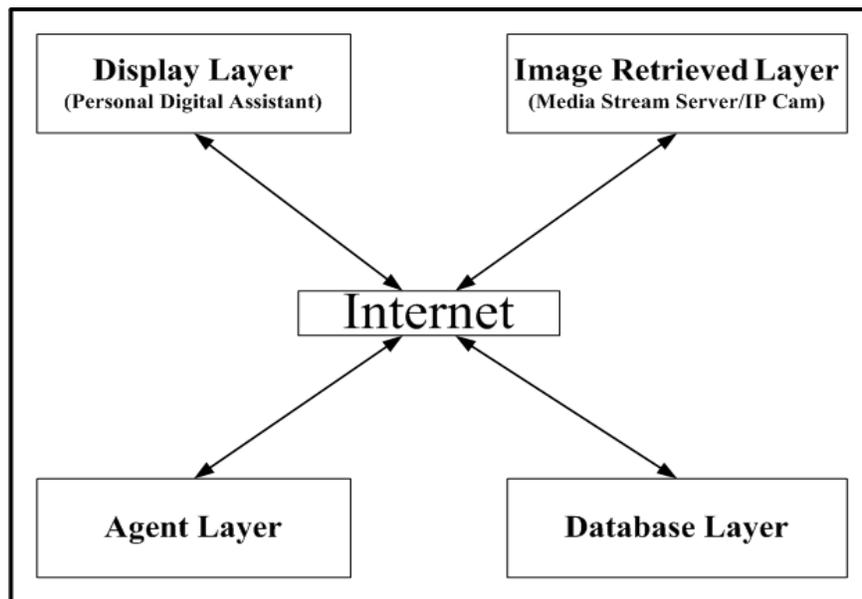
A software architecture design has many benefits including aiding comprehension, supporting early analysis, and providing guidance for subsequent development activities (Justin & Timothy, 2006). The monitoring system is digitized and the information transfer is systematized. The definition of a photograph in this information system and the convenience in its management are apparently different from those of a conventional system; a video frame can be viewed via a network. The previous studies have focused on mechanical monitors and control of the bottoms; they didn't add intelligent functions on the bottoms. The mobile information system has facilitated convenience in campus safety management. Nowadays, intelligent systems are extensively being applied for monitoring at homes and companies for safety management and burglary prevention; however, intelligent systems have not yet been widely applied for campus safety.

## **METHODOLOGY AND RESEARCH DESIGN**

The mobile information system is developed in the environment of: Microsoft Windows Server 2008, Internet Information Services 7.0 (IIS 7.0), Microsoft Structured Query Language (MS SQL) Server 2008, and Visual Studio 2008 (VS 2008). The human-computer-interface software is developed in the environment of Microsoft Windows Embedded CE 6.0 release 2,

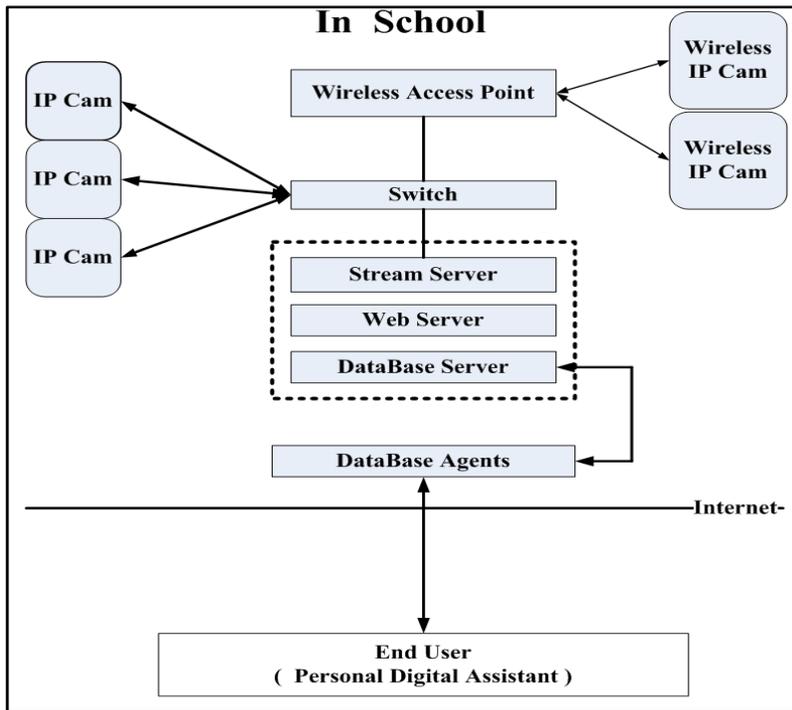
MS SQL server 2008, and edited using VS 2008. The programming languages are Extensible Markup Language (XML) and C#. Several parts are stated as below in this study. Figure 1 shows the main frame of the general concept of this study.

**Figure 1: Main Frame of The General Concept of This Study**



This study is conducted on the basis of a distributed system. Thus, the display layer, image retrieved layer, agent layer and information could be placed at any point on the Internet. The advantage of using a frame in this study is its high availability; any layer, when shut down, can be restarted in another location. Space is unlimited and the server should be placed in local schools. The practical frame diagram for a single school is shown in Figure 2.

**Figure 2: Practical Frame Diagram For A Single School**



The wireless IP-Cam is linked through a wireless access point (802.11g); the wired IP-Cam is connected to switch via an RJ-45 connector. The switch is linked to a media streaming server on the Intranet of the campus for saving and retrieving images. The media streaming server builds a broadcasting point through which images that are collected from the inner network are broadcast on the outer network for the users to monitor.

The images that the users want to monitor are automatically retrieved through agents and downloaded to the users' mobile tools after they login to their accounts. Moreover, the users can monitor real-time images of any classroom or any corner of the campus through the agents.

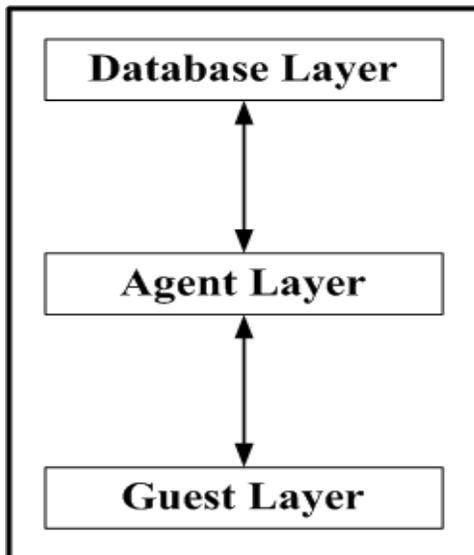
## **Establishment of the database**

This study adopts the relational database management system to establish the database. The Boyce-Codd Normal Form (BCNF) is used for database normalization. During the process of standardization, a larger amount of time is required to integrate the joins when checking the segment of relational joins. Therefore, a balanced point should be obtained between the flexibility and efficiency of the database. As a result of the high-speed reaction in time, and for obtaining a balanced point between flexibility and efficiency, a compromise task is required for obtaining the BCNF. Microsoft SQL Server 2008 is adopted for the platform ~~in~~ (as) the database management system. The study adopts the 'three-layer frame', which is the basic frame of the N-Tier architecture. The three-layer frame is shown in Figure 3.

Each layer has its own responsibility, and they are stated as follows:

- 1) Database layer: It stores the data. The basic information of the users and children are stored in this layer.
- 2) Agent layer: When the users expect certain information, the agent retrieves it and replies to the users. The agent layer can be considered to be a middle layer between the Internet and database server. When the users send a request for monitoring the images of their children in class, the agents will begin to find the data demanded by the users.

**Figure 3: Three-Layer Frame**



3) For example, the location of the student in the class). Since the expected information is expressed in a text format it must be uploaded to the streaming server and converted to string flow images. Then, the stream images are transferred to the users' machines.

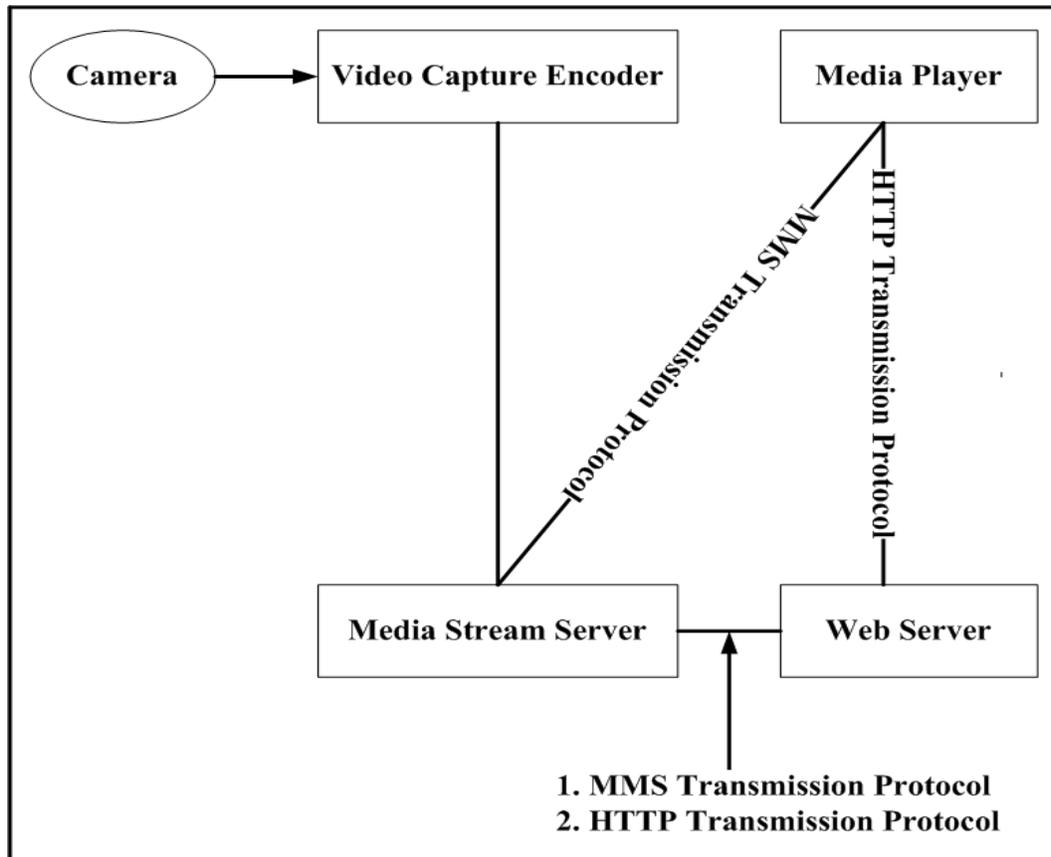
4) Guest layer: It means the end user. Users send a request through the Internet to the agent layer, and the agent layer is responsible for storing or retrieving the information from the database.

### **Stream Images**

Stream images play an important role in this study because they are the means by which the users receive image information of situations that they expect to monitor. As shown in Figure

4, the Microsoft Media Server (MMS) protocol is employed between the web server and the media stream server (Microsoft, 2007) .

**Figure 4: MMS Protocol Used Between The Web Server And Media Stream Server**

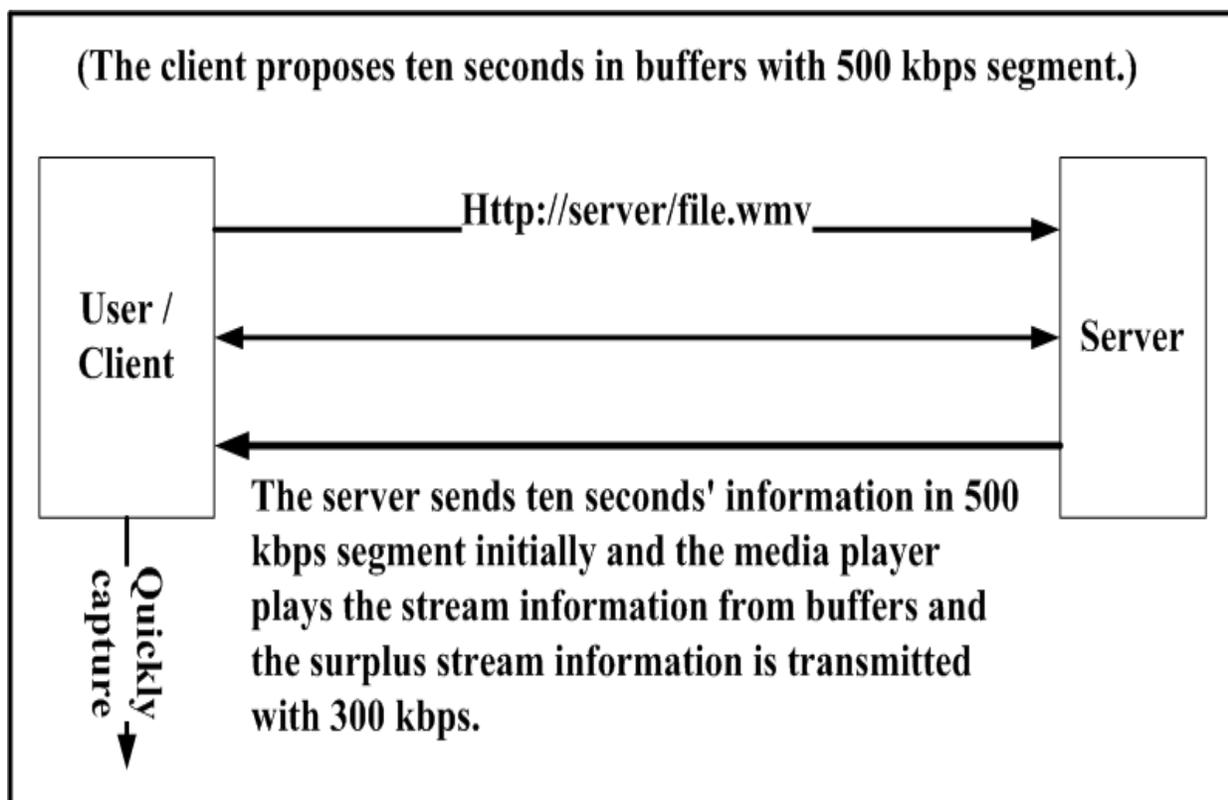


The process of linking is described by an example of a WMV file of 300 kbps in the linking of 500 Kbps. In this example, users request a 300 kbps WMV file from the server with a speed of 500 Kbps; then, the server will send the information for approximately the first 10 s in order to store in the buffer area. In this process, the linking speed is 500 Kbps; however, the

remaining stream information utilizes the speed of 300 Kbps to transmit to the users, as shown in

Figure 5.

**Figure 5: The Linking Speed Is 500 Kbps; However, The Remaining Stream Information Utilizes The Speed Of 300 Kbps To Transmit To The Users**



The problems with IP-cams can be solved by establishing a streaming media server.

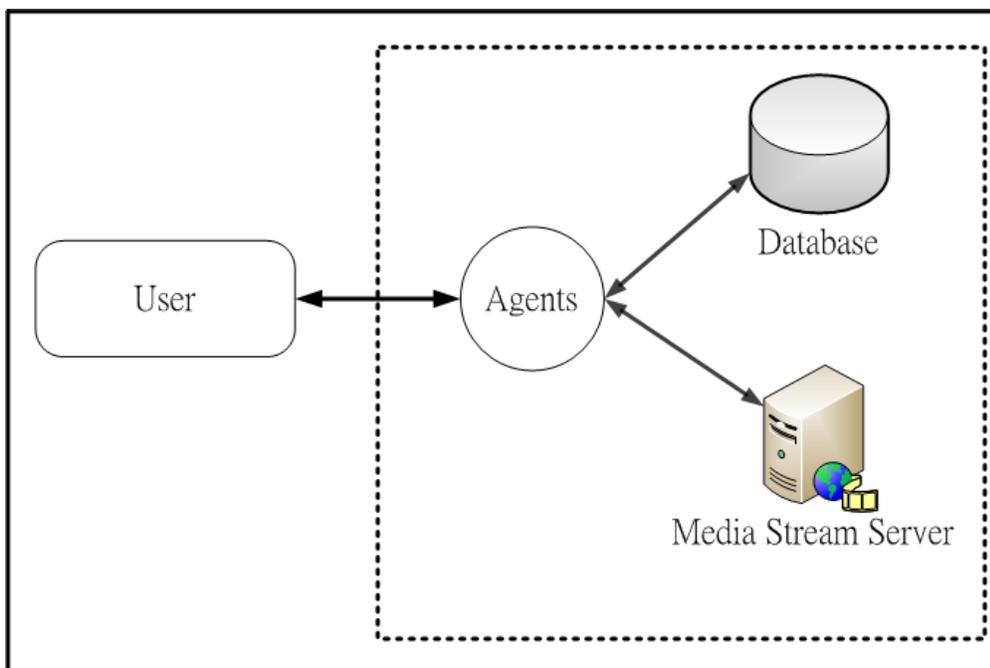
Hence, the problems related to simultaneous transfer of information and limited bandwidth can

be solved; further, in order to achieve the monitoring demanded by the users, the retrieved

images can be transmitted in a planned and systematic manner.

When the users login to the system, they will search the images from the database and the agents will capture the images to transfer them to the users from the streaming server, as shown in Figure 6.

**Figure 6: Users Login To The System**



A portion of the database server codes programmed with the Virtual C# language are shown in Figure 7.

## RESULTS

The mobile information system for PDAs has been developed successfully, as shown in Figures 8–10. This study provides a solution (including hardware solutions) to promote campus safety management. The system developed will bring advantages to school staff and students.

**Figure 7: Portion Of Database Server Codes**

```
"select * from Parent join Student " +  
    "on Parent.uid = Student.uid join Class_of_Student " +  
    "on Class_of_Student.std_number = Student.std_number join Course " +  
    "on Course.class = Class_of_Student.class " +  
    "where Parent.uid = '" + name + "' and " +  
    "datepart(weekday,getdate()-1) = week " +  
    "and datepart(hour,getdate()) between datepart(hour,beg) and datepart(hour,en) " +  
    "and  
convert(int,REPLACE(SUBSTRING(CONVERT(char(16),getdate(),120),12,16),':','')) " +  
    "between  
convert(int,REPLACE(SUBSTRING(CONVERT(char(16),beg,120),12,16),':','')) " +  
    "and convert(int,REPLACE(SUBSTRING(CONVERT(char(16),en,120),12,16),':',''))  
";
```

## CONCLUSIONS

In this study, we have adopted a new generation technology to alter a conventional safety system. The size of the software is 20 kilobits; therefore, the software is not a liability for the users' mobile tools. Users need not use the browser; they can directly communicate with the intelligent mobile system via mobile tools. School staff can monitor classroom situations through the system and direct visits are not required. It is successful.

**Figure 8: Login Frame**

Pushing System 02:21

## National Cheng Kung University

Welcome to  
Intelligent Image Information Pushing

School Name:

Account:

Password:

Login Query

**Figure 9: Selection Frame**



**Figure 10: Campus Frame**



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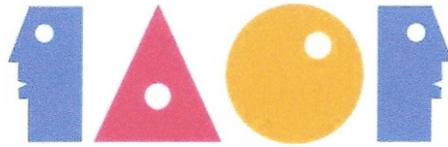
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**MANAGERIAL AND MARKET-VALUE PERFORMANCE OF  
CONVENTIONAL FIRMS IN TAIWAN**

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**ABSTRACT**

The primary goal of managers from the financial management's view is maximizing the shareholder's wealth. In other words, a brilliant manager must be possessed of managerial and market-value performances simultaneously. This paper adopts cumulative two-stage data envelopment analysis (DEA) by use of financial statements to assess these two kinds of performances of managers for twenty-nine listed conventional firms in Taiwan comprehensively. The results reveal that there are ten and five firms lied on managerial and market-value efficient frontiers respectively and two kinds of efficiencies are fully achieved by only two firms. In addition, on this ground that managerial efficiency is generally better than market-value efficiency, it can lead to conclusion that conventional firms in Taiwan can be under-estimated.

**Keywords:** Two-Stage Data Envelopment Analysis, Conventional Firms, Managerial Efficiency, Market-Value Efficiency

## INTRODUCTION

Authorities have begun to pay attention to the conventional industry since 2001, for example, the project of “Conventional Industry Technology Development” is executed by Ministry of Economic Affairs to improve the technological ability of conventional firms. In the past, the conventional industry stands for slow growth, labor-intensive technology and low wage, nevertheless, the position of conventional industry has changed continuously better and better as the rise in BRICS over the last years. In addition, in spite of conventional industry, successful conventional firms are still necessary to advance their competitive ability in globalization era today. For reasons mentioned above, the importance of the performance of managers, especially for listed conventional multinational firms cannot be overemphasized.

To evaluate the manager’s performances in management and stock market, Data Envelopment Analysis (DEA) here is adopted to calculate the efficiency scores in twenty-nine conventional multinational firms in 2006. The main advantage of this paper is to make use of a “cumulative” two-stage DEA framework to examine whether a manager can accomplish both managerial and market-value efficiencies.

This paper is organized as follows. In Section 2, the two-stage DEA and its economic meaning will be presented. In Section 3, the empirical model and related data are both described

in detail. Section 4 points out important managerial and investment implications that emerge from the results of estimation. Finally, a conclusion will follow.

### **Two-stage DEA methodology**

The DEA model offers a non-parametric approach which does not impose any unknown relationship. More importantly, the estimation procedure of the DEA is based on the frontier (best) performance rather than an average outcome from econometric studies and this view is totally in agreement with the performance management.

#### *Two-stage DEA methodology*

The DEA is introduced by Charnes, Cooper and Rhodes (1978) based on Farrell (1957) and it is a procedure derived from the principles of linear programming method to measure relative efficiency of decision-making units (DMUs).<sup>1</sup>

The optimization procedure in the DEA serves to ensure that the particular DMU being evaluated is given the highest ratio possible and it is called the efficient unit. The efficiency scores of all conventional firms can be computed by the ratio of the estimated maximum production to the actual production and their scores rang from zero to one, where higher efficiency score represents better performance.

<sup>1</sup> Charnes, Cooper and Rhodes (1978) designed a DEA model with constant return to scale and this programming is called CCR model.

Two-stage DEA methodology suggests that intermediate products in the production process are necessary to be observed (Charnes et al., 1994; Färe and Grosskopf, 1996). Färe and Whittaker (1995) and Sexton and Lewis (2003) applied this method to analyze agriculture and major baseball league respectively. The most important point so far is whether two-stage DEA is prior to traditional DEA regarding to firm's productivity and efficiency. First, many commercial activities are rooted from two-stage process, for example, Sexton and Lewis (2003) guessed that corporate behavior is composed of acquisition/production and marketing/sales. Similarly, the ultimate goal of the financial management is maximizing the wealth of shareholders and stock price, so the fundamental analysis of stock price believes that an outstanding manager must first manage a firm very well and then it is reflected to external market value and stock price of a firm. And this is another notable example of two-stage process. Finally, it is well known from the fundamental analysis that the stock price should be determined by future earning, which is evaluated from financial statements. However, the core of all questions is how to obtain reasonable future revenue and earning. The overwhelming majority of past researches used econometric methods to predict future earning through financial statements data (Ou and Penman, 1989; Sloan, 1996; Setiono and Strong, 1998; Charitou and Panagiotides, 1999). Only few attempts have so far been made on the DEA to analyze corporate financial data (Thore, Kozmetsky and Phillips, 1994; Thore, 1996), it remains an unsettled question: how to obtain

future earning from the DEA. Abad, Thore and Laffarga (2004) provided an answer: projected (best) output from the first stag as future earning can further evaluate the performance of stock price.

#### *Model setup of two-stage DEA*

In turn, a model must be established to estimate the managerial and market-value efficiencies of conventional firms through a mathematical programming of two-stage DEA, which is mostly followed by Abad, Thore and Laffarga (2004).

Two-stage DEA complexes the notation of model: first, for firm  $j$ ,  $X_{ij}$  and  $Y_{kj}$  are  $i$ -th input and  $k$ -th output from the first stage respectively. Second,  $k \in K_1 \subset K$  and  $k \in K_2 \subset K$  represent that the index  $k$  run over all elements in the set  $K_1$ , which is the set of all outputs from the first stage and in the set  $K_2$ , which is the set of all inputs into the second stage. Second, two sets are not necessarily identical:  $K_1 \cap K_2$  means that the set of all indices  $k$  serve as both outputs from the first stage and inputs from the second stage. Furthermore,  $K_2 - (K_1 \cap K_2)$  implies that the set of all inputs into the second stage is not outputs from the first stage. Finally,  $r$ -th output from the second stage is written  $Z_{rj}$ .

For the first stage, the output-oriented CCR model as follows:

Maximize  $\theta_1$

$$\begin{aligned} & \theta_1 Y_{k0} - \sum_j \lambda_j Y_{kj} \leq 0, k \in K_1 \\ \text{subject to } & \sum_j \lambda_j X_{ij} \leq X_{i0}, i = 1, \dots, m \\ & \lambda_j \geq 0, j = 1, \dots, n \end{aligned} \quad (1)$$

Where  $\theta_1$  is efficiency score from the first stage;  $\lambda$  is weight and inequalities ensure that all points lie on or below the frontier and “0” is the subjective DMU. The projected outputs from the first stage can be computed as

$$Y_{k0}^* = \sum_j \lambda_j^* Y_{kj}, k \in K_1 \quad (2)$$

In turn, the projected outputs can be fed as the inputs into the second-stage programming:

Maximize  $\theta_2$

$$\begin{aligned} & \theta_2 Z_{r0} - \sum_j \lambda_j Z_{rj} \leq 0, r = 1, \dots, s \\ \text{subject to } & \sum_j \lambda_j Y_{kj}^* \leq Y_{k0}^*, k \in K_1 \cap K_2 \\ & \sum_j \lambda_j Y_{kj} \leq Y_{k0}, k \in K_2 - (K_1 \cap K_2) \\ & \lambda_j \geq 0, j = 1, \dots, n \end{aligned} \quad (3)$$

## Empirical Model and Data Description

This section is divided into two parts: empirical model and data description. Although two-stage DEA is our estimation tool, empirical model must practicably be fulfilled by selected variables, which are later outlined from data description.

### *Empirical Model and Conventional firms in Taiwan*

First, first-stage function is

Revenue=f (receivable, inventory, fixed assets, other assets, operating expenses) (4)

The projected revenue can be obtained from the DEA of equation (4) to represent the future revenue. In the second stage, the causes of stock value must carefully be checked. The stock value generally comes from book value of equity (now) and present value of future earning (future) (Ohlson, 1995; Penman, 1998). The second-stage DEA can be written as

Market Value=g (book value, projected earning)

=g (book value, projected revenue, operating expenses) (5)

It follows from what has been generally defined that manufacturing industry except for high-tech industry all belongs to conventional industry, which consists of various fields, including cement, food, plastics, rubbers, textiles, electronic machinery, steel, automobile, glass, paper and chemical. The sources of accounting and financial data for these firms are quoted from *Market Observation Post System* of Taiwan Stock Exchange Council. The basic information and statistics of all selected variables are shown as Table 1.

### **Estimation Results**

#### *Correlations*

First, Spearson correlation coefficients are applied to check whether selected inputs are really correlated to the output from the two-stage DEA as Table 2. Table 2 shows that the equations (4) and (5) are both proven reasonable.

Table 1: Basic data of twenty-nine listed conventional firms

Unit: million NTD

DMU	receiv.	invent.	fixed asset	other assets	operating expenses	revenues	book value	market capitalization
1	46,929	43,304	148,873	7,464	14,414	276,366	263,598	413,961
2	9,999	18,484	97,866	6,828	7,605	155,323	192,547	309,477
3	10,725	56,470	166,724	6,149	9,766	278,511	234,130	382,460
4	18,706	16,569	115,848	24,454	22,125	143,434	128,334	123,971
5	20,241	22,147	99,138	20,991	61,165	257,667	73,803	109,009
6	8,691	5,787	101,517	6,307	2,408	64,942	77,518	92,520
7	5,706	2,993	31,683	9,466	1,635	31,446	62,013	78,496
8	17,638	28,157	148,950	8,795	8,689	205,131	210,481	301,098
9	26,496	19,180	55,534	12,771	23,506	187,494	76,791	90,379
10	21,058	7,624	19,053	15,862	6,149	43,916	60,345	57,099
11	8,544	10,873	13,722	3,904	6,738	40,982	38,523	31,716
12	5,937	5,507	9,838	2,074	4,935	39,129	45,763	41,405
13	9,712	16,020	20,930	3,054	3,249	123,391	65,216	56,451
14	2,263	2,708	20,922	7,626	1,454	36,787	20,410	16,427
15	4,783	7,780	19,736	2,297	2,434	37,909	50,116	41,611
16	1,374	3,525	14,536	4,589	1,078	15,466	22,230	23,822
17	7,493	5,433	18,043	3,756	4,582	39,353	24,286	22,106
18	3,822	4,612	28,369	1,306	2,597	24,919	37,417	45,798
19	1,089	2,013	30,709	1,269	578	11,203	50,085	61,054
20	4,892	7,487	38,083	2,235	5,374	47,984	23,098	39,273
21	7,865	5,336	9,765	811	2,990	29,089	13,649	35,857
22	1,222	4,240	8,465	495	1,493	25,337	12,987	22,276
23	893	1,239	10,101	559	1,220	10,577	7,497	18,752
24	1,126	709	3,250	1,412	516	10,728	12,520	16,802
25	2,324	1,936	4,172	2,060	947	22,227	11,746	15,403
26	1,651	3,708	30,681	808	1,398	22,265	17,544	21,431
27	5,146	5,452	11,046	1,881	1,630	35,247	17,056	26,379
28	1,072	7,255	13,955	1,685	1,096	45,462	13,735	24,407
29	4,665	8,991	19,988	2,562	2,358	48,792	24,799	19,833
mean	9,037	11,225	45,224	5,637	7,039	79,692	65,112	87,561
St. dev.	9,869	12,599	48,302	5,976	11,746	82,981	70,082	110,838
max.	46,929	56,470	166,724	24,454	61,165	278,511	263,598	413,961
min.	893	709	3,250	495	516	10,577	7,497	15,403

Table 2: Spearson correlation coefficient between each input and output

<i>the first-stage</i>					
	receivables	inventory	fixed assets	Other assets	operating expenses
Revenues	.771*** (.000)	.925*** (.000)	.878*** (.000)	.562*** (.002)	.679*** (.000)
<i>the second-stage</i>					
	projected revenues	operating expenses	book value		
market capitalization	.984*** (.000)	.280 (.141)	.857*** (.000)		

Note: The numbers in parentheses are the p-value ; “\* ”, “\*\* ” and “\*\*\* ” indicate that the t test are statistically significant for the 10%、5% and 1% critical values under  $H_0$  : no correlation exists.

### *Results of Two-stage DEA estimation*

The output-oriented CCR model is used to estimate managerial and market-value efficiencies by two-stage DEA. In the first stage, we can determine every firm’s location relative to the frontier, which is the maximal revenue under the best-managed listed conventional firms. In turn, projected revenue as an input from the second stage can further compute the market-value efficiency. The results of two-stage DEA are reported in Table 3.

First, Table 3 shows that there are ten firms with the highest efficiency score relative to other firms and the lowest efficiency score is 48.01 of DMU 10 from the first-stage DEA, while there are five firms with the highest market-value efficiency and the lowest efficiency score is 32.56 of DMU 11 from the second stage. Second, projected output is reached by 100% efficiency and hence projected output and actual output are the same as the firms with best efficiency. Projected revenue from the first-stage DEA and actual revenue or projected market value from

the second-stage DEA and actual market value are also shown to understand their differences for any firm. More differences imply that managers must work harder to improve it. Third, the average efficiency score (82.63) from the first stage is generally larger than one (68.69) from the second stage. This result seems to imply that stock prices for these listed conventional firms averagely may be underestimated and how to promote stock prices is one of managers' responsibilities.

Finally, standard deviations in two-stage process are averagely 17.04 and 22.38 respectively. This reveals that the efficiency from the stock market is more unstable and unreliable than one from firm's managerial efficiency itself. This observation is in agreement with the nature of stock market, which is mixed with the state of firms' operation, industrial perspective, country risk, spectacular motivation, rumors and a panic after all.

### *Comprehensive Analysis*

In this section, we wish to combine managerial with market-value efficiencies to discuss the whole performance of managers. It will be useful, to begin with, to make a distinction among performance of twenty-nine firms. For the analytical convenience, managers' performance is classified into four parts according to average efficiency scores from the first and second stage as Table 4. To put it more precisely, the four kinds of performances of managers are described as follows:

(1) As a firm with more than 82.63 and 68.69 from the two stages is referred to “type 1” firm: high managerial and market-value efficiencies and its manager gets through with an excellent work for performance management.

(2) For a firm with higher than 82.63 and lower than 68.69 from the first and second stage, it is called by “type 2” firm: high managerial efficiency but low market-value efficiency.

(3) As a firm with lower than 82.63, but higher than 68.69 belongs to “type 3” firm: low managerial efficiency but high market-value efficiency.

(4) When a firm is lower than 82.63 and 68.69 from the first and second stage, it falls into “type 4” firm: low managerial and market-value efficiencies and this type of firms are faced with the most serious management difficulties no matter from managerial or market-value efficiency.

This is especially noteworthy in the case of type 2 or type 3 firms. In the light of investors, abnormality provides the opportunities of the arbitrage behavior to take advantage of differentials between two kinds of efficiencies. Since market value or stock price of type 2 and type 3 firms are now possibly underrated and overestimated respectively, smart investors should actively buy type 2 firms’ stocks and sell type 3 firms’ stocks immediately to make a profit.

Table 3: Results of firms' performance from two-stage DEA

DMU	The first-stage DEA			The second-stage DEA		
	efficiency scores (%)	actual revenues	projected revenues	efficiency scores (%)	actual market value	projected market value
1	87.72	276,366	315,043	90.96	413,961	455,097
2	100	155,323	155,323	100	309,477	309,477
3	100	278,511	278,511	100	382,460	382,460
4	67.74	143,434	211,741	38.51	123,971	321,958
5	100	257,666	257,666	56.22	109,009	193,884
6	100	64,942	64,942	80.09	92,520	115,517
7	76.92	31,446	40,881	88.83	78,496	88,365
8	88.74	205,131	231,170	87.85	301,098	342,756
9	97.71	187,494	191,889	44.97	90,379	200,971
10	48.01	43,915	91,480	45.82	57,099	124,603
11	50.66	40,982	80,895	32.56	31,716	97,395
12	82.73	39,129	47,295	46.8	41,405	88,470
13	100	123,390	123,390	51.17	56451	110,320
14	100	36,786	36,786	43.62	16,427	37,661
15	59.94	37,908	63,249	49.35	41,611	84,324
16	49.62	15,466	31,170	63.71	23,822	37,393
17	72.4	39,352	54,355	35.57	22,106	62,149
18	66.03	24,919	37,738	66.87	45,798	68,492
19	65.6	11,203	17,077	100	61,054	61,054
20	77.56	47,984	61,865	64.72	39,273	60,681
21	80.17	29,088	36,283	100	35,857	35,857
22	100	25,337	25,337	79.47	22,276	28,030
23	94.61	10,577	11,180	100	18,752	18,752
24	100	10,727	10,727	82.82	16,802	20,288
25	100	22,226	22,226	68.58	15,403	22,461
26	82.66	22,265	26,936	64.1	21,431	33,433
27	77.12	35,246	45,703	76.58	26,379	34,445
28	100	45,462	45,462	93.2	24,407	26,187
29	70.28	48,791	69,426	39.67	19,833	49,997
mean	82.63	79,692	92,612	68.69	87,561	110,838
St. dev.	17.04	82,980	86,936	22.38	15,403	413,961
max.	100	278,511	315,043	100	121,120	455,097
min.	48.01	10,577	10,727	32.56	18,752	18,752

## CONCLUSIONS

Financial management's primary goal is shareholder wealth maximization, which depends on maximizing the price of the firm's stock, so a good manager must operate a business efficiently, at the same time, this excellent management accomplishment must be fully reflected on stock price. Thus, this paper introduces two-stage DEA to estimate two kinds of efficiencies by use of financial statements, including balance sheet and income statement.

**Table 4: Four kinds of classifications for DMUs**

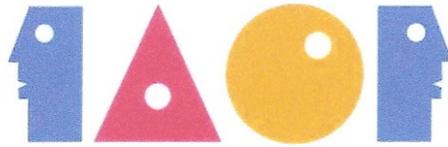
	high efficiency from the second stage	low efficiency from the second stage
high efficiency from the first stage	1, 2, 3, 6, 8, 22, 23, 24, 28 (type 1)	5, 9, 12, 13, 14, 25, 26 (type 2)
low efficiency from the first stage	7, 19, 21, 27 (type 3)	4, 10, 11, 15, 16, 17, 18, 20, 29 (type 4)

Managerial and market-value efficiencies are estimated by use of 2006 annual consolidated financial statement of twenty-nine listed conventional multinational firms and two-stage DEA. The results express that there are ten firms with best managerial efficiency and there are five firms with best market-value efficiency. Combined two kinds of efficiencies, only two firms achieve the best overall performance. It is important to note that managerial efficiency is generally higher than market-value efficiency, namely, these conventional firms as a whole may be under-estimated in stock market. All these things make it clear that investors can consider investing them, while managers should provide more complete and transparent information to enhance stock price and investor's reliance.

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**CUSTOMER VALUE TOWARD SHORT MESSAGE SERVICE:  
AN EMPIRICAL INVESTIGATION**

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**ABSTRACT**

Emerging research has begun to explore usage issues for mobile service like SMS, however this work is still preliminary. The goal of our study is to integrate marketing perspective into IS field and introduce value constructs: customer value, to examine SMS usage behavior. By analyzing the survey data from 401 SMS users, the study contributes several insights into SMS usage. First, the traditional conceptualization of customer satisfaction and customer loyalty was successfully applied in the new mobile commerce context. Second, perceived value was found to have a significant influence on customer satisfaction and loyalty toward SMS usage.

**Keywords:** Short Message Service (SMS), Perceived Value, Customer Satisfaction, Customer Loyalty.

## **INTRODUCTION**

Unlike traditional IS system context, almost mobile users are individuals and use SMS for personal purpose. SMS users are often charged for every text message sent (Turel et al., 2007; Kim et al. 2007). Thus, the users of SMS are customers rather than simply technology users. There is a need for in depth understanding of what influences customer behavior and customers attitudes not only to the technology, but more importantly to the content and service provider offering the services.

## **THEORETICAL BACKGROUND AND THE RESEARCH MODEL**

Perceived value gives a good foundation to attract people who share similar value perceptions, not just an attitude to technology in general (Turel e al., 2007; Kim et al., 2007; Pura, 2005).Sheth et al. (1991) explained consumption in terms of functional value, social value, emotional value, epistemic value and conditional value and these five dimensions are the most comprehensive aspects on perceive value up to now. Holbrook (1999) introduced eight types of value: convenience, quality, success, reputation, fun, beauty, virtue and faith. Sweeney and Soutar (2001) suggested a view of value of consumer durable goods that had four dimensions: performance/quality, emotional, value-for-money, and social. In this study, we evaluate three dimensions of the perceive value construct including Monetary value, Emotional value, Conditional value (Sheth et al., 1991; Anderson and Srinivasan, 2003; Sweeney and Soutar, 2001; Holbrook, 1999).

Giese and Cote (2000) argued that consumer satisfaction appears to consist of three essential components: (1) summary affective response, which varies in intensity; (2) time of determination, which varies by situation but is generally limited in duration; and (3) satisfaction focus around product choice, purchase, and consumption. In our study, Customer satisfaction can

be defined as “a summary affective response of varying intensity that follows SMS usage, and is stimulated by several focal aspects, such as perceived value.

Mobile loyalty depends on user willingness to revisit a site (Chae et al., 2002; Lin and Wang, 2006). With extent to SMS context, customer loyalty in this article was defined as the customer’s favorable intention toward m-commerce service-SMS, resulting in repeat usage SMS behavior.

Perceived value has gained recent attention as a stable construct to predict buying behavior (Anderson and Srinivasan, 2003; Chen and Dubinsky, 2003; Dodds and Monroe, 1991; Hellier et al., 2003; Parasuraman and Grewal, 2000; Sweeney et al., 1999). Additionally, customers’ value perceptions have been found to increase their willingness to buy and decrease their search intentions for alternatives (De Ruyter and Bloemer, 1999; Grewal et al., 2003; Hellier et al., 2003). Consistent with past academic research, behavioral intentions have been used to predict loyal behavior (Mathwick et al., 2001; Odin et al., 2001; Sweeney et al., 1999). Thus, our first three hypotheses were:

H1: Perceived Monetary value has a positive effect on customer loyalty.

H2: Perceived Emotional value has a positive effect on customer loyalty.

H3: Perceived Conditional value has a positive effect on customer loyalty.

Satisfaction is considered a strong predictor for behavioral variables such as repurchase intentions, word-of-mouth recommendations, or loyalty (Eggert and Ulaga, 2002). Consumer satisfaction is also believed to mediate consumer learning due to prior experience and to explain key post-purchase behaviors, such as complaining, word of mouth, repurchase intention, and product usage (Oliver, 1980; Westbrook and Oliver, 1991). Thus, our fourth hypothesis was:

H4: Customer satisfaction has a positive effect on customer loyalty.

Hallowell (1996) argued that customer satisfaction is the result of a customer's perception of value received. Some studies adapting appraisal, emotional, response coping framework (Bagozzi, 1992) to m-commerce context suggests that the more cognitively oriented value appraisals precede affectively-oriented satisfaction (Anderson et al., 1994, Lin and Wang, 2006). Then, the following hypothesis was tested:

H5: Perceived Monetary value has a positive effect on customer satisfaction.

H6: Perceived Emotional value has a positive effect on customer satisfaction.

H7: Perceived Conditional value has a positive effect on customer satisfaction.

## **METHODOLOGY**

Items selected for the constructs were primarily adapted from prior studies to ensure content validity. Likert scales (ranging from 1 to 7), with anchors ranging from “strongly disagree” to “strongly agree” were used for all questions. The final instrument is given in Appendix A. Data were gathered from a Convenience sample of 463 respondents from two University of Science and Technology in Southern Taiwan. Fifty-two respondents were excluded from further analysis because missing value. The remaining sample to be analyzed consisted of 401 responses. Sample demographics represented in Table 1.

## **RESULTS**

Seven fit indices were used to assess the measurement model's overall goodness of fit; these fit indices were estimated by using LISREL 8.54, as shown in Table 2. The correlations between the composite variables are shown in the lower triangle in Table 3. Convergent and discriminate validity was assessed by calculating the average variance extracted (AVE). All AVE values were well above 0.50, and therefore, it can be stated that the constructs display a high degree of convergent validity (Fornell and Larcker, 1981). Furthermore, high discriminate validity was

also demonstrated by the fact that the square root of AVE of each construct is higher than the correlations between that construct and any other construct in the model. Thus, the constructs are both conceptually and empirically distinct from each other (Fornell and Larcker, 1981).

Table 1  
Sample Demographics

Characteristics	Frequency	Percentage	Characteristics	Frequency	Percentage
Age			Gender		
Less than 20	82	20.4	Male	184	45.9
20-30	297	74.1	Female	217	54.1
30-40	22	5.5	usage year		
Education background			< 1 year	42	10.5
High school	123	30.6	> 1 to 4 years	157	39.2
College/University	256	63.8	> 4 to 8 years	142	35.4
Graduate	22	5.5	> 8 years	60	15.0

All of the items in the research model had factor loadings greater than 0.70. Also, squared multiple correlations between the individual items and their a priori factors were high (above 0.50 in all cases, except  $m_3=0.49$ ). Thus, all factors in the measurement model had adequate reliability and convergent validity.

Table 2  
Assessment Of Model Fit

Fit indices	Recommended value	Measurement model	Structural model
GFI	> 0.90	0.93	0.94
AGFI	> 0.80	0.91	0.92
RMSEA	< 0.08	0.053	0.047
NFI	> 0.90	0.97	0.97
NNFI	> 0.90	0.98	0.98
CFI	> 0.90	0.98	0.99
$\chi^2/df$	< 3	2.130	1.892

Table 3 Reliability, average variance extracted, and discriminate validity

Construct	1	2	3	4	5
1. Customer satisfaction	<b>0.816</b>				
2. Customer loyalty	0.52	<b>0.865</b>			
3. Monetary value	0.36	0.39	<b>0.745</b>		
4. Emotional value	0.55	0.51	0.51	<b>0.745</b>	
5. Conditional value	0.6	0.35	0.34	0.54	<b>0.781</b>
<b>Composite reliability</b>	<b>0.889</b>	<b>0.922</b>	<b>0.789</b>	<b>0.789</b>	<b>0.862</b>

A similar set of fit indices was used to examine the structural model; fit indices were showed in Table 2. The results of the path analysis were shown in Table 4.

Table 4  
Research Models: Direct, Indirect And Overall Effects

Dependent Construct	Independent Construct	Direct effect	Indirect effects	Overall effect
Customer satisfaction	Customer Loyalty	0.35*	N.A.	0.35*
Monetary value	Customer Loyalty	0.14*	0.03*	0.17*
	Customer satisfaction	0.07*	N.A.	0.07*
Emotional value	Customer Loyalty	0.28*	0.1*	0.38*
	Customer satisfaction	0.29*	N.A.	0.29*
Conditional value	Customer Loyalty	-0.07*	0.15*	0.08*
	Customer satisfaction	0.42*	N.A.	0.42*

Note: \*denotes significance at  $p < 0.1$ ; \*\*denotes significance at  $p < 0.05$ ; NA: unable to derive the data value from the path analysis.

Properties of the causal paths, including standardized path coefficients, explanatory power of the research model was shown in Figure 2.  $R^2$  values show that Monetary value, Emotional value, Conditional value account for 43% of variance in customer satisfaction; customer satisfaction, Monetary value, Emotional value, and Conditional value account for 36% of variance in customer loyalty.

## DISCUSSION AND INTERPRETATION

Consistent with previous study, customer satisfaction was significant predictor of customer loyalty. As for perceived value construct, Monetary value and Emotional value both exhibited significant impact on customer loyalty. It means that the cost-effectiveness was a significant predictor of the employment of SMS service, which is on pay-per-use context. Turel et al. (2007) concluded that price and emotion were critical drivers in the SMS service adoption. Xu et al. (2003) also argued that the cost effectiveness and interoperability of the wireless infrastructure is the most important success indicators for SMS service. Perception of Conditional value was the key factor influencing customer satisfaction. Reasons contributing to SMS growth include low

cost, asynchronous natural and potential for private/quiet use (Mitchell et al., 2002). The use of SMS service to enhance user's interactivity in many different situation increased interest and motivation.

Although the findings are encouraging and useful, the present study had certain limitations that necessitate future research. First, the subjects of SMS users were from only one college and

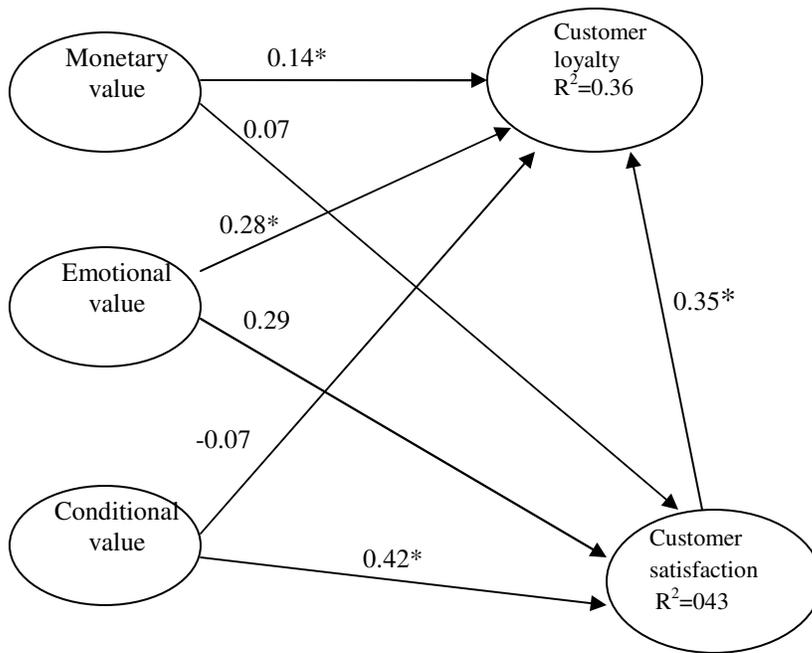


Figure 1 Analysis results of the causal path.

a convenience sampling method was utilized. Second, data collection was geographically limited to Taiwan. As SMS adoption is a worldwide phenomenon, replication of the findings across geographical contexts is necessary. Future studies could perhaps be cross-national.

## APPENDIX A

### Survey Items Used In The Study

- Money value(Chen and Dubinsky,2003;Dodds and Monroe,1991)

MV1: The price of this mobile service is acceptable

MV2: This mobile service is good value for money

MV3: SMS services are reasonably priced.

- Emotional value (Sheth et al., 1991; Sweeney and Soutar, 2001).

EV1: SMS services are ones that I enjoy.

EV2: SMS services are ones that I feel relaxed about using.

EV3: I used this mobile service to experiment with new ways of doing things

- Conditional value (Sheth et al.,1991; Holbrook,1999)

Con1: In some special context not to use mobile phone, SMS is important for me.

Con2: When I want to keep the content of text message, SMS is important for me.

Con3: when something difficult to express by oral communication. .

Con4: In some situation not to communication with sound, SMS is important.

- Customer satisfaction (Lin and Wang, 2006).

Sat1: I am satisfied with the SMS service

Sat2: Use SMS has met my expectations.

Sat3: I am pleased with the experience of using SMS.

Sat4: My decision to use SMS was a wise one.

- Customer loyalty (Lin and Wang, 2006).

Cl1: My preference for using SMS would not willing change.

Cl2: It would be difficult to change my beliefs about SMS.

CI3: I will continue using SMS in the future.

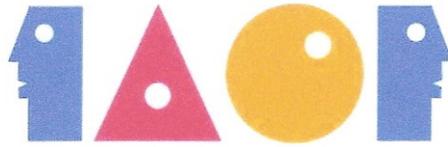
CI4: if friends recommended another service, preference for SMS would not change.

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## A NOVEL APPROACH TO THE MEAL BOX INDUSTRY

### HEALTH INDEPENDENT MANAGEMENT

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#### ABSTRACT

This purpose of this paper is to present a research study of the meal box industry health independent management and to propose a HACCP food safety control system for the meal box industry. A secondary purpose is to propose an associated hardware layout and software management system. As the family structure has changed rapidly in Taiwan, most people eat out or take out a meal box for lunch and dinner. The food sanitation control of meal box is a very important subject and is the focus of this investigation. The study examines twelve meal box factories around the area of Kaohsiung City, Kaohsiung County, and Pingdong County in southern Taiwan. Eight of them have been approved by a pilot certification system for food safety issued by the Department of Health, Executive Yuan, ROC and the remaining four are not certified yet. The researchers visit these factories making inquiries and find that more than 94% of them have passed the regulations of the Food Sanitation Control Act. Based on the research results of this study, the authors propose a method to upgrade the professional knowledge of managers in food supply of meal box factories, guide operators of food processing in establishing self-control systems, enhance sanitation self-control capabilities, and attain the goal of controlling meal box at the source of production. With the research results of the hardware layout, the meal box suppliers can improve the current inefficient hardware layout and build a new more efficient production line with better self-control system as needed. The results of software management can reduce deficiencies in the production process and disclose uncontrollable factors in the production process so as to accomplish the real-time control goals of the factory.

**Key Words:** HACCP (Hazard Analysis Critical Control Point), GHP (Good Hygiene Practice), Meal Box.

## INTRODUCTION

### *Research Motivation and Purpose*

Due to social change and family structural variance, people's lives have improved in Taiwan. Now, Taiwanese people do not eat to allay their hunger only, but also eat for nutrition and good health. As people dine out or bring meal boxes home to eat more often, food hygiene safety and quality have become increasingly important. Food poisoning is mainly caused by bacteria. For example, excessive amounts of pathogenic bacteria such as *Vibrio Parahaemolyticus*, Golden Yellow Staphylococcus and *Samonella* can infect people and make them ill. The increase of bacteria is probably caused by secondary post-heat treatment pollution, including cross pollution arisen from unclean devices, apparatus, water resources, insects and mice, or improper personal operation and hygiene.

From 2001 to 2005, the number of food poisoning cases in Taiwan increased from 67 to 146, showing that foods were polluted or treated improperly in the food supply business. The number illnesses showing that foods were polluted or treated improperly in schools increased from 7 to 27 (Department of Health, Executive Yuan, 2003). Despite the introduction of the Hazard Analysis Critical Control Point (HACCP) System, food processors are not yet capable of significantly reducing occurrence of food poisoning. This shows that the HACCP System still needs to be improved, which is the motivation of this research.

### *Research Process.*

In order to further examine these processes, a research study was conducted. The research study included the following steps:

(a) Collect and consult relative national and foreign literature to inform Research Design

- (b) Develop Research Design
- (c) Develop Questionnaire based on research hypotheses
- (d) Implement Survey Questionnaire, assisted by interview method to make up the shortage of the questionnaire interview
- (e) Make statistics and analysis on data
- (f) Discuss research results
- (g) Make summary and Conclusions

In this research, establishment and processes of meal box industry hygiene independent management is discussed. This discussion is divided into hardware planning and software management establishment, Characteristic Diagram analysis, Pareto Diagram analysis, HACCP Food Safety Control System proposal establishment, and other topics.

#### *Research Sample*

The Research Sample consists of 12 meal box manufacturers selected from the Kaohsiung City, Kaohsiung County and Pingdong County of Taiwan Area. Of these, 8 meal box manufacturers have obtained the guidance certification of the Food Safety Control System of Department of Health, Executive Yuan.

#### *Research Method and Process*

In order to understand the concept of meal box industry hygiene and safety in Kaohsiung City, Kaohsiung County and Pingdong County of Taiwan Area, the researchers conducted a Literature Survey. The HACCP Food Safety Control System Proposal is built on the basis of GHP Practices. The relevance between standard operation procedure and GHP is established, and then Foodservice Manufacturer Proposal will be offered for reference. After carefully study of these theses and works written by Chinese and foreign scholars, with a focus on rational

viewpoints, scientific demonstration and relative theories such as catering management food hygiene and safety and nutriology, the research study was conducted next.

### *Survey Instrument*

This research study was conducted using a Direct Interview of Structured Questionnaire and Unstructured or Un-standardized Questionnaire.

## **LITERATURE REVIEW**

In order to upgrade food hygiene and safety quality in Taiwan Area, Food Hygiene Management Law was published and implemented in February 9, 2000. According to Clause 20 of this Law, the places and facilities for Foodservice Manufacturers to manufacture, process, concoct, pack, transport, store and sell foods or food additives and their Quality Assurance Systems should comply with Good Hygiene Practice (GHP) specified by Central Authority of Taiwan Area, and the specific types of food sector being singled out and published by the Central Competent Authority should conform with Food Safety Control System specified by Central Authority of Taiwan Area. In this law, Food Safety Control System contained Good Hygiene Practice (GHP) and Hazard Analysis Critical Control Point (HACCP) system. Good Hygiene Practice (GHP) was published in September 7, 2000, and Hazard Analysis Critical Control Point (HACCP) system will be published and implemented recently. Food Safety Control System formulated can offer foodservice manufacturers with management and safety guideline required during manufacturing and distributing foods. Especially at a time when Taiwanese Government is taking active actions for Taiwan Area accession to World Trade Organization (WTO), it is urgent how to adapt to international trade change trend in the future and ensure producing, manufacturing, transporting and selling foods in safe conditions so as to guarantee consumers' health and safety.

In order to guarantee daily food hygiene safety of Taiwanese people, Department of Health, Executive Yuan conducted in 1998 Catering Public Health Inspection System Plan. This Plan was implemented according to the resolution of the 108<sup>th</sup> Provincial Governmental Conference held in March 24, 1997. After this Conference, Health Office of Taiwan Province (Central Region Office of Department of Health, Executive Yuan currently) conducted all the preparation and coordination conferences on Hazard Analysis Critical Control Point (HACCP) Guidance Work since July 1997, invited and collected relative people from catering industry, government and academia to discuss procedures, study out relative guidance work outline and complete “Anticipatory Guidance Work Outline of Implementing Hazard Analysis Critical Control Point (HACCP) in Catering Industry in Taiwan Province” finally after many conferences. This outline acted as foundation of guidance work.

From July 1, 1998 to June 30, 1999, guidance work team was composed of members from provincial health offices and prefectural and municipal health bureaus and experts and scholars. Among team members, those from health bureaus held the post of conveners while the rest acted as guidance work team member. All expenses on guidance work came from the budget formulated by government. First was to develop guidance work. Meal box foodservice manufacturers were taken as the target of guidance. For those manufacturers to be receiving guidance, in addition to qualification specified, they should have at least one member of Hazard Analysis Critical Control Point (HACCP) Promotion Team, who had received relative training courses offered by Food Industry Research and Development Institute. Ordinarily speaking, after at least 4 on-spot guidance from guidance work team and cross inspection from outside, it would be decided whether such guidance was completed or not. Those manufactures having passed inspection would obtain Anticipatory Guidance Certification awarded by government. That year,

there were totally 23 meal box food factories receiving this Certification. From July 1, 1999 to 2000, it changed to commissioning scholars to carry out guidance work in manner of project plan. In this manner, scholars acted as plan presider as well as guidance work team convener, while guidance work team was still composed of members from provincial health offices, prefectural and municipal health bureaus, experts, etc.. In addition to original meal box foodservice manufacturers, guidance targets that year were also spread into other large-scale catering service industry. After receiving internal guidance and external inspection, totally 50 meal box food factories and 25 catering service suppliers obtained Anticipatory Guidance Certification.

It had been approved internationally to apply Hazard Analysis Critical Control Point (HACCP) System to food hygiene management, so Taiwanese Government continued supporting this guidance work. From July 1, 2000 to May 2001, 56 meal box foodservice manufacturers and 12 catering service suppliers obtained Anticipatory Guidance Certification in Taiwan Province. That year, similar guidance work was also conducted in Taipei and Kaohsiung City. In Taipei City, totally 16 meal box foodservice manufacturers obtained Anticipatory Guidance Certification. While in Kaohsiung City, guidance work was only conducted in catering service industry, and totally 9 catering service suppliers obtained Anticipatory Guidance Certification after external inspection.

In the United States, food industry Hazard Analysis Critical Control Point (HACCP) System was firstly implemented on low acid canned food, and this System was jointly developed by the industry and government to prevent *Bacillus botulinus* from causing hazard to low acid canned food. At the time of System development, processing flow had been divided into two kinds, one needing control and another not, among which the processing flow needing control should be

strictly controlled. National Advisory Committee on Microbiological Criteria for Foods (NACMCF) pointed out that HACCP System had been executed for a period of time and both its fundamental principals and implementation steps had been understood in the United States and the world. Besides, NACMCF also indicated that government and foodservice manufacturers should perform their own functions respectively and cooperated with each other in respect of HACCP Food Safety Control System. However, competent authorities of government should play a role in HACCP System as below. First was to ensure HACCP System was implemented in accordance with decrees. Second was to confirm HACCP complied with General Principles and Guidelines of decrees. Third was to set legal control limits if necessary. Fourth was to set each analysis and sampling method if necessary. Fifth was to validate effect of foodservice manufacturers' executing HACCP System. Sixth was to collect epidemic data. Seventh was to provide relative information and improve correctness and effectiveness of HACCP System. Eighth was to offer financing support of HACCP –related study. Ninth was to integrate relative organs participating in HACCP study and thereby identify new food safety hazards and look for correspondent control method. Tenth was to take the stand of the United States to discuss each topic on HACCP in international conferences. Eleventh was to hold and attend each kind of education activity to encourage promotion of HACCP System. Twelfth was to cooperate with foodservice manufacturers to establish general HACCP System. Thirteenth was that any food safety control measure against possible hazard to consumers' health should be formulated by government. Foodservice manufacturers should play a role in HACCP System as below. First was to develop, implement and maintain effective HACCP System. Second was to compose HACCP team to ensure correct and effective implementation of HACCP System. Third was to ensure periodical update of HACCP System and keep relative records for reference of

external inspection. Forth was to find defects of HACCP System implemented and renew its contents in time to ensure consumers' safety (Kvenberg, Stolfa, Stringfellow & Garrett, 2000).

In 1990, the British government encouraged foodservice manufacturers to implement similar concept of HACCP Food Safety Control System in accordance with suggestions of UK Expert Committee, which were as below. First was that food processing procedure should comply with HACCP control principles. Second was that inspection personnel should adopt HACCP concept in the course of inspection. Third was that environmental conservation personnel should receive training on HACCP and its operation (Barnes & Mitchell, 2000).

Before 1996, the departments responsible for food safety control in Canada included Department of Agriculture and Agri-food, Department of Health, Department of Industry and Department of Fisheries and Oceans. In April 1, 1997, Canadian government integrated relative units of the 4 above-mentioned departments into Canada Food Inspection Agency (CFIA), which head of Department of Agriculture and Agri-food took charge of. CFIA was responsible for all affairs on food inspection, whose responsibility was extended from food and feed production to such affairs as transportation and retail. The major objective of CFIA was to enhance and fulfill Canadian food safety inspection system to ensure that consumers' safety could be guaranteed in the course of food production, transportation and marketing. Establishment of CFIA had indicated that Canadian government had determined to guarantee consumers' safety and also played an important role in participating international conferences related and international trade (McEachern & Mountjoy, 1999).

When the HACCP System was initiated in New Zealand in 1990, all industries volunteered to introduce HACCP System. At that time, foodservice manufacturers were not compelled to establish HACCP System in accordance with decrees of New Zealand. However, New Zealand

was a country majorly exporting meat products and fishery products processed. Therefore, in order to conform to the requirements of international trade for meat and fishery products, it had to be reevaluated whether voluntary HACCP System was adopted yet or not. In September 1996, food safety system had been listed in decrees of New Zealand and Australia (Lee & Hathaway, 2000).

Enforcement of HACCP System in Australia could be traced back to 1980. At first, HACCP System was executed by dairy manufacturers. In 1984, major dairy processing factories in Austria had executed HACCP System. Due to regional difference, HACCP System developed in Austria not in compliance with single system but multiple systems such as Australian Quarantine Inspection System (AQIS) and CODEX. However, in order to go with the stream of food safety in the world, National Food Authority was established in Australia in 1991, which was renamed Australia New Zealand Food Authority (ANZFA) majorly in charge of food standard development and setting. The decree pursuant in Australia was Food Standards Code. This Code standardized such items as food composition, safety and marking, but did not normalize such relative items as food hygiene in processing. In view of this problem, governmental authorities had requested ANZFA to commence formulating relative decrees. In September 1996, Australia and New Zealand governments announced to bring food safety control into decrees, which became compelling requirement system. Newly-enforced food safety standards would apply to all food-related industries in Australia, which requested foodservice manufacturers to execute HACCP System as well as Good Hygiene Practices (Peters, 1998; Souness, 2000).

Before formation of European Union (EU), all EU member states had respectively quality management system, including such items as decrees, trace management and confirmation. Therefore, it was really a great challenge to integrate such sophisticated food safety control

system in EU. European Commission had made a series of actions to expect that HACCP System could be effective and unanimously adopted by EU member states. Food Linked Agro-Industrial Research Programme (FLAIR) were mainly responsible for preparation works, among which such works as establishing definition of HACCP-System-related terms and over 250 kinds of HACCP-related databases were completed (Jouve, 1994). Such member states as the United Kingdom, France, Denmark, Spain, Sweden, Belgium, Portugal, Holland, Ireland and Greece had set training courses and prepared cooperation plans and activities among inspection units, research laboratories and offices. The next work was to complete a series of guiding principles, which were expected to integrate HACCP System into laws of each EU member states. The guiding principles completed contained fishery products (DIR 91/439), meat products (DIR 92/5) and milk and dairy products (DIR 92/46), which could reach the following targets with regard to the specific types of food sector being singled out. First was to identify critical control points involved in processing program. Second was to set monitoring system and method to monitor critical control points. Third was to collect and send samples to qualified inspection units for inspection and ensure that adopted steps of cleaning and sterilizing met standard of relative guiding principle (DIR 91/439, DIR 92/5, DIR 92/46). Forth was to keep and save work records for reference of relative personnel in inspection.

Furthermore, in accordance with Good Practices of 1993 (DIR 93/43/EEC), hygiene legislation system framework was further established in each EU member state. This guiding principle, mainly based on HACCP concept and principle, was used to evaluate and monitor critical control points in food processing. However, the situation of this guiding principle being implemented in each EU member state was not ideal. The major reasons were as below. First was that HACCP system or similar management system had existed in each EU member state

beforehand and been different from each other. Second was that HACCP systems or similar management systems and decree structures had originally existed in member states and been different from each other. Third was that complexity and relative decree regulations of member states' executing HACCP System were different from each other (Ropkins & Beck, 2000).

Since 1992, Quality Assurance Directorate (DAC) began to promote HACCP System under lead of Ministry of Fishery Industry (MIP) in Cuba. In Cuba, there were 40 enterprises engaged in fish and shellfish processing, of which 14 enterprises were qualified exporters. In according with Cuban regulations (Minister's Resolution No. 344/1996), manufacturers under MIP's jurisdiction had to execute HACCP System. In other words, any establishment engaged in fishery-related industry such as fishing, processing and selling had to execute HACCP System (Torres, 2000).

Thailand was a fishery product exporter, mainly exporting its fishery products to such countries and areas as Japan, North America, European Union, Middle East, New Zealand, Australia and South America. Each year, the companies registered in Thailand produced 800,000 tons of products to other countries and areas. In Thailand, the organ responsible for inspection and quality management of export products was Department of Fisheries (DOF). Each year, there were about 288 people participating relative quality management activities of exported fishery products, which included inspection personnel, laboratory personnel, administrative support personnel and management personnel, etc.. However, these people could only make a little sampling and inspection on a large amount of fisheries exported each year. Even so, there were still 1 to 2 percent of inspection samples not reaching the standard and accordingly being returned each year. This showed that there existed potential quality and safety hazards (Suwannrangsi, 2000).

In Malaysia, HACCP System was not compulsory. Since 1995, promotion of HACCP System started in Malaysia, for which Ministry of Health (MOH) was mainly responsible. In 1997, ISO System was prepared with reference to Malaysian Standard Department and Third Party Inspection Procedure was introduced in Malaysia. Over here, MOH played a role of verification organ, while Malaysian Agricultural Research and Development Institute (MARDI) was responsible for inspection. When resources were becoming enough, MOH would open registration of inspection personnel, and those qualified had to pass through HACCP inspection training course, have such academic background as food science and processing and participate in inspecting HACCP System of food companies in their own country (Merican, 2000).

## **THEORETICAL FOUNDATION**

### *History of HACCP*

In 1960, HACCP was exploited by reason of aerospace plan development in the United States. In 1970, HACCP was established to ensure low acid canned food safety by both U.S. Food and Drug Administration (FDA) and food processors. In 1973, HACCP was introduced into Low-acid Canned Food Good Practices. Since several serious food poisoning cases occurred in the United States in the middle of 1980, consumers began to request their government to present effective food management strategy. Then, Fishery HACCP System was presented by National Marine Fisheries Service and evaluated by FDA. In 1994, the Protocol of Fishery HACCP System was issued by FDA. In 1997, Fishery HACCP System became effective. U.S. Department of Agriculture suggested HACCP should be applicable to meat and poultry processors.

## **HOW TO USE SEVEN IMPORTANT PRINCIPLES OF HACCP**

### *Hazard analysis.*

(a) List in detail the hazards occurred in process possibly in relation with safety and workable preventative measures

(b) Analysis on Three Kinds of Hazards: Physical hazard, chemical hazard, biological hazard.

*Deciding critical control point.*

(a) Critical control point refers to a certain point, step or procedure that can be control to prevent, remove or reduce food hazard down to the lowest acceptable level.

(b) Based on hazard analysis tree judgment, practical experiences and risk evaluation.

*Establishing control limit.* The standards set, which can be time, temperature and others enabling food to meet safety regulations, should comply with request of each critical control point.

*Executing control point monitoring.* It refers to designedly monitoring whether critical control points accord with control limits and keeping a record of control for future reference and confirmation.

*Setting corrective measures.* When finding any unconformity with control limits in control process, should take corrective measures to restore critical control points to the status controlled.

*Setting record system.*

(a) All the operation programs should be documented and critical control points kept record in HACCP System.

(b) As being recorded to be indispensable information of proving that HACCP System is really implemented, files should be collected and controlled accurately and perfectly.

*HACCP system confirmation.* Set confirmation steps to prove whether operation of HACCP Management System is effective and correct.

*Steps and Principles of Implementing HACCP*

The following is a brief introduction on HACCP planning and implementation. At the time of make HACCP planning, a processor should adopt the procedures as below.

- (a) Establish HACCP team (or commission) and illustrate duties and responsibilities of each member.
- (b) Illustrate product, saving method, circulation way and marketing mode.
- (c) Confirm food usage, major consumer characteristics and consumption mode.
- (d) Narrate in detail product manufacturing flow process and operation chart.
- (e) Check flow process and operation chart.
- (f) Make planning of Hazard Analysis Critical Control Point planning.

#### *Principles of Implementing HACCP Management Plan*

- (a) Conduct hazard analysis. Evaluate the hazards possibly occurred in growth, rearing, harvest, manufacture, processing, transportation, distribution, selling and conditioning of fresh materials and other materials and consumption of their final products, and reduce the hazard level in these stages under the preventative measure required at permissible level.
- (b) Select critical control points (CCP) being able to control hazard.
- (c) Set CCP control standard (control limits).
- (d) Set each CCP monitoring condition, for example, control method and measurement method.  
  
If long-time microorganism measurement is unsuitable, adopt as far as possible physical or chemical methods that can be used for ceaseless monitoring. If exceeding time limit, can automatically stop or have alarm system.
- (e) Set corrective measures against variation occurred.
- (f) Set simple, intelligible and effective record form and mode.

(g) Confirm feasibility of HACCP correction. Use physical, chemical or functional inspection or microorganism inspection (if necessary) to confirm the result of implementing HACCP.

Regularly or when processing condition changes, make necessary review and modification of HACCP management plan.

## **ANALYSIS ON MEAL BOX INDUSTRY HYGIENE INDEPENDENT MANAGEMENT**

### *Connotation of Sampling Survey (Interview)*

This survey started from July 17, 2006 and ended at August 16, 2008. It is a sampling survey (interview) on kitchen conditioning site environmental management, warehouse materials keeping, kitchen waste disposal, operator hygiene behavior, etc. of 8 meal box foodservice manufacturers with HACCP certification and 4 meal box foodservice manufacturers without HACCP certification, which were selected from Kaohsiung City, Kaohsiung County and Pingdong County. As kitchen environment and operator hygiene behavior were vital to meal box quality as well as key to HACCP certification, such items as personal hygiene of operators, hygiene of conditioning site, mess site and other sites and hygiene of warehouse materials were included in this survey (interview). Daily operation inspection on hygiene of food offered by meal box foodservice manufacturer covered operator hygiene, conditioning site, food management, tableware, utensil safety hygiene and sterilization, kitchen waste disposal and warehouse management. The inspection on operation in catering industry covered kitchen data, food materials, food safety, operators' personal hygiene, food equipments and conditioning utensils, water supply, sewage, water pipe, lavatory and hand washing measures, disposal of garbage and waste, prevention and treatment of insects, mice and beasties, floor, wall and ceiling, lighting, ventilation, dressing room and others.

### *Comparison of Survey (Interview) Difference*

It was discovered in this survey (interview) that there was no apparent deficiency on kitchen environmental management and operator hygiene behavior of 8 meal box foodservice manufacturers with HACCP certification and 4 meal box foodservice manufacturers without HACCP certification (there were only few cases such as not wearing clothes and hats, mouth shades and gloves, not recording in detail caution mark's being complete, food source's being confirmed, foods' being stored separately according to principles of "first in first out") (See details in Table 1, 2 and 3). And there was no significant difference ( $P > 0.05$ ) among meal box foodservice manufacturers. In other words, according to statistical result of survey (interview) on kitchen conditioning site environmental management and kitchen operator hygiene behavior of meal box foodservice manufacturers from Kaohsiung City, Kaohsiung County and Pingdong County, over 94% surveyed (investigated) manufacturers from the above-mentioned cities and counties met the standard. To be specific, for those with HACCP certification whose kitchen conditioning site environmental management met standard, statistic data were as below. Kaohsiung City was 97.92%, Kaohsiung County 97.29% and Pingdong County 98.96%. For those with HACCP certification whose kitchen operator hygiene behavior met standard, statistic data were as below. Kaohsiung City was 100%, Kaohsiung County 100% and Pingdong County 100%. For those without HACCP certification whose kitchen conditioning site environmental management met standard, statistic data were as below. Kaohsiung City was 97.08%, Kaohsiung County 96.67% and Pingdong County 96.53%. For those without HACCP certification whose kitchen operator hygiene behavior met standard, statistic data were as below. Kaohsiung City was 95%, Kaohsiung County 94% and Pingdong County 93.33%. There was no significant difference ( $P > 0.05$ ) (see details in Table 3). All these should be owed to great promotion of HACCP System into government and non-governmental enterprises in recent years. HACCP

System had already had embryonic model and achieved splendid results. In view of situations in many counties in the world, for example, University of Iowa in the U.S. would actively apply HACCP System to promoting food safety (Henroid & Sheed, 2004), it was really necessary to completely promote HACCP certification in meal box industry in Taiwan Area so as to upgrade meal box quality, which also belonged to urgent affair.

### *Survey Results*

Survey results showed that it was necessary for 4 meal box foodservice manufacturers without HACCP Certification to actively make preparations for HACCP certification so as to upgrade meal box quality.

## **DISCUSSION AND CONCLUSIONS**

As to meal box industry hygiene independent management, this survey (interview) result showed that there was no apparent deficiency on kitchen environmental management and operator hygiene behavior of 8 meal box foodservice manufacturers with HACCP certification and 4 without HACCP certification. According to statistical result of survey (interview) on kitchen conditioning site environmental management and kitchen operator hygiene behavior of meal box foodservice manufacturers from Kaohsiung City, Kaohsiung County and Pingdong County, over 94% surveyed (investigated) manufacturers from the above-mentioned cities and counties met the standard. To be specific, for those with HACCP certification whose kitchen conditioning site environmental management met standard, statistic data were as below. Kaohsiung City was 97.92%, Kaohsiung County 97.29% and Pingdong County 98.96%. For those with HACCP certification whose kitchen operator hygiene behavior met standard, statistic data were as below. Kaohsiung City was 100%, Kaohsiung County 100% and Pingdong County 100%. For those without HACCP certification whose kitchen conditioning site environmental

**Table 1.**

Survey (Interview) Results on Kitchen Conditioning Site Environmental Management (8 Meal Box Foodservice Manufacturers with HACCP Certification and 4 without HACCP Certification in Kaohsiung City, Kaohsiung County and Pingdong County).

Object	Item	Treatment	Statistics of Survey Result			
			8 with HACCP Certification		4 without HACCP Certification	
			Meeting standard #	Not meeting standard #	Meeting standard #	Not meeting standard #
Kitchen conditioning Sites' Environmental Management	Appliances	Keep clean	8/8	0/8	4/4	0/4
	Oven face	Keep intact and clean	8/8	0/8	4/4	0/4
	Oil and smoke exhaust machine	Make timely cleaning and maintenance	8/8	8/0	3/4	1/4
	Cooler and freezer	Keep refrigerator below 0 degree C and freezer below minus 18 degrees C . It is unsuitable for storage capacity to exceed 70%. Fresh food should be separated from cooked food	7/8	1/8	4/4	0/4
	Food conditioning face	Stainless steel	8/8	0/8	4/4	0/4
	Utensil, container and tableware	Cannot directly touch floor, should take food as cleaner	7/8	1/8	4/4	0/4
	Window, wall and floor	Keep clean and in safe storing	8/8	0/8	4/4	0/4
	Pillar, ceiling, roof and lighting decoration	Keep clean and dry	8/8	0/8	3/4	1/4
	Screen door and window	Entrance and exit, door and window and other passage	8/8	0/8	3/4	1/4

	Drainage system	Sewage should be removed from kitchen. Water log is not allowed. Keep intact and unblocked	7/8	1/8	3/4	1/4
	Garbage can	With cover	8/8	0/8	3/4	0/4
	Refrigerator	periodic cleaning	8/8	0/8	4/4	0/4
	In work place and dinner room	Not allowed for accommodation and livestock raising	0/8	0/8	4/4	0/4
	Conditioning site	Not allowed to place personal effects	0/8	0/8	4/4	0/4
	Three-tank-style tableware washing machine	Set according to regulations	0/8	0/8	4/4	0/4
	Knife and chopping block	Over 2 sets and riftless	0/8	0/8	4/4	0/4
	Dishcloth	Cleaning and sterilizing	8/8	0/8	4/4	0/4
	Water quality	Should reach standard of drinking water quality	8/8	0/8	4/4	0/4
	Lavatory	Isolated from food conditioning site. Should adopt wash-down water to keep clean and have hand-washing facilities	8/8	0/8	4/4	0/4
Keeping of Warehouse Materials	Not allowed for accommodation and livestock raising	Place materials in order and not pile up junk	8/8	0/8	4/4	0/4
	Foods	Record in detail caution mark's being complete, food source's being confirmed, foods' being stored separately according to principles of "first in first out"	7/8	1/8	3/4	1/4

	Set pallet	Take good measures such as prevention of insect, mouse and moisture, and keep clean	8/8	0/8	4/4	0/4
	Ventilation	Good ventilation and humidity and temperature control	8/8	0/8	4/4	0/4
Kitchen Waste Disposal	Are kitchen waste bins enough and with covers? Should use hermetic garbage can and kitchen waste bin to make suitable disposal of residual dishes, kitchen waste or other garbage. Kitchen foods should be treated properly the same day		8/8	0/8	4/4	0/4

management met standard, statistic data were as below. Kaohsiung City was 97.08%, Kaohsiung County 96.67% and Pingdong County 96.53%. For those without HACCP certification whose kitchen operator hygiene behavior met standard, statistic data were as below. Kaohsiung City was 95%, Kaohsiung County 94% and Pingdong County 93.33%. There was no significant difference ( $p > 0.05$ ) (see details in Table 3). All these should be owed to great promotion of HACCP System into government and non-governmental enterprises in recent years. HACCP System had already had embryonic model and achieved splendid results.

## SUMMARY

### *Hardware management:*

In space utilization, moving line (human being, animal, air and water), facility disposition and management planning, square meal box factory building was all better than those in rectangular or storey shape. This shape of building was also helpful to prevent food from cross pollution. However, educational training and single control implementing should be still strengthened.

Table 2  
 Schedule of Survey (Interview) Results on Kitchen Operator Hygiene Behavior of 8 Meal Box  
 Foodservice Manufacturers with HACCP Certification and 4 without HACCP Certification in  
 Kaohsiung City, Kaohsiung County and Pingdong County

Object		Item	Statistics of survey result			
Content of Survey (Interview)	Health examination	Periodically at least one time a year	8 with HACCP certification		4 without HACCP certification	
			Meeting standard #	Not meeting standard #	Meeting standard #	Not meeting standard #
			8/8	0/8	4/4	0/4
	Behavior of polluting foods	Smoking, chewing areca, eating and drinking, etc.	8/8	0/8	4/4	0/4
	Wearing clothes and hats, mouth shades and gloves	Prevent hair, scurf and inclusion from falling into foods	8/8	0/8	4/4	0/4
	Hand	Be of no wound, keep hands clean, often wash and sterilize hands	8/8	0/8	4/4	0/4
	Nail	Not allowed to grow nails, vanish nails and wear decorations	8/8	0/8	4/4	0/4
	Operator dressing room	Should keep neat	8/8	0/8	4/4	0/4

Table 3

Schedule of Survey (Interview) Results on Kitchen Conditioning Site Environmental Management and Kitchen Operator Hygiene Behavior of 8 Meal Box Foodservice Manufacturers with HACCP Certification and 4 without HACCP Certification in Kaohsiung City, Kaohsiung County and Pingdong County

Category			Kitchen conditioning site environmental management	Kitchen operator hygiene behavior
Kaohsiung City	With HACCP	Meeting standard	97.92%	100%
		Not meeting standard	2.08%	0%
	Without HACCP	Meeting standard	97.08%	95%
		Not meeting standard	2.92%	5%
Kaohsiung County	With HACCP	Meeting standard	97.29%	100%
		Not meeting standard	2.71%	0%
	Without HACCP	Meeting standard	96.67%	94%
		Not meeting standard	3.33%	6%
Pingdong County	With HACCP	Meeting standard	98.96%	100%
		Not meeting standard	1.04%	0%
	Without HACCP	Meeting standard	96.53%	93.33%
		Not meeting standard	3.47%	6.67%

$X^2=6.211$   $p=0.226$  ( $p>0.05$ )

**Software management:**

In this research, all the air bacteria count detection values in different-cleanliness operation areas of 12 meal box foodservice manufacturers conformed to GMP requirements. However, gates of entrance and exit and passage in different-cleanliness operation areas should

be kept in the status of convenient closing, so as to guarantee implementation of operation area environmental hygiene.

For establishment of meal box foodservice manufacturer hygiene independent management mode and implementation of system, importance should be attached to hardware planning and software hygiene management firstly. However, reasonable moving line arrangement was the primary factor directly affecting hygiene independent management, and cognitive and educational training of workers were also the foremost factor influencing moving line and hygiene independent management implementation. In accordance with practical operation of meal box foodservice manufacturer, we prepared operation procedure in conformity with spot operation standard, set control limits and continuously solved problem and upgraded hygiene by force of PDCA so as to ensure meal box catering safety of consumer and raise goodwill of meal box foodservice manufacturer.

Achievements of hardware planning in this research could be offered to meal box foodservice manufacturers for reference before establishing factories or when improving hardware planning, and were also helpful to moving line arrangement and hygiene management implementation. In respect of establishing software management, practical online operation defects of meal box foodservice manufacturers were known. After defect evaluation, we should clear those control items that could not be implemented to try our best to reach the aim of real-time control.

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