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# Critical Factors of ERP Adoption for Small- and Medium- Sized Enterprises: An Empirical Study

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## Abstract

*Small- and Medium-sized Enterprises (SMEs) play a vital and pervasive role in Taiwan's economy. According to the 2002 annual white paper released by the Ministry of Economic Affairs (MOEA), about 1.08 million of SMEs were established in Taiwan. SMEs shared nearly ninety-eight percent of all businesses in Taiwan. Due to its flexible, agile, and efficient characteristics, SMEs create quite a few miracles in Taiwan's economic development history. Recently, the evolution and its application of Enterprise Resource Planning (ERP) systems have enabled the large enterprises to directly contact with their clients via e-Commerce and that led to the sharp competition for the SMEs. This study conducts a theoretical model to explore the critical factors which have influence on ERP adoption in Taiwan's SMEs. Four constructs, including "CEO characteristics", "innovative technology characteristics", "organizational characteristics", and "environmental characteristics", are empirically examined. Using a mailing survey, 139 usable responses were obtained. The response rate to the survey yield approximates 17.38%. The results of analysis indicate that CEOs' attitude towards information technology (IT) adoption, CEOs' knowledge of IT, employees' IT skills, firm size, competition pressure, cost, complexity, and compatibility are important determinants of ERP adoption to the SMEs.*

**Keywords:** Enterprise Resources Planning, CEO Characteristics, Small- and Medium-sized Enterprises, Information Technology Adoption

## 1. Introduction

The economic development in Taiwan heavily depends upon small and medium-sized enterprises (SMEs). According to the 2002 annual white paper released by the Ministry of Economic Affairs (MOEA), there were around 1.08 million SMEs in Taiwan and they shared nearly ninety-eight percent of all businesses in Taiwan. Due to its flexible, agile and efficient advantages, SMEs create quite a few miracles in Taiwan's economic development history. The evolution and its application of information technology (IT) have enabled large enterprises to directly contact with clients via e-Commerce and that create sharp competition among SMEs. In addition, the trend of trade liberalization arisen from Taiwan's entry into the World Trade Organization (WTO), the globalization of economic development, the rapid dispersion of industrial knowledge and the impact of the latest technology on the industries are the major challenges for SMEs. Moreover, enterprises must intensify their organization structure and business processes by improving and adjusting themselves continuously into the ever-lasting fast-changing market and be responsive to external challenges. With a need to cope with future challenges, enterprises must obtain newer market ideas, sensitive to advanced technology and equip with more innovative solutions to maintain core competence, values and to place more focus in research and development. Enterprise Resource Planning

(ERP) Systems are proved solution for the integration of business processes and resources to enterprises' operational and management strategy (Davenport 1998; Klaus et al. 2000; Markus et al. 2000).

SMEs do not only face highly competitive environment but also has limitations such as financial constraint, lack of proficient expert and easy exposure to external pressure (Welsh et al. 1981). Besides, SMEs usually lack of experience in better managing IT and information system professionals. Even SMEs willing to recruit information system professionals, it is also difficult to retain them to continue employment (Gable, 1991). Although technology, time and human resources may not be the major constraints for large organizations, but to the SMEs, these are the main resource issues for business plan and management.

Literatures confirm that factors of the new information system adoption involved in large enterprises are not applicable to SMEs (Raymond 1985; Thong and Yap 1995; Premkumar and Robert 1999). ERP system is closely related to organizational process reengineering and has to integrate with corporate software and hardware. Substantial software and consulting expenses are incurred in system adoption. Thus, the successful of ERP implementation is crucial to the existence of SMEs.

This study is based on information system integration model set forth by Thong in 1999 to explore the crucial factors which have influence on ERP adoption in Taiwan's SMEs under four constructs of "CEO characteristic", "innovative technology characteristic", "organizational characteristic" and "environmental characteristic". If Taiwan share the same environmental and cultural characteristic as Singapore, then Thong's research model can be followed to explore which factors affect the adoption of new information system in Taiwan's SMEs. But Hung and Liang (2001) indicate that there are obvious differences between Taiwan and Singapore in terms of cultural characteristic. Taiwan's cultural characteristic in general is more fearful of risk and reluctant to seek innovations. This behavior is being referred as the "uncertainty avoidance" and it rated high in Taiwan. Among Singapore's cultural characteristics, "uncertainty avoidance" is rated low; representing Singapore is more courageous to seek innovation and is more willing to face unknown risk. A common phenomenon appearing in the SMEs in Taiwan is that CEO is usually either owner or manager. So the characteristic of CEO is critical to new technology adoption (Thong 1995). Thus, "uncertainty avoidance" will be the major factor to decide if SMEs wish to adopt the innovative technology. This study will focus on the difference in cultural characteristic to further propose the policy for ERP adoption.

ERP is a new area of information system rising in the 1990s. Literatures concerning ERP are characterized by introduction to functions on the basis of practical cases (Bingi et al. 1999; Holland and Light). Our academic institutions mostly stress case research into large enterprises' adopting ERP. It is remarkably few studies refer to how to successfully adopt ERP system and what factors are affecting SMEs' ERP adoption. And the critical factors involved in large enterprises' adopting ERP are not applicable to SMEs due to resources constraint. As SMEs are principal part of Taiwan's economy, the outcome of ERP adoption will have substantial influence on the competitive advantage of enterprise and nation in the future. The exploration into critical factors to ERP adoption becomes the important theme for this study. This study aims to forward the conclusion after research to serve as the reference of SMEs' ERP adoption in order to lower adoption obstruction and uncertainty, and reduce potential failure in adoption.

## 2. Literature Review

### 2.1 ERP Market in Taiwan

Figure 1 demonstrates the recent movement of ERP market in Taiwan (Data source: MIC of Institute for Information Industry; Chinatrust Securities Investment Consulting Co., Ltd.). In 2001, the scale of ERP market in Taiwan reaches NT\$ 8.2 billion, as compare to 2000 it went up 7%. In 2002, ERP market increases to 12% to NT\$ 9.2 billion. Following the sharp growth of in 1998, the growth rate slows down from 1999 to 2001. It is predicted that, the growth rate in the future will be higher than 2001, due to three major reasons: First, the proportion of ERP adoption in Taiwan's SMEs increases gradually in a day by day basis. This increase as a whole will shorten the learning curve of SMEs. Meanwhile, more and more ERP vendors value the potential of SMEs market and thus concentrate on lots of promotion strategy and better-fit of function alternatives. Thus, Taiwan's system vendors are expecting to install ERP on the basis of SMEs. Second, many leading system vendors around the world suggest cooperating manufacturers in Taiwan to install ERP to increase production efficiency of supply chain. Third, the transfer of Taiwan's SMEs to Mainland China urgently needs the application of ERP to the cross-strait business management.

Though ERP market has slowly increased for the last years, the adoption of ERP for SMEs appears to be sluggish. According to Hung and Liang (2001), SMEs in Taiwan always employ the attitude of observation because ERP adoption has to match with business process reengineering; ERP adoption also incurs substantial expenses while the expected effect is unknown. Hence, Hung and Liang concluded that most of enterprises still hesitate to move forward.

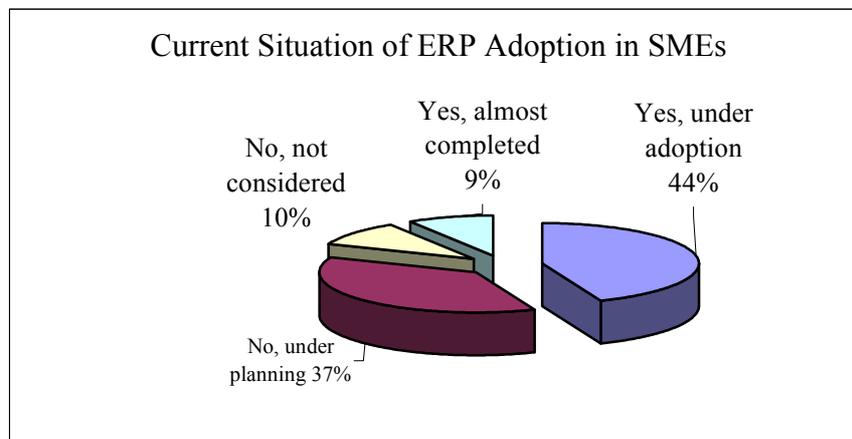


Figure 1: Current Situation of ERP Adoption in SMEs

### 2.2 Critical Factors to IT Innovation Adoption

Innovation Diffusion Theory of Rogers (1983) has been one of the most accepted theories of innovation technology. Later, researchers began to combine with other factors to improve the model to be more comprehensive and explanatory. Rogers (1983) further defines innovation as a new concept with great influences to the enhancement of either personal or organization goals and measures. According to the definition of Poutsma (1987), innovation has four characteristics and they are: (1) Process innovation or production innovation; (2) Innovation beginning from the basis or incremental innovation; (3) Innovation happening in technology push or market pull; and (4) Planned innovation or incidental innovation.

Following of Poutsma's definition, ERP belongs to a process of innovation through the employment of new methods, machineries or equipments that enhance data processing, distribution logic and service standards. ERP is also an innovation beginning from the basis where it utilizes the information technology to proceed with the improvement of basis, which is a large reform. The potential reason for ERP adoption is in accordance to the strong trend of technology push or market pull that matches Poutsma's definition. ERP it is obviously a planned innovation.

Raymond (1985) found that organizational theory and practical operation applicable to large enterprises may not suit the small enterprises. Welsh et al. (1981) considers that small enterprises operate their businesses in the highly competitive environment and are limited to resources such as the finance, the shortage of professionals and it is easy exposure to external pressure. Similarly, Yap (1992) also found that as compared to the large businesses, SMEs lack competence human resources, financial resources and material resources. In gathering the variables concerned, this study will be based on the literatures applicable to the technology innovation in SMEs.

Considering the adoption of new technology in small enterprises different from large enterprises, Iacovou et al. (1995) made use of opposite benefit factor, organizational factor and environmental pressure factor to explore the EDI adoption in small businesses and critical factors. Fink (1998) observed how Australian SMEs adopted the information technology in terms of organizational factor and environmental factor. The research of Cragg and King (1993) took innovation technology characteristic, organizational factor and environmental factor into consideration. Thong (1999) approached the adoption of information technology in Singaporean SMEs on the strength of CEO characteristic, innovation technology characteristic, organizational characteristic and environmental characteristic.

Among the viewpoints of the researchers mentioned above, the optimal constructs are four constructs of CEO characteristic, innovation technology characteristic, organizational characteristic, and environmental characteristic which stated by Thong (1999) who investigated the adoption of innovation technology in SMEs in Singapore.

### **3. Research Method**

#### ***3.1 Research Model and Hypotheses***

Based on the integration model set forth by Thong and other external associate variables as discussed earlier, this study explore the critical success factors to ERP adoption in Taiwan's SMEs. The proposed research model is shown in Figure 2.

##### ***3.1.1 CEO Characteristics***

When small enterprises adopt a new strategy, the support from the high-ranking manager has been confirmed by a lot of literatures to be the conspicuous factor (Grover 1993; Thong 2001; Yap 1992; Bingi et al. 1999; Holland et al. 1999; Premekumar and Robert 1999). Being the owner-manager of SMEs, CEO is the crucial factor to accept the use of new technology (Thong and Yap 1995).

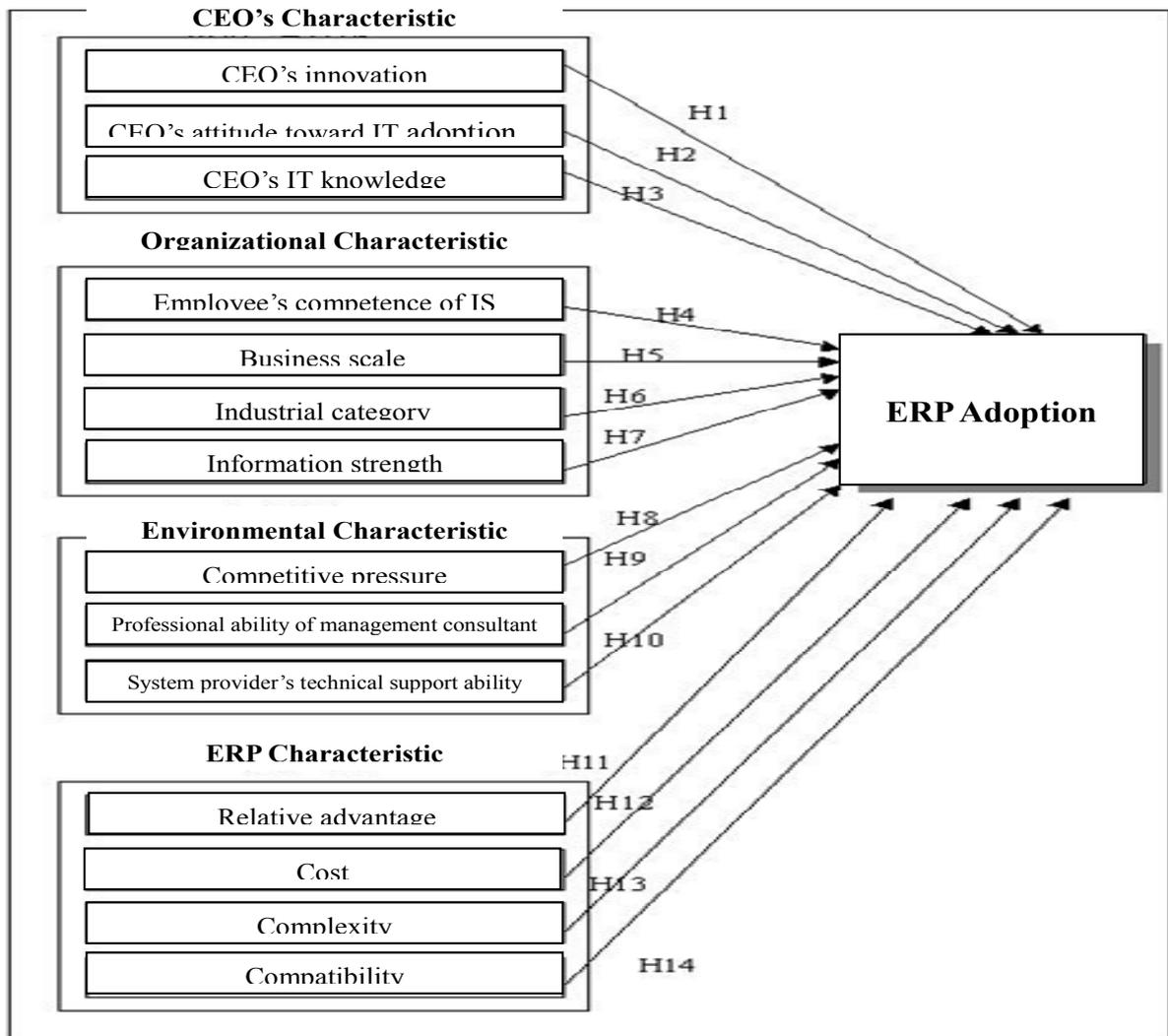


Figure 2: Conceptual Model of this Study

Three associated variables namely “CEO’s innovation”, “CEO’s attitude toward the adoption of information technology”, and “CEO’s knowledge of information technology” are used to explore factors which are critical to the adoption of information technology. Inquiry into the written sources in the previous literature reveals that there are difference exists between Taiwan and Singapore and the difference is termed as “uncertainty avoidance”. “Uncertainty avoidance” refers to the attitude of CEO in the process of decision making. The uncertainty avoidance is evaluated high in Taiwan but low in Singapore. CEO with the characteristic of high uncertainty avoidance was fearful to unknown circumstance and reluctant to accept risk, thus tend to refuse different idea or behavior and resist to innovation; as compared to the characteristic of low uncertainty avoidance, CEO tend to be more welcome to unknown circumstance and unfamiliarly risk, thus take up different challenge and innovative idea and behavior. Furthermore, Taiwan’s cultural characteristic is more fearful of risk and unwilling to seek innovation while Singapore’s cultural characteristic is courageous to seek innovation and not fearful of unknown risk. Therefore, CEO of Taiwan’s SMEs usually reject the unknown innovation and take wait-and-see attitude to observe if there is successful case happen to their competitors. This study not only explores the influence of CEO characteristic on the adoption of new information technology but also inspect the acceptance and attitude of CEO toward new information technology in Taiwan.

- 【Hypothesis 1】 More innovation of high-ranking manager has the positive influence on ERP adoption.
- 【Hypothesis 2】 The attitude of high-ranking manager toward IT adoption has the positive influence on ERP adoption.
- 【Hypothesis 3】 IT knowledge of high-ranking manager has the positive influence on ERP adoption.

### ***3.1.2 Organizational Characteristics***

DeLone (1988) pointed out that SMEs lack professional knowledge about information system and skilled experts are under-equipped. Lack of sourcing in information technology and associated IT knowledge will delay the adoption of new information technology. Tsai(1998) reported that the deep understanding and participation of all levels of employees are significant factors to the success of ERP adoption in Taiwan's electronic industry. The research of Yap et al. (1992) revealed that IT experience and user's involvement in the organization would also affect the adoption of new information technology. According to Thong (1999), the competence of employees about information system had positive influence on the adoption of information technology in small businesses.

- 【Hypothesis 4】 The competence of employees in information system has positive influence on ERP adoption.

Grover (1993) discovered that organizational scale was the major factor that affected the adoption of new information technology. Thong (1999) also found that the scale of enterprise was influential to IT adoption especially in small businesses. Numerous other literatures have confirmed that the organizational scale is one of the key factors to new information technology (Lees 1987; Premkuamr and Robert 1999; Thong and Yap 1995). However, the requirements of information system adoption vary with the industrial category.

Information strength refers to the timely supply of supporting information that requires in the product or service when the enterprise is in a competitive situation. The requirements of information processing vary from enterprise to enterprise. For example, travel agents need higher information strength because their major duties are involved in the processing and collection of travel information (Thong 1999). Thong (1999) further indicated that while information strength may not have straight positive relationship to the adoption of information technology, indirect influences are there.

- 【Hypothesis 5】 “Greater organizational scale” has the positive influence on ERP adoption.
- 【Hypothesis 6】 “The industrial category” which the organization lies in has the positive influence on ERP adoption.
- 【Hypothesis 7】 Higher “information strength” has positive influence on ERP adoption.

### ***3.1.3 Environmental Characteristics***

Crage and King (1993) discovered that the competitive pressure had impact on the adoption of new information technology in small enterprises. The research of Premkumar et al (1997) also indicated that pressures from other rivals carry notable impacts on the adoption of EDI in the enterprise. Other numerous literature have supported that competitive pressure is one of the critical factors to the adoption of new strategy in SMEs (Iacovou et al. 1995; Premkumar and Ramamurthy 1995; Premkumar and Robert 1999).

As cited by DeLone (1988), small enterprises usually possess little computing experience and do not have enough professionals to take care of internal information system. In short, small enterprises are bound to rely on the external support. A research conducted by Yap et al. (1992) demonstrated that the professional competence of consultant and the supporting competence of system vendor are also impacting factors on the adoption of new information technology in small enterprises. According to Thong et al. (1996), the technical support of system provider was remarkably influential on the comprehensive performance of information system. Bingi et al. (1999) also found that the selection and coordination of ERP consultant and selection of ERP provider had influence on the installation of ERP in the enterprise. Many different literatures have confirmed that the professional competence of management consultant and the technical competence of system provider are critical to whether the adoption of new information technology is successful (Crage and King 1993; Fink 1998; Grover 1995; Premkumar and Roberts 1999).

【Hypothesis 8】 Higher competitive pressure of industrial environment which the enterprise is situated in has positive influence on ERP adoption.

【Hypothesis 9】 The professional competence of consultant has positive influence on ERP adoption.

【Hypothesis 10】 The technical support competence of system vendor has positive influence on ERP adoption.

#### **3.1.4 ERP Characteristics**

Rogers (1983) first set forth innovation consciousness characteristic variables, i.e. relative advantage, compatibility, complexity, trial-ability, and observe-ability. In exploring the impact factors on EDI adoption, Premkumar et al. (1999) introduced the theory of Rogers to present four variables: (1) Relative advantage, (2) Cost, (3) Complexity, and (4) Compatibility. The research of Tornatzky et al. (1982) demonstrated that relative advantage, compatibility and complexity were important factors for adoption. Thong (1999) further indicated that relative advantage, compatibility and complexity of information technology were considerably influential on the adoption of new technology in small businesses. Due to the lack of financial resource, the corporate cost is also important to the adoption of IT. According to Tornatzky et al (1982), it was more potential to adopt the technology of low cost. Bingi et al (1999) also found that cost concern is crucial to ERP adoption. Thus, the cost and software integration were key factors for ERP installation in Taiwan's electronic industry.

【Hypothesis 11】 Higher “relative advantage” of ERP has positive influence on ERP adoption.

【Hypothesis 12】 Lower “cost” of ERP implementation has positive influence on ERP adoption.

【Hypothesis 13】 Lower “complexity” of ERP has positive influence on ERP adoption.

【Hypothesis 14】 Higher “compatibility” of ERP has positive influence on ERP adoption.

#### **3.2 Research Design**

The questionnaire is designed on the basis of the Likert's five-point scale. To ensure suitability and correctness of the questionnaire contents, a group of information management experts were used to inspect if any sentence or use of words that need to be revised from the

manuscripts. Then, experienced supervisors and academic experts from the Information Department were invited to conduct pre-test in order to make sure that all questions are clear and specific. Generally, SMEs are set up with highly centralized structure; that high-ranking managers are mostly decision makers. This study focuses on SMEs' responsible persons, supervisors of the Information Department and high-ranking managers. The scope of main research selects a sample of 800 companies from the following organizations: (1) The Hand Tool Manufacturers' Association of the Republic of China; (2) The Small & Medium Enterprises Association and (3) The Managers from the China Credit Information Publication.

## **4. Results**

### ***4.1 Basic Information***

A total of 800 questionnaires are delivered to the high-ranking officers of SMEs in Taiwan. Within the six-week duration (from April 27, 2002 to June 7, 2002), efforts was made to the collection of questionnaires through follow-up calls and re-send incomplete questionnaires. With a returning rate of 18.5%, 148 copies of questionnaires were received totally. However, nine questionnaires were classified as void due to incompleteness. As a result, effective questionnaires were counted 139 copies; lowering the returning rate to 17.38%.

In terms of industrial category, among the samples received respondents from the manufacture business ranks first (64.9%) then, followed by the electronic information business (20.9%). The combination of both occupies 84.9%. This demonstrates the information of samples collected is consistent with actual distribution. At present, the objects of ERP promotion are still based on manufacture and electronic information businesses.

About the length of operational years, respondent companies that established over 25 years ranks first with 27.3%, secondly are companies with 20-24 years of history (20.9%) while company with 15-19 years of duration ranks third with 18.0%. The sum percentage is 66.2%. It can be generalized that samples collected are manufacturers who have operated the business for a long time. According to Small and Medium Administration, MOEA, businesses (including information, electronic business) which have paid-up capital below 80 million or with employees number less than 200 persons are recognized as SMEs.

It is revealed from the data that respondent companies with capital below 12 millions occupy at 23.0% where companies possess capital over 80 millions represents 26.6%. While companies that own capital above 90 millions occupies the highest percent at 54.7%. The enterprises with less than 80 employees represent 59.7% in the samples collected. It reveals that responses are mostly from small-sized businesses.

Enterprises which annually invest 0.11 to 0.5 million in information expenses (including software, hardware and system development) stands at 34.5%, below 0.1 million at 25.9%, totaling 60.4%. This also demonstrates that a lot of SMEs' information investment is still pending on promotion. About 59.7% of companies agree that ERP in business operation brings significant outcomes. This indicates that there is substantial potentiality for the application and development of ERP system in enterprises. Therefore, it deserves close attention of information personnel.

Data reveals that the majority of enterprises still have no experience in ERP adoption, occupying 64.0%. The enterprises planning to adopt ERP occupy the maximum percentage at 40.4%. But the percentage of enterprises not thinking of ERP adoption is as high as 37.1%. The potential cause is that organization doesn't understand ERP. That can be proved from the 44.8% of answers to "no understanding of ERP" that was asked to give reasons for not adopting ERP. Data indicates that 42% of respondents have one to two years of experience in ERP, followed by, half a year to one year of experience (32.0%). These data demonstrate that ERP system is a kind of rising software in SMEs. For frequency of ERP adoption, the daily use stands at 86.0%.

This study focuses upon 50 companies to investigate into the function modules of ERP adoption, efficiency of ERP adoption, difficulties arising during ERP adoption and crucial factors to ERP adoption. Since questions are presented in the format of multiple choices, the total sum of percentage will become greater than 1. Based upon data analysis of ERP adoption, the first four ERP function modules are financial management (88.0%), manufacture management (84.0%), marketing management (62.0%) and product data base management (54.0%) in sequence.

#### ***4.2 Reliability and Validity***

Reliability refers to the stability and uniformity of testing results. The Cronbach's  $\alpha$  coefficient method is being used in this study to measure sample reliability. It is used because it is of the most frequently used method of reliability testing. Hair (1998, p.88) indicated that the lowest acceptable value ranged between 0.6 and 0.7. The reliability test shows that Cronbach's  $\alpha$  coefficient is higher than 0.6.

Validity means correctness. It is important to ensure the survey will deliver message surely cover intended characteristic or function. The questionnaire of this study derives from the past literature with substantial face validity. Information management experts are used to revise some of the phrases in each question. They also went through the manuscripts carefully to eliminate errors and omissions. Before the pre-testing of questionnaire is conducted, a group of academic scholar with practical experiences and some supervisors from the Information Department were invited to examine the questionnaire in order to make sure all questions are clear and concise to ensure the content validity of this study.

For construct validity, this study makes use of principal component analysis of factor analysis and varimax of orthogonal rotation to proceed with rotation of factors that the meaning of each factor is clearer. The results represent good construct validity.

#### ***4.3 Discriminant Analysis***

Discriminant analysis is an interdependent method for single standard variable. The standard variable is preset category or group. The variable pattern of this study's independent variable is interval, the dependent variable is "if ERP is adopted" and variable pattern is category. Thus, the discriminant analysis is used to evaluate the hypothesis of research and the discriminant function is available for testing if the variable can obviously discriminate two populations. The discriminant function of this study is shown in Table 1. Wilks' Lambda is 0.563 ( $X^2=75.296$ ,  $df=12$ ,  $p=0.000$ ). The results reveal that this study can obviously discriminate two populations adopting or not adopting ERP.

Results also indicates eight variables are significant, including CEO's attitude toward the adoption of information technology, CEO's knowledge of information technology,

employee's competence of information system, organizational scale, competitive pressure, cost, complexity and compatibility which have influence on ERP adoption. The results of correct discriminant rate testing reveal that correct classification rate is 83.5% for discriminant function, 80.9% for organization adopting ERP and 88% for organization not adopting ERP.

Table 1: Results of the Discrimination Analysis

Wilks' Lambda = 0.563, Chi-Square = 75.296, Degrees of Freedom = 12, Significance = 0.000							
Variable	Discriminant Coefficient	Discriminant Load	Unadopting (n=89)		Adopting (n=50)		Significant standard
			Average	Standard Deviation	Average	Standard Deviation	
CEO's innovation	-0.239	0.098	2.140	0.559	2.258	0.678	0.295
CEO's attitude toward IT adoption	0.140	0.298	2.161	0.616	2.491	0.746	0.002*
CEO's IT knowledge	0.441	0.396	2.200	0.768	2.787	0.785	0.000**
Employee's competence of information system	0.566	0.458	1.910	0.522	2.474	0.699	0.000**
Organizational scale	0.299	0.397	3.320	1.110	4.090	0.960	0.000**
Information strength	-0.391	-0.046	1.911	0.683	1.185	0.729	0.624
Competitive pressure	0.442	0.301	2.231	0.695	2.620	0.823	0.001*
Professional ability of management consultant	0.005	0.102	3.202	0.957	3.382	0.915	0.273
Technical support ability of system provider	-0.073	0.062	3.240	0.926	3.357	1.018	0.503
Relative advantage	-0.179	0.101	2.234	0.575	2.248	0.608	0.280
Cost	0.318	0.407	2.935	0.715	3.484	0.643	0.000**
Complexity	0.303	0.462	2.853	0.705	3.462	0.684	0.000**
Compatibility	0.093	0.329	2.520	0.762	2.978	0.768	0.001*
Classification Accuracy							
	Grand Total		Unadopted ERP		Adopted ERP		
Unadopted ERP	89		72 (80.9%)		17 (19.1%)		
Adopted ERP	50		6 (12.0%)		44 (88.0%)		
Overall Accuracy 83.5%, Chance Accuracy 53.92%							
Note 1: Information strength and compatibility are analyzed after square root is taken.							
Note 2: **: p < 0.01; *: p < 0.05							

## 5. Discussions

After the aforesaid hypotheses have been tested, this study organizes the results as follows. The testing results are summarized in Table 2.

### 5.1 CEO Characteristics

Through the obtained data, characteristics such as the "CEO's attitude toward the adoption of information technology", the "CEO's knowledge of information technology" have positive influences toward whether ERP is adopted or not. "CEO's knowledge of information technology" is the predicting variable which is most capable of discrimination as most CEO in SMEs are known as owners/managers and also refer as decision makers. Therefore, adopting ERP or not rely largely on their hands owning to how much they know.

Due to lack of IT knowledge, the majority of small businesses always take priority to select hardware other than software. As a result, they fail to achieve the desired goal (Lees 1987). The application of information technology in Taiwan's SMEs is deeply affected by the manager. If the manager has explicit and great ideas, the level of information application is higher. Otherwise, the business operation only remains in the stage of traditional

transaction system. Moreover, CEO's favorable concept of management shall be beneficial to expanding the level and scope of information system application. CEO's positive attitude and profound IT knowledge are closely related to if ERP is adopted.

Table 2: Results of the Hypotheses Testing

Hypothesis	Description	Support
H1	Higher "high-ranking officer's innovation" has positive influence on ERP adoption.	No
H2	"High-ranking officer's positive attitude" has positive influence on ERP adoption.	Yes
H3	"High-ranking officer's IT knowledge" has positive influence on ERP adoption.	Yes
H4	"Employee's competence of information system" has positive influence on ERP adoption.	Yes
H5	Greater "organizational scale" has positive influence on ERP adoption.	Yes
H6	Organizational "industrial category" has positive influence on ERP adoption.	No
H7	Higher "information strength" has positive influence on ERP adoption.	No
H8	"Higher competitive pressure" has positive influence on ERP adoption.	Yes
H9	"Management consultant's professional ability" has positive influence on ERP adoption.	No
H10	"System provider's technical support ability" has positive influence on ERP adoption.	No
H11	Higher "relative advantage" of ERP system has positive influence on ERP adoption.	No
H12	Lower "cost" of ERP installation has positive influence on ERP adoption.	Yes
H13	Lower "complexity" of ERP system has positive influence on ERP adoption.	Yes
H14	Higher "compatibility" of ERP system has positive influence on ERP adoption.	Yes

Among the characteristics of CEO, the results of this study are considerably different from those of Singapore's scholar Thong and Yap (1995) and Thong (1999) in terms of the variable "CEO's innovation". Hung and Liang (2001) also indicated that the cultural characteristic in Taiwan is more fearful of risk and less courageous to seek innovation while the cultural characteristic in Singapore is more courageous to seek innovation and less fearful of unknown risk. Thus, "CEO's innovation" is the outstanding variable which has impact on the adoption of new information technology in Singapore's SMEs. The "CEO's innovation" in Taiwan rather, shown no remarkable influence to the adoption of new information technology.

### 5.2 Organizational Characteristics

The results reveal that "employee's competence of information system" and "organizational scale" positively affects the adoption of ERP. SMEs usually lack the experts who are proficient in information system and know-how. The study finds that the businesses that do not have IT/IS professionals stand for 37.9%; while 26.4% of businesses claim for shortage of development resources.

Considering the cost and skilled professional involved in information system, the average domestic SMEs employ less than 5 MIS persons. Some businesses even designate other department to be responsible for MIS. (Descriptive analysis of basic information demonstrates that businesses with less than 5 persons working for the Information Department share the percentage of 90.6%) Nevertheless, when the operation scale of businesses is up to a certain degree, urgent need of information system tend to appears. Many enterprises recruit the employees with much experienced in information system to lower the risks arising from ERP adoption (Thong, 1999) since small businesses are limited to resources while larger enterprises have more resources to adopt ERP. Therefore, the larger the organizational scale, the higher to possibility to adopt ERP.

Lastly, there are no remarkable difference exists between this study and Singapore's scholar Thong and Yap (1995) and Thong (1999) in terms of organizational characteristic.

### ***5.3 Environmental Characteristics***

When looking into environmental characteristic, this study comes to conclusion that “competitive pressure” is positively crucial to “whether ERP is adopted or not”. The booming development of information technology alters the behavior of many business operations. SMEs start to face the competitive challenges as a result. These competitive pressures may signify that other SMEs have launched to apply ERP. So they were worried about the loss of competitive advantage. According to IMF statistics indicate that of logistics cost incurred in purchase, sale and inventory occupy 10% of total production costs in U.S.A.; 13% in Taiwan and 26% in China. The competence of information processing is critical to cost reduction because it can promote production efficiency. Particularly, when numerous enterprises gradually transfer their production sectors to China at the same labor costs, the competence of information processing shall directly influence competitive advantage. Shih, Shu-Chi, assistant manager of the Sales Department for Oracle Taiwan, said that “enterprises not using ERP fail to compete with others and they shall face more difficulties at the time of ERP adoption”. This explains the dilemma that many enterprises have when they adopt ERP. Thus, sharp competition is positively related to the use of ERP.

The results of this study are remarkably different from those of Singapore’s scholar Thong (1999) in terms of the variable “competitive pressure”. The research results conducted by Thong (1999) reveal that “competitive pressure” doesn’t directly influence the adoption of information technology but indirectly the adoption of information technology through the characteristic of influence on information technology. According to the research of Premkumar and Robert (1999), “Competitive pressure” is a remarkable variable. To explore its reason, the research structure of Thong (1999) consists of two parts. Part one is to discuss if information system is adopted. Part two is to explore if the adoption of information system is increased. Premkumar and Robert (1999) researched into if information system is adopted. Moreover, the manner of research conducted by Thong (1999) and Premkumar and Robert (1999) causes the difference of remarkable results.

### ***5.4 ERP Characteristics***

In ERP characteristic, “cost”, “complexity” and “compatibility” are remarkable variables affecting the adoption of ERP. Owing to the financial restraints in SMEs, the cost is the crucial factor to information system planning. (Descriptive analysis of basic information demonstrates that enterprises have less than 0.5 million of annual information budgets including software, hardware and system developments occupy 60.4%. It can be known that enterprises invest only limited budget in information every year.) For the product combination of Data Systems Consulting Co., Ltd., “super special assistant” and “small special assistant” are available for small-sized company at the expense of less than 0.3 million. The second business group’s Workflow ERP focuses on the middle-sized company, with annual turnover between 0.2 and 2 billions. The expense of software adoption is nearly 1.5 million-plus which is still not accepted by a lot of SMEs. Thus, the cost is predicting variable with remarkable ability among ERP characteristics.

As for the variable “complexity”, the results indicate that “no understanding of ERP” occupies the maximum percentage of 44.8% being the reasons for not adopting ERP. It reveals that most of SMEs are still unaware of ERP. The complexity of ERP has substantial influence on its adoption in SMEs. When ERP is more capable of integrating the information system and operation information of all departments or multi-departments, the organization tends to adopt ERP to promote inner competitiveness.

Among ERP characteristics, remarkable difference exists between this study and the research of Thong in terms of the variable “relative advantage”. The potential reason is that Thong’s research focuses on IT system, while IT system has reached the maturity either in the application region or in the application time. Thus, “relative advantage” of IT system is generally identified by the organization as well. ERP referred to, in this study, is still of the latest software in SMEs. So its domain of application is not up to maturity. It is obvious that “relative advantage” doesn’t remarkably affect if ERP is adopted.

## 6. Conclusions

Based on the data analyzed in the study, the following suggestions are expected to be of contributory values to the academic field, small- and medium-sized enterprise, consulting firms and software vendors, and government agencies.

This study found that “compatibility” of ERP is crucial to ERP adoption in SMEs. According to the president of Advanced TEK International Corporation who adopted ERP into the organization, indefinite goal and high turnover rate are the problems they faced in adopting ERP. Enterprises often unaware of their own needs or expected outcome, some enterprises even misinterpreting ERP for all healings. Therefore, enterprise should depend upon existing operation system and objectives to adopt the most appropriate system. This study found that “cost” is another critical factor to ERP adoption in SMEs. Thus, the following systems are recommended for SMEs: the SAP.com All-in-One launched by both SAP and PreVision Technology Ltd., Oracle’s EbusinessWorks and “super special assistant”, “small special assistant”, “super special assistant SmartERP” and “Workflow ERP” of Data Systems Consulting Co., Ltd.

The complexity of ERP causes difficulty of installation. When selecting software provider, SMEs’ decisions are remarkably related to whether the ERP is easy to understand and use. Instead of a multi-function complicate model, a simple and easier model should find more suitable for SMEs. SMEs can obtain assistance such as technical guidance and consultation through governmental help since there are many e-service training programs available for “SMEs”. Since most SMEs are found to have “no understanding of ERP” and the attitude of CEO has positive influence on ERP adoption, software providers should strive to intensify SMEs’ recognition of ERP. Since complexity and cost of ERP software reduces the willingness of organization to adopt ERP, software vendors should make ERP affordable, easy to learn and operate for SMEs.

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