A Study of Constructing Knowledge Management for Taiwan's Small and Medium-sized Enterprises by Successful Factors

Shiaw-Wen Tien[1], Ming-Lang Wang[1], Yi-Chan Chung[2], Chih-Hung Tsai[2†], and Si-Yi Lee[1]

[1] Graduate Institute of Management of Technology
Chung-Hua University
30 Tung-Shiang, Hsin-Chu, Taiwan, ROC

[2] Department of Industrial Engineering and Management
Ta-Hwa Institute of Technology
1 Ta-Hwa Road, Chung-Lin, Hsin-Chu, Taiwan, ROC
Tel: +886-3-5430-466, E-mail: ietch@thit.edu.tw

Abstract

In the Knowledge-based Economic Era, all of the enterprises are facing global competitive pressure. The activities of knowledge accessing, codifying, and application will obviously become the main inner function on enterprise operation. Knowledge will be the primary competitive advantage; therefore, he who wants to hold the competitive advantage should do the knowledge management (KM) very well. In this study, we construct the research dimensions and variances by the successful factors of KM, which had been practiced very well by big enterprises inside and outside our country, and which was recommended by the related scholars. In order to approach the differences between big enterprises and small and medium-sized enterprises (SMEs) towards implementing KM, this study takes the way of questionnaire investigation to do empirical analysis and to construct the model of KM by path analysis. The study found out when implementing KM, SMEs should highlight "leadership," "library-architecture," and "corporate culture" these three aspects, while "information technology" and "performance evaluation" these two aspects show no remarkable influence. It shows that he who wants to construct KM might not too overweight on information technology to build the KM system. Therefore, we suggest when implementing KM, enterprises should reinforce the corporate culture by sharing, organized KM process, learning environment for all employees, and highly authorization by top managers in order to reach the expectant success of KM. The result of this study offers practical thinking directions to reach the expectant success for the policy makers in SMEs, who are accessing to or evaluating to implement KM.

Key Words: Knowledge-based Economy, Knowledge Management, Small and Medium-sized Enterprises, Successful Factors

† Corresponding Author

1. Introduction

Benjamine Franklin once said that knowledge is an investment that yields highest return rate. Thurow [43] also mentioned in his book *In Knowledge-based Economy* that in the time of knowledge-based economy, the key factor for success in people has become "knowledge", which has replaced the key factors of natural resources such as lands, gold and oil for becoming successful in the industrial age. Knowledge has become the cornerstone of wealth. The present study used small and medium-sized enterprises (SMEs) as the research population, with the hope that the results of the study will contribute to SMEs. Most of the literatures associated to knowledge management (KM), enterprises that have successfully practiced knowledge management, and the development and practices of knowledge management systems used on large enterprises and hi-tech industries that are knowledge-oriented as their target population, whilst very limited numbers of studies were based on SMEs, as well as traditional industries. Therefore, one of the motivations of the present study is to combine the key factors for successful practices of knowledge management of large enterprises, and to develop a theoretical and practical knowledge management system suitable for SMEs. In the time of knowledge-based economy, enterprises face pressures of global competition, and professional knowledge developments will become the major internal function of enterprises. Knowledge will become the main focus of competition. It is only with good knowledge management that an enterprise can maintain its competitiveness. The SME is a business form vital in the economic framework of Taiwan, and the contributions on economic developments are well recognized.

In our general impression, there seems to be a close association between knowledge-based economy and hi-tech manufacturers, for hi-tech industries tend to be characterized by knowledge-based economy. However, the importance of knowledge-based economy in SMEs, traditional industries, and service industries has often been overlooked. Therefore, SMEs were used as the study population, and the development of KM framework for elevating the competitiveness of the enterprises is another motivation of the present study. The objectives of he present study are summarized as the following: (1) developing the constructs and relevant factors for a KM model by discussing theories proposed regarding factors for successful KM proposed by researchers, as well as by analyzing successful factors of large enterprises that have a well practiced KM system; (2) comparing differences in practices of KMs between SMEs and large enterprises; (3) discussing whether there are difference in the practice of KM of SMEs between different business areas; (4) defining a KM model suitable for SMEs by getting SMEs to do surveys generated based on successful factors and factors for KM systems, and by analyzing the survey data through statistical means, in order to serve as a reference for the SMEs.

2. Literature Review

The present chapter reviews the literatures relevant to knowledge-based economy, as well as KM in SMEs. There are four sections in the chapter, in which the basic theories of KM development will be illustrated, as well as the meaning and the significance of the present study.

2.1 The Introduction of Knowledge-Based Economy

Thurow [43] mentioned in book "Building Wealth" that after the first industrial revolution, energy had replaced lands as the cornerstone that sustains the pyramid of wealth. During the third industrial revolution, knowledge has further taken the place of land and energy, and become the new cornerstone of wealth. The economy created based on knowledge is referred to as the knowledge-based economy. You [2] in book "Knowledge Management and Innovation" concerning the evolution of economic stages said that digital technology and global market are the two main trends that created "knowledge-based economy". According to the definition of Organization of Economic and Development (OECD, 1999) referred by Wu and Wen [6], "knowledge-based economy" is the economy of production, distribution and application based on knowledge; knowledge refers to all the understandings created and accumulated by human beings thus far, and the understandings of scientific technology, business management and behavioral sciences have been regarded as the most important of all. Furthermore, "White Book for Small and Medium-sized Enterprises" [4] suggested that "knowledge-based economy" is a knowledge-based economic system, in which knowledge takes the place of capital and labor, and becomes the future key factor of the productivity and competitiveness of a nation; the prerequisite of becoming a knowledge-based economic society, is to create a economic system that benefits original thinking and strengthens soft/hardware facilities, so as to accelerate the accumulation, production, expansion and significant value-added application of knowledge.

Regarding the natures of knowledge-based economy, Sun [8] suggested that the nature of knowledge-based economy is to make use of the incessantly progressing knowledge to create new industries and develop economy. Therefore, human talent training and increasing development will transfer knowledge into something of market values. This is particularly important in the development of knowledge-based economy. Tapscott [42] pointed out that as knowledge has gradually become the key resource of development, even if the operational environment of an individual organization was limited within a country, a region, or a particular area, there would actually be only one global economy being operated. The difference between the age of knowledge-based economy and the age of industrial economy, is that the former is centered by knowledge. Tapscott [42] further indicated that in the new economic system, or the knowledge-based economic system, everything we produce and the way of

producing things would be based on how to use human knowledge. In a knowledge-based economic system, low-reward strategies would not facilitate the progression and success of a nation; rather, it is only through labors with value added, high education standard, high level of encouragements, high standard training, high standard authorization, and the equipment of the latest knowledge tools and the construction of knowledge foundation, that a nation would be able to attract investments, create new wealth and high-paid jobs. Wang and Sun [3] conducted a study concerning the differences in the nature between knowledge-based economy and traditional economy, and proposed eight factors of productive factor, productivity, market range, medial instrument, technological transformation, industrial structure, product nature, and developmental strategy for comparison.

Drucker [26] pointed out that the global leading economic statuses of the advanced countries in the 20th century were realized mainly by increasing the productivity of the laborers. However, in the 21st century, the leading economic statuses will transfer to nations with the most systematic and successful increase in the productivity of the knowledge laborers. According to the study by Chen [11], OECD has categorized knowledge concentrated industrial regions into two major groups of knowledge concentrated manufacturers and knowledge concentrated service industries. The former includes high-tech manufacturers, and the latter includes professional personal services and productive service industry. Based on the categorization, using the definition provided by OECD, Council for Economic Planning and Development conducted estimation according to input-output chart and suggested that knowledge concentrated industries in Taiwan would reach 40.6% of GDP in year 1996, which was still somewhat distant to the average value of over 50% by OECD at the time. As for the growth rate of value-addition, knowledge concentrated manufacturers had a 12.6% increase from year 1991 to year 1996, which was slightly higher than the 11.3% of the knowledge concentrated service industries. Nonetheless, when the percentage size of GDP is considered, the number of knowledge concentrated service industries was approximately five fold of that of the knowledge concentrated manufacturers. Ministry of Economic Affairs pointed in the "White Book for Small and Medium-sized Enterprises" [4] that the in the time of knowledge-based economy, there are also new business opportunities for SMEs, and electronic business is one of them; there is also a relatively large space for development for SMEs in terms of knowledge service industries. Nevertheless, in order to cope with the swift transformation of the knowledge-based economic age, leverage of IT instruments, new lines of thoughts and knowledge seeking.

2.2 The Introduction of SMEs

The primary objective of the present study is to construct a framework of KM suitable for SMEs, thus the present chapter will focus on the definition, contribution and the status

quo of SMEs, as a way to distinct the enterprises from large enterprises. The evaluation of an enterprise's scale equals to defining its size, and the total capital, the turnover and the employee number are used as the measures for evaluating the scale of an enterprise; the latest one was for May 2000. Moreover, since there are differences in the definitions of SMEs due to global comparisons [4, 32] of economic issues, study objectives, and the defining criteria of SME between nations. Concerning the operational weaknesses of SMEs, Yu and Wang [1] pointed several situations that might be found in the enterprises, for instance, being small in scale would have no advantages of large-scale economy; having a imperfect accounting system would deprive an enterprise of the convenience brought by banking and financing; having too much family influences in an enterprise would result a people-ran enterprise, as opposed to a system-ran enterprise. "White Book for Small and Medium-sized Enterprises" [4] suggested that SMEs also have some developmental advantages in the time of knowledge-based economy. For example, SMEs are often smaller in scale, hence the interpersonal interactions are closer; group knowledge developed through brainstorming and knowledge sharing between people would facilitate developments of new products and new technologies; furthermore, new advantages of competitiveness could be resulted from knowledge sharing. Since SMEs have better flexibility, together with the digitalization and online documentation, the development of market responding systems of the enterprises would be strengthened, so as the actions of crisis detecting and solving through knowledge.

2.3 The Introduction of KM

Before discussing KM, the meaning of knowledge is illustrated. Davenport and Prusak [22] defined knowledge as: knowledge is a flowing combination, which includes structured experience, value and verbalized information. Moreover, it also includes unique viewpoints from professionals for evaluating and integrating new experience, as well as provides the relevant framework. Malhotra [19] defined KM as: KM is a practical expression of an organization's procedure of seeking, and it is the resulting efficacy of integrating the management abilities of figure and information technology, as well as the creativity and originality of the staffs during the procedures. Koulopoulos and Frappaolo [35], on the other hand, provided a rather simple definition for KM; KM is to give full play to the power of collective wisdom, in order to increase the responds and originality of an enterprise. Alice [16] stated that KM is the collection of an enterprise's experience, technology and wisdom, and what's collected could be freely used by people inside the organization. Based on the above definitions, the present study concluded the definitions of KM as following: KM is collecting and integrating of knowledge, and enabling the enterprise staffs to apply knowledge on works using the power of the organization and information technology, as to increase the originality and competitiveness of the enterprise. Drucker [26] said, "in the 20th century, productive equip-

ments are the most valuable assets for an enterprise, whilst the most valuable assets for organizations (regardless of commercial or non-commercial organizations) in the 21st century will be the knowledge laborers and their productivity. Davenport and Prusak [22] clearly stated that the knowledge of all the staff members in an enterprise, the efficiency of the enterprises' knowledge use, as well as the swiftness, would be the only way for an enterprise to maintain its advantages. Andersen [14] suggested that knowledge is indispensable for realizing goals and maintaining competitiveness, and is also beneficial for extending customer services.

Gupta and Govindarajan [29] indicated that there are two key jobs for knowledge organizations, the first one is producing and obtaining knowledge, and the second one is sharing and using knowledge through the enterprise's networks. Doing the three jobs of knowledge production, knowledge obtaining and knowledge maintenance to accumulate knowledge, so that the knowledge accumulation could be done through learning from the works, internalization of exterior knowledge, and reducing the loss of professional knowledge to the minimum. Koulopoulos and Frappaolo [35] proposed seven major trends of KM: (1) KM not only is the factor to distinguish enterprises, but also the prerequisite of competitions between enterprises; (2) the biggest challenge of KM is the way to share implicit knowledge; (3) the evaluation of KM efficacy should focus on creativity; (4) successful enterprises would give full play to the organization's knowledge through knowledge distribution; (5) KM would lead to the economy of free worker; (6) technology will become a necessary but insufficient propeller; (7) KM develops new rules for strategic competition. Nonaka and Takeuchi [38] discussed the five-stage model of organizational knowledge production in book "The Knowledge-Creating Company". The model uses basic concepts developed within the theoretical framework, as well as combines construct of time, and proposed a integrated, and five-staged procedural model for organizational knowledge production. Jurisica [33] found a logical relationship between two sets of knowledge finding systems, the quantitative findings, which is the relationship between quantitative values, and the qualitative findings, the qualitative values. Two major steps were involved during the procedures of finding, model confirmation and description. In short, some other steps were also involved: from the choice of information arrangement, pre-processing, knowledge transformation, through using different systems for information obtaining, to the visualization of the model.

Zack [45] proposed five stages of KM in the procedures of producing and delivering knowledge in the database. According to the concept of KM framework of Zack, an enterprise could group the procedures of KM into two major categories, the integrativity and the interactivity; each with different goals of KM. Combining the two methods, multiple functions of KM can be developed. Zack [45] proposed that organizations with well managed knowledge have the following characteristics: (1) understanding the strategic knowledge that one needs; (2) developed a knowledge strategy matches the company's business strategies; (3) developed organizational framework and technological framework suitable for the KM of

the organization; (4) the above characteristics facilitate the organization in producing, explaining, sharing, applying and improving knowledge. Storck and Hill [41] conducted a study on "IM 2000" (Xerox comprehensive information technology strategy), the transformed ally of Xerox, and proposed that the key for the successful transformation alliance as: (1) designing a interacting model, encouraging the staffs to be open with one another, and resulting in unexpected gains; (2) basing on a same organizational culture; (3) successfully solving and realizing the enterprise's goals in the early times of the team, and confirming the existence of mutual benefits; (4) making good use of and respecting the organizational culture of collective learning values; (5) amalgamating the facilities of knowledge sharing into the team working procedure; (6) creating a knowledge sharing environment, and having the operational procedures and cultural organizations established by the team, instead of other departments in the organization.

Storck and Hill [41] further suggested that strategic teams of an organization could produce long-lasting values through learning, originality and knowledge transfer, and thus give the full play of wisdom capitals, regular interactivity of the organization, the mutual benefits, the recognition of the learning values, and the incentives of knowledge sharing, in order to create a wisdom network. Sarvary [40] suggested that "KM system" is a basic facility during an organization's procedure of executing KM, and the system mainly serves as an information system and the basic framework of the organization, as to fulfill the goal of transforming information into knowledge. As for the framework of KM, Koulopoulos and Frappaolo [35] pointed out that all the technologies are for the explicit knowledge, whilst the solutions are in the people-oriented implicit knowledge. You [2] analyzed the KM system of Taiwan Semiconductor Manufacturing Company (TSMC), and found that TSMC has already established the culture and regulations for KM; furthermore, the three executive strategies for KM were concluded: (1) creating a learning culture by mighty leadership: creating a "customer-oriented" learning culture from the executives to the staffs, and providing various training classes accompanied by a well practiced reward system; (2) making good use of information technology storage and knowledge copy: systematically arranging, standardizing, and filing of professional knowledge through information technologies, and integrated into "standardized procedures", so that experiences can be passed on; (3) knowledge renewal by the technological committee: regularly providing, sharing, discussing and improving the best technologies and knowledge within committee members. Having the accumulation and copy of knowledge as the keys for KM, conduct continuous improvements through gradual innovations, and establishing a strict procedure of "knowledge renewal". Andersen [14] suggested that a KM system is consisted of the KM procedures and KM factors, and the factors are not independent from one another, instead, they function through the close relationship with one another; the factors provide combined functions, and assist in the realization of KM.

2.4 Factor Analysis for Practicing Successful KM

Understanding the factors and secrets of successful KM in well practiced enterprises is of high reference values, and reduces the failure rate. Davenport *et al.* [23] analyzed successful factors of 31 KM cases in 24 enterprises, whereas Buren proposed eight evaluating factors for developing KM models; Teleos, an investigation company of the UK annually provides global enterprise evaluation, "MAKE™, the most praised knowledge-based enterprises", in which the indices for evaluating KM mainly involve factors of successful practices; Xerox analyzed the best business revolution of the twenty and some most advanced industries that had positively practiced KM, and proposed ten successful factors basing on the business achievements of the top ten industries practicing KM.

Hauschild and Stein [30] reported the conclusion based on the study of the KM systems adopted by thirty enterprises: the business environments of the knowledge culture established by successful enterprises not only could elicit the desire of knowledge seeking in the staffs, but also ensures that the knowledge would be incessantly applied, distributed and produced. Davenport and Prusak [22] proposed the following criteria for evaluating whether a KM project is successful or not: (1) planning the increase of relevant resources, including the number of the staffs and the budget; (2) the increase of the knowledge contents and the application rate (for instance, the number of documents in the database, the number of times extracted by users, or the number of people participating in discussion-based database); (3) Whether the project is able to continuously progress without the input of certain staffs; in other words, the project is not a personalized matter, but a common goal for the whole team; (4) Whether every staff of the team could accept the concepts of "knowledge" and "knowledge management"; (5) The possibility of financial recycling, such as the KM itself, or the overall benefit payback of the organization. When evaluating KM projects, Davenport noticed two levels of success, one being the transformation of the foundation of an enterprise, and the other the improvement of procedures or functions in particular parts of works.

According to the relevant literatures on enterprises with successful KM, the present section discussed and summed up factors for success, in order to serve as the reference of the study variables. The world top ten most praised knowledge-based industries in year 2000 announced by Teleos [10] of the UK were all Western industries, indicating that Western industries have been actively working on KM since late 90s, and as the consequence, the organization values have evidently been elevated. Furthermore, the most praised industries included a wide range of services such as information, financial and manufacture, suggesting that the practice of KM has crossed limitations of different industries, and that all industries strive for elevating the business values, so as to respond to the speedy changes of the business environment.

The analysis of Buckman Lab's knowledge management by Dixon [25] suggested that the

successful factor is the ability of efficiently transform knowledge of the "technological forum". "Technological forum" has been established since year 1992, has been divided into 24 sections according to different industrial circles, and the main purpose for the forum is to provide staffs to raise questions and offer solutions online. Since staffs often learn a lot from the forum, they tend to actively participate in the forum, and the company supervises and cares for the "technological forum". Matsutaro and Tomohiro [5] studied the KM of seven of the world's top twenty most praised industries, including Lucent, and they found the important factors for the successful KM in these industries, as well as the characteristics and factors for successful KM practices in industries [5, 29]. KM system is an important construct of KM, via the construct, the staffs could enjoy an immediate and convenient communication environment for practicing KM, and hence the framework for the KM system has influences on its efficacy. The KM framework of LOTUS [36], the KM framework of Andersen [34], the KM framework of ITIS [14], the KM advisory framework of HP [13], the KM framework of Siemens [27], and the KM framework of AT&T [2] are the KM frameworks of industries that have well practiced KM, and the key factors for the success will be discussed.

3. Research Methodology

The study generates structure and variables for the present study as the reference of KM framework basing on the systematic structure and successful factors of KM, together with the concept basis of KM and the literature review.

3.1 Theoretical Framework and Study Variables

The KM system developed by Andersen [14] is mainly consisted of KM procedures and KM factors, which include "strategic leadership", "industrial culture", "information technology", and "achievement evaluation". The major purposes of these factors are to give full play to the combined efficacy, and assist in the realization of KM. The progress of KM should be carried out in terms of personnel and business simultaneously; as for the personnel, leadership strategy and organizational culture are the biggest propelling factors; as for business, information technology and achievement evaluation are the biggest propelling factors. Matsutaro and Tomohiro [5] studied the KM project of Shell Company, and concluded a cycle of four stages of project practice. Gupta and Govindarajan [29] pointed in their study of the social side of KM that an efficient KM is not only dependent on the platform of information technology; rather, it is even more dependent on the social ecology of the organization. Social ecology refers to the social system in which people work and act. The determinants of social ecology are culture, structure, information system, reward

system, procedure, personnel and leadership. Basing on the successful factors and systematic structures of KM previously mentioned, together with the views regarding successful KM factors proposed by researchers, the present study has generated five constructs and important factors of "leadership", "organization staffs", "organizational culture", "information technology", and "achievement management". These are summarized in Table 1.

Table 1. Study constructs influencing KM framework

Construct categorization and important factors	**Scholars, industries**
Constructs of leadership	Arthur Andersen, APQC, Matsutaro
A1. Supports of the chief executives	Davenport, Buren, Teleos
A2. High level of authorizations	Ncuor
A3. Project practice and management	Buren
A4. The mentoring, awareness and responsibility of knowledge sharing	Xerox
Constructs of organization staffs	Gupta, Sarvary
B1. Technological and organizational structures	Davenport
B2. Creating innovated knowledge	Xerox, Nokia
B3. Sharing of a company's internal knowledge	Lucent, Nokia, GE
B4. Valuing procedures of KM	Nokia, Xerox
B5. Creating an environment for learning	Xerox, Arthur Andersen
B6. Group discussions, knowledge sharing	Buckman Lab, Ncuor
B7. Using knowledge maps (distribution map)	IBM
Constructs of industrial cultures	Arthur Andersen, APQC, Matsutaro, Gupta, Hauschild
C1. Using knowledge assets of the organization and the staffs	Xerox
C2. Innovating the organization's culture	Shell
C3. A knowledge-oriented organizational culture	Davenport, Buren, Buckman Lab
C4. The level of infiltration of the continuous learning culture	Teleos
Constructs of information technology	Arthur Andersen, APQC, Matsutaro, Gupta, Sarvary
D1. Establishing knowledge banks	Xerox, Buckman Lab, Arthur Andersen
D2. Mapping of professional network	Xerox
D3. Multiple knowledge transferring channels	Davenport
D4. Standard and flexible knowledge structures	Davenport
D5. Using technology to construct the operational procedures	Buren
D6. Establishing a best way of practice	IBM, Xerox
Constructs of achievement evaluation	Arthur Andersen, Gupta
E1. Increasing the efficacy of knowledge sharing	Teleos
E2. Providing encouragements and rewards	Buren, Buckman Lab
E3. Paying rewards for knowledge sharing	Nokia
E4. The understanding and measurement of knowledge values	Xerox
E5. Practicing achievement management	Buren, Nucor

There would always be goals and expected results when an organization practices KM. Davenport and Prusak [22] proposed the efficacies for an organization when practicing KM: elevating the staffs' productivity and creativity, as well as enrichment of the organization's knowledge. Andersen [14] suggested that the expected results of practicing KM might be of fixed quality and fixed quantity. There would be differences in the expected results for different companies, however, what's important is that there are distinctive results, and the results would aid to the elevation of quality, increasing speed, and reducing costs, as shown in Table 2.

Table 2. Study constructs of the expected results of KM

Items of expected results	Researcher
Expected results	
E1. Increasing knowledge assets	Davenport
E2. Increasing the speed of innovation and the originality	Davenport
E3. Elevating the quality of internal operation	Arthur Andersen
E4. Increasing the attending ability and speed when facing customers	Arthur Andersen
E5. Reducing the operational cost	Arthur Andersen

In addition, in order to determine the requirement level of KM system interfaces by SMEs, the present study generated major interface factors of the system basing on the KM systems of Lotus, AT&T, HP, Siemens, Arthur Andersen, and ITIS, as shown in Table 3.

Table 3. Study variables of the KM system interfaces

Items of systematic constructs	Researcher, industry
Systematic construct	
F1. Resource sharing zone	ITIS, HP
F2. Discussing zone (Q&A)	Arthur Andersen, AT&T, HP, Siemens
F3. Database	ITIS, Lotus, HP, Siemens
F4. Knowledge categorization	Lotus, HP
F5. Knowledge distributing map (professional network)	Lotus
F6. Group resources	Arthur Andersen, ITIS
F7. Search engine	ITIS, Lotus, HP, Siemens
F8. Best practical references	Arthur Andersen
F9. Internal documentation management	Lotus, HP
F10. Notice board	ITIS, HP

3.2 Study Hypotheses

According to the study objectives, the present study proposed the following hypotheses by

focusing on the requirement level of KM development for SMEs, referring the successful factors proposed in literatures, as well as considering the differences of important variables of KM systems.

1. **Differences of KM frameworks between SMEs and large enterprises**

   First series of hypotheses:

   H1a: There are no significant differences in the perception of successful factors in terms of leadership and the development of KM system between SMEs and large enterprises.

   H1b: There are no significant differences in the perception of successful factors in terms of organization staffs and the development of KM system between SMEs and large enterprises.

   H1c: There are no significant differences in the perception of successful factors in terms of organizational culture and the development of KM system between SMEs and large enterprises.

   H1d: There are no significant differences in the perception of successful factors in terms of information technology and the development of KM system between SMEs and large enterprises.

   H1e: There are no significant differences in the perception of successful factors in terms of achievement management and the development of KM system between SMEs and large enterprises.

2. **Differences of the KM frameworks between SMEs and different industries**

   Second series of hypotheses:

   H2a: there are no differences in the perception of successful factors in terms of leadership and the development of KM system between different types of industries.

   H2b: there are no differences in the perception of successful factors in terms of organization staffs and the development of KM system between different types of industries.

   H2c: there are no differences in the perception of successful factors in terms of organizational culture and the development of KM system between different types of industries.

   H2d: there are no differences in the perception of successful factors in terms of information technology and the development of KM system between different types of industries.

   H2e: there are no differences in the perception of successful factors in terms of achievement management and the development of KM system between different types of industries.

3. Correlations between successful factors of KM and expected results

Third series of hypotheses:

H3a: leadership, organization staffs, organizational culture, information technology and achievement evaluation influence expected results.

H3b: leadership, organization staffs, and organizational culture influence achievement evaluation.

H3c: leadership, organization staffs, and organizational culture influence information technology.

H3d: leadership and organizational culture influence organization staffs.

A α value of 0.05 was used for the hypothesis analyses. A null hypothesis was supported when the p value is equal to or bigger than α ($p \geq 0.05$), and was rejected when it was not.

3.3 Survey Design

There were two major parts in the survey designed for his present study. The first part was the framework factors of KM system, including five constructs; the second part consisted of KM system interfaces of KM practices and expected results; the third part was the basic details of the participated companies for subsequent information analyses. Likert 5 Point Scale that has been commonly adopted for studies of social behavioral sciences was used for the survey, and linear analysis and mean difference analysis of the outcome were conducted. In order to prevent situations when participants answer in an arbitrary fashion, and to increase the reliability of the survey outcome, there was a reverse question item in every five major points of the first part of the survey, they were items A3, B4, C3, D4, and E2.

3.4 Statistical Analyses

The present study used the software SPSS for Windows 10.0 for conducting data analyses in a personal computer. The method for data analysis is described in the following: (1) Descriptive statistics: this was conducted for yielding the statistical analyses of mean, standard deviations and proportion for the variables. (2) Reliability analysis: reliability refers to the stability of the analysis outcomes. The present study adopted Cronbach's α coefficients for the analysis, in order to examine the reliability of different construct scales. (3) T test: given that the construct factors of KM frameworks were mainly generated from successful factors of KM practiced by large enterprises and from views of researchers, *t* test was done to compare and examine whether there were differences in the successful factors and construct factors between SMEs and large enterprises. (4) One-way analysis of variance (ANOVA):

this was conducted to compare and examine the differences between SMEs of different types of industries in terms of construct factors, expected results, and system interfaces of KM frameworks. (5) Path analysis: conducted for determining the causal relationship between the constructs of KM frameworks and the expected results in actual practices, so as to develop a structural model.

3.5 Study Sample

The study sample selected was SMEs, but survey studies were also conducted on large enterprises, as a comparison with the SMEs. The categorization of the SMEs was done according to the types of industries used by Ministry of Economic Affairs, and comparisons were done between the three industry types with biggest number of SMEs and highest sale; these industry types were the trade industry, manufacture industry, and industrial services.

4. Empirical Results and Analysis

The present section is consisted of data analyses of the 232 valid returned surveys. Firstly, descriptive statistics were done on the details of the sample enterprises, and the scales and industry types of the enterprises were determined. Then the differences analyses between enterprises with different scales and the enterprises' industry types were conducted. Lastly, path analysis was conducted for analyzing constructs of successful factors and developing a structuralized model.

4.1 Analyses of the Sample Structure

The present study gathered 23,317 e-mail address of relevant enterprises, and sent 21,533 surveys through e-mails from October 27 to November 27, and 250 surveys were returned by December 21, 2005, as well as 10 surveys returned after the due date, with a return rate of 1.21%. There were 232 valid surveys in the 250 returned surveys, with the validity return rate of 1.08%. According to the "Standards for Identifying Small and Medium-sized Enterprises" published by Ministry of Economic Affairs in year 2000, the present study induced 187 enterprises from the 232 valid surveys, which was 80.6% of the sample. Amongst the SMEs, 130 were medium-sized enterprises, whilst 57 were small enterprises. In addition, 45 were large enterprises, and were 19.4% of the sample enterprises. According to the industrial categorization of "Small and Medium-sized Enterprises Developing Statute", eleven industries such as manufacturing industry, contracting industry, trade industry, industrial services, and transport industry were distinguished. Apart from mining industry and quarrying industry, the sample enterprises ranged in ten industries. The majority of the SMEs were of manufacturing industry, with 123 enterprises (65.78%); the second was the 37 enter-

prises (19.7%) of commercial industry trade industry; the third was the 16 enterprises (8.56%) of industrial service. The top three industries for the large enterprises were the same as that for the SMEs, the manufacturing industry, trade industry, and industrial services, and the percentages were similar to that for the SMEs. The proportions matched the top five industries (trade industry, manufacturing industry, social services and personal services, contracting industry, and industrial services) in year 2000's White Book for Small and Medium-sized Enterprises [4].

4.1.1 Analysis of the Location of Sample Enterprises

As for the survey design, the 23 counties and cities of Taiwan were defined into nine regions according to the geological locations of the enterprises. Having each region had returned sample strengthened the generalizability of the survey population. The top three regions with the most enterprises were Taipei County and Keelung City (64 enterprises, 27.59%), Taipei City (63 enterprises, 27.16%), Taichung City, Taichung County and Miaoli County (44 enterprises, 18.976). The survey targets of the present study were the people in charge or executives of the enterprises. In order to seek data precision, the positions of the participants were analyzed. Eighty point one percent of the participants were enterprise owners, 38.36% were high-order executives, and 18.1% were middle-order executives. Participants with these three positions were 74.56% of the entire population, indicating an obvious representativeness of the participants. In terms of the working years of the participants, 46.55% of them had over 11 years of working experience, whilst 73.7% had over six years of working experience, suggesting that the participants had relatively deeper understanding of the enterprises. In terms of the level of education, participants with the educational level of over tertiary education were 91.81% of all participants, indicating a high educational level of the participants. In conclusion, most of the participants could serve as the representatives, and their understanding for the survey questions should be certain.

4.2 Reliability Analysis

The present study adopted Cronbach's α for examining the reliability of the survey, and the analyses for all constructs and the overall table were both done, both of which yielded Cronbach's α that was above the standard. Cuieford [21] suggested that having a α value of over 0.7 indicates a high reliability, a α value between 0.7 and 0.35 is somewhat acceptable, however, a α value lower than 0.35 indicates a low reliability, which should be rejected. Wortzel [44] also suggested that a α value over 0.7 is reliable, and between 0.7 and 0.98 is high in reliability, whilst lower than 0.35 should be rejected. Apart from leadership construct (α= 0.4814) and achievement evaluation construct (α= 0.6261), the present study found that all other constructs had a reliability value of over 0.7, furthermore, the reliability value for the overall scale was 0.9461, indicating a high reliability of the present study.

4.3 Conditions of KM Practices by the Enterprises

As for the condition of KM practice, the present study grouped enterprises into three conditions of already-in-practice, planning-to-practice, and not-yet-practiced, and found that 28.89% enterprises amongst the large enterprises had already practiced KM, whilst only 12.83% of the SMEs had practiced KM, which was not even half the number of that of the large enterprises. Moreover, there were approximately 47% of the large enterprises and the SMEs, respectively, planned but still had not practiced KM. Sixty percent of the SMEs were enterprises already practicing KM and those have not practiced but planning to practice, this indicates high expectations of the enterprises' wisdom assets through KM by the SME. In the study of enterprises' IT development in year 2002, Chen [12] conducted survey research focusing on the IT software and operational platforms used by enterprises. The results showed that 27.5% of the enterprises had already established KM, 46.6% had not practiced KM but would consider it, and 24.8% had not practiced and would not consider it. The results showed similar conditions of KM practices in the large enterprise of the present study.

4.4 Requirement Analysis of KM System Interfaces by Different Industries

When an enterprise practices KM, it expects to use KM systems for managing the enterprise's knowledge. The present study induced and analyzed interface factors of KM systems of enterprises recognized by their KM, and obtained the enterprises' level of requirement of the system interface (as shown in Table 4). The result supported Andersen's [14] point that effective and appropriate document management is one of the important and indispensable umentation management is "use" and not "management", and that the documentation manageconditions for practicing KM. If one could correctly understand that

Table 4. Analyses of interface requirement of KM system for SMEs of different industries

Construct items	Manufacture industry			Trade industry			Service industry		
	Average n=123	Standard Deviation	Order	Average n=37	Standard Deviation	Order	Average n=20	Standard Deviation	Order
Resource sharing zone	4.30	0.65	4	4.32	0.63	5	4.25	0.55	4
Discussion zone	4.17	0.66	7	4.16	0.65	8	4.15	0.49	6
Database	4.42	0.59	2	4.41	0.64	3	4.45	0.60	1
Knowledge categorizations	4.36	0.57	3	4.19	0.70	7	4.45	0.60	1
Knowledge distribution map	4.02	0.72	9	3.86	0.82	10	4.05	0.69	9
Group resources	4.02	0.68	9	3.92	0.83	9	4.00	0.65	10
Search engine	4.13	0.69	8	4.22	0.58	6	4.25	0.55	4
Best practical references	4.26	0.63	6	4.35	0.63	4	4.15	0.49	6
Internal documentation management	4.46	0.62	1	4.51	0.65	1	4.35	0.49	3
Notice board	4.28	0.66	5	4.49	0.56	2	4.10	0.64	8

the purpose of docment and the enterprise's strategy share the same direction, the "use" of documentation management would be easier and simpler. The table shows the results of the industries for interface factors of KM system. According to the order of the analysis, the KM systems were established in phases, in order to yield twice the result with half the effort.

4.5 Difference Analysis of KM Frameworks of SMEs and Large Enterprises

Since the construct factors of KM framework were mainly generated basing on successful KM factors of large enterprises and the viewpoints from researchers, the present section discusses whether SMEs have the similar view for successful factors, and mean difference analysis for the 187 samples of SMEs and the 45 samples of large enterprise was conducted using t-tests (as shown in Table 5).

Table 5. Difference analysis of KM frameworks for enterprises of different scale sizes

Study construct	SMEs		Large enterprise		*t* value	significance (two-tailed)
	Average n = 187	Order	Average n = 45	Order		
Leadership	4.504	H	4.378	L	1.977	0.049*
Organization staffs	4.359	H	4.143	L	3.722	0.000***
Organizational cultures	4.294	H	4.156	L	1.795	0.074
Information technology	4.190	H	4.137	L	0.676	0.500
Achievement evaluation	4.055	H	3.942	L	1.477	0.141
Expectation efficacy	4.446	H	4.236	L	2.777	0.006**
Systematic construct	4.232	H	4.131	L	1.301	0.195

Note: 1. *p<0.05; **p<0.01; ***p<0.001;

2. H refers to the highest value; L refers to the lowest value

By looking at Table 5, it is noted that there are significant differences in the two successful factors of leadership ($t = 1.977$, $p < 0.05$) and organization staffs ($t = 3.722$, $p < 0.001$) between the SMEs and large enterprises. These two successful results were recognized more by SMEs. As for the expected results of KM practice ($t = 2.777$, $p < 0.01$), SMEs tended to have higher expectations than that did large enterprises. The SMEs recognized successful KM factors more than the large enterprises did.

4.6 Difference Analysis of KM Frameworks for SMEs of Different Industries

Amongst the SMEs, those of different industrial structures and operational styles would have different industrial characteristics, which would consequently cause differences in the

perception of KM. Basing on "Standard for Identifying Small and Medium-sized Enterprises" of Ministry of Economic Affairs, the present study conducted mean difference analysis for the industries of the sample SMEs, and of which 123 were of manufacturing industry, 37 were of trade industry; Given that social services and personal services and industrial services were similar in nature, they were grouped as the service industry, and 20 sample enterprises were of this category. The above enterprises were 96.26% of all sample population. Since there were three types of industries included in the study, mean difference analysis was conducted using ANOVA. Test of homogeneity of variance for the sample was also conducted together with ANOVA, and Scheff's method of post hoc comparison was conducted when the F value of the variable analysis reached significance level, in order to analyze differences between different groups.

Table 6. Test of homogeneity of variance in different industries

Study construct	Levene statistic	Significance
Leadership	1.457	0.236
Organization staffs	0.979	0.378
Organizational culture	2.302	0.103
Information technology	0.315	0.730
Achievement evaluation	0.710	0.493
Expectation efficacy	0.680	0.508
Systematic construct	2.069	0.129

Note: $^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$

Table 6 shows that the Levene statistic for the constructs did not reach significance, therefore did not violate the hypothesis of homogeneity.

Table 7. Difference analysis for KM frameworks of different industries

Study construct	Manufacturing industry		Trade industry		Service industry		F value	Significance (two-tailed)
	Average n = 123	Order	Average n = 37	Order	Average n = 20	Order		
Leadership	4.506		4.487	L	4.550	H	0.181	0.835
Organization staffs	4.380	H	4.378		4.293	L	0.382	0.683
Organizational culture	4.305		4.345	H	4.238	L	0.333	0.718
Information technology	4.217	H	4.198		4.100	L	0.488	0.615
Achievement evaluation	4.068		4.043	L	4.070	H	0.042	0.959
Expected results	4.465		4.476	H	4.380	L	0.333	0.717
System interface	4.241		4.243	H	4.220	L	0.018	0.982

Note: 1. $^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$;

2. H refers to the highest value; L refers to the lowest value

Table 7 shows that there were no significant differences in the constructs of KM practices between the SMEs of manufacturing industry, trade industry and service industry. Furthermore, the constructs' averages were over 4.0 or even 4.5, indicating high recognition of successful factors by SMEs of all three industries.

4.7 Path Analysis of KM Patterns

Chiou [7] pointed out that path analysis was first proposed by geneticist Wright in year 1921, but was not recognized until the 60s. The analysis is a statistical technology used for determining structural models of causal relationship between multiple variables. Technologically, path analysis is consisted of a series of regression analyses; apart from adopting the principle of regression equation, it combines different equations through hypothetical structures, and to form a structural pattern. The present study will conduct path analyses on the relationship between constructs of the KM structures, with the hope that the expected goals would be easily fulfilled in KM practices of the enterprises. The present study will analyze the five successful KM constructs of leadership, organization staffs, organizational culture, information technology, and achievement evaluation, as well as the construct of expected results of KM practiced by the enterprises, and develop a rudimentary model according to the relationship between the constructs. The structural relationships will be consisted of the following four hypotheses: hypothesis 1, leadership, organization staffs, organizational culture, information technology and achievement evaluation influence the expected results; Hypothesis 2, leadership, organization staffs and organizational culture influence achievement evaluation; Hypothesis 3, leadership, organization staffs and organizational culture influence information technology; Hypothesis 4, leadership and organizational culture influence organization staffs. Based on the above hypotheses, the regression analysis equations are as the following:

$$Y_1(\text{expected result}) = b_{11}X_1(\text{leadership}) + b_{12}X_2(\text{organization staffs}) + b_{13}X_3(\text{organizational culture}) + b_{14}X_4(\text{information technology}) + b_{15}X_5(\text{achievement evaluation}) + a_1 \quad (1)$$

$$Y_2(\text{achievement evaluation}) = b_{21}X_1(\text{leadership}) + b_{22}X_2(\text{organization staffs}) + b_{23}X_3(\text{organizational culture}) + a_2 \quad (2)$$

$$Y_3(\text{information technology}) = b_{31}X_1(\text{leadership}) + b_{32}X_2(\text{organization staffs}) + b_{33}X_3(\text{organizational culture}) + a_3 \quad (3)$$

$$Y_4(\text{organization staffs}) = b_{41}X_1(\text{leadership}) + b_{42}X_3(\text{organizational culture}) + a_4 \quad (4)$$

A structural equation for KM of the present study was developed basing on the above four equations, and is referred to as the causal model. The Y_i is the dependent variable, X_i is the independent variable, b_{ij} is the correlation coefficients between the dependent and the independent variables, or the path coefficient, and a_i is the intercept. In order to determine the independence between the studies constructs, the present study used Pearson correlation

Table 8. Pearson Covariance Matrix for the study constructs

	Leadership	Organization staffs	Organizational culture	Information technology	Achievement evaluation	Expected result
Leadership	1.000					
Organization staffs	0.512**	1.000				
Organizational culture	0.461**	0.645**	1.000			
Information technology	0.432**	0.665**	0.686**	1.000		
Achievement evaluation	0.393**	0.530**	0.588**	0.584**	1.000	
Expected result	0.457**	0.575**	0.586**	0.547**	0.490**	1.000

Note: **p<0.01

Table 9. Explanatory power and significance analysis of the causal model

Model	Dependent variable	Adjusted R Square	F value	Significance	Independent variable
Y_1	Expected result	0.430	29.082	0.000***	Leadership, organization staffs, organizational culture, information technology, achievement evaluation
Y_2	Achievement evaluation	0.381	39.118	0.000***	Leadership, organization staffs, organizational culture
Y_3	Information technology	0.549	76.536	0.000***	Leadership, organization staffs, organizational culture
Y_4	Organization staffs	0.469	83.077	0.000***	Leadership, organizational culture

Note: * p<0.05; ** p<0.01; *** p<0.001

Table 10. Path coefficients of the casual model

Model	Dependent variable	Independent variable	VIF	Path coefficient β	β value test	
					T	Significance
Y_1	Expected result	X_1 Leadership	1.428	0.144	2.183	0.030*
		X_2 Organization staffs	2.227	0.211	2.556	0.011*
		X_3 Organizational culture	2.338	0.238	2.807	0.006**
		X_4 Information technology	2.383	0.114	1.331	0.185
		X_5 Achievement evaluation	1.734	0.116	1.586	0.115
Y_2	Achievement evaluation	X_1 Leadership	1.412	0.094	1.371	0.172
		X_2 Organization staffs	1.903	0.223	2.803	0.006**
		X_3 Organizational culture	1.782	0.401	5.202	0.000***
Y_3	Information technology	X_1 Leadership	1.412	0.048	0.817	0.415
		X_2 Organization staffs	1.903	0.363	5.345	0.000***
		X_3 Organizational culture	1.782	0.430	6.537	0.000***
Y_4	Organization staffs	X_1 Leadership	1.270	0.273	4.535	0.000***
		X_3 Organizational culture	1.270	0.519	8.617	0.000***

Note: * p<0.05; ** p<0.01; *** p<0.001

coefficient to examine the correlation level. Asher [17] suggested that a real estimation parameter is still obtainable with a correlation coefficient within 0.8, whilst over 0.8 would lead to estimation bias. Chiou [7] defined that within the range of correlation coefficients of between 0.40 and 0.69 refers to a medium level of correlation. Tables 8 to 10 indicate that the correlation coefficients of the present study were all between 0.393 and 0.676, thus were the most valid estimation parameter value.

Through the regression analysis of leadership, organization staffs, organizational culture, information technology, and achievement evaluation to predict expected result in model Y_1, the R^2 values suggest that the construct variables of the model have 43% of explanatory power for the expected result, and $F = 29.082$, $p < 0.001$, indicating that the explanatory power is statistically significant. The β weight estimation of the path coefficient suggests that leadership, organization staffs, and organizational culture could effectively predict expected result, and the path coefficient of organizational culture is the highest of all, 0.238 ($t = 2.807$, $p = 0.006$), followed by the path coefficient of organization staffs, 0.211 ($t = 2.556$, $p = 0.011$), and the path coefficient for expected result was 0.144 ($t = 2.183$, $p = 0.03$). In addition, the path coefficients for information technology and achievement evaluation are 0.114 and 0.116, respectively, and have not reached the significant level through t test, suggesting no direct effect of information technology and achievement evaluation on expected result. The equations in model Y_2 is the regression analysis of the prediction of achievement evaluation by leadership, organization staffs, and organizational culture, the result indicates that the construct variables have 38.1% explanatory power for achievement evaluation ($F = 39.118$, $p < 0.001$). The result of path coefficient estimation suggests that organization staffs and organizational culture could effectively predict achievement evaluation, and the path coefficient for organizational culture was 0.401 ($t = 5.202$, $p = 0.000$), which is with a high significance, whereas the path coefficient for organization staffs is 0.223 ($t = 2.803$, $p = 0.006$), and the path coefficient for leadership is 0.094 ($t = 1.371$, $p = 0.172$), which has not reached the significance level through t test, suggesting no direct effect on achievement evaluation.

Model Y_3 is the regression analysis of predicting information technology by leadership, organization staffs, and organizational culture. The result indicates that the construct variables have 54.9% explanatory power for information technology, which is the highest explanatory power amongst all four equations ($F = 76.536$, $p < 0.001$). The result of path coefficient estimation shows that organization staffs and organizational culture could effectively predict achievement evaluation, and the path coefficient for organizational culture is 0.430 ($t = 6.537$, $p = 0.000$), which is highly significant; the path coefficient of organization staffs is 0.363 ($t = 5.345$, $p = 0.000$), and is also highly significant; the path coefficient of leadership is only 0.048 ($t = 0.817$, $p = 0.415$), which has not reached significance level in the t test, indicating no direct effect of leadership on information technology. The equation of model Y_4 is the regression analysis of predicting organization staffs by leadership and organizational culture,

and the result shows that the construct variables have 46.9% explanatory power for achievement evaluation ($F = 8.617$, $p = 0.000$), and both variables are highly significant, suggesting direct effects of leadership and organizational culture on organization staffs. The models of structural equations basing on the constructs with direct effects and significant path coefficients were developed.

The analyses indicate that the five constructs of successful factors (as shown in Table 11) influencing expected result support findings of Davenport and other two researchers on customer KM: the majority of organizational leaders believe that an organization's role and responsibility, organizational culture and structure are the key for successful customer KM. Furthermore, as for the influences between constructs, the coefficients for direct effects and indirect effects were the main basis for determining the influences. However, since the path variables that produced spurious correlations are too complicated, thus, no comments will be made regarding these variables in the present study, and the listed spurious correlation coefficients only served to indicate third correlations produced within the constructs.

Table 11. Relationship between constructs of expected result and successful factors

Variable	Expected result				
	Direct effect	**Indirect effect**	**Sum of effect**	**Spurious correlation**	**Total correlation**
Leadership	0.144*	0.058	0.202	0	0.202
Organization staffs	0.211*	0	0.211	0.221	0.432
Organizational culture	0.238**	0.110	0.348	0.072	0.420
Information technology	0	0	0	0.238	0.238
Achievement evaluation	0	0	0	0.179	0.179
R^2	0.430				

Note: * $p<0.05$; ** $p<0.01$; *** $p<0.001$

Amongst all the variables influencing achievement evaluation, organizational culture has the biggest influence, with the direct effect of 0.401, furthermore, it has the moderator variable of organization staffs that has an indirect effect of 0.116, indicating organizational culture is the most influential variable. In addition, there is also a positive correlation between organization staffs and achievement evaluation, with the direct effect of 0.223 (as shown in Table 12).

As for information technology, organization staffs have a direct effect with a path coefficient of 0.363; organizational culture is most influential on information technology, with a direct effect of 0.43, as well as the indirect effect of 0.188 brought by the moderator variable of organization staffs. In contrast, the influence of leadership on information technology appears insufficient, but there is still an indirect prediction power of 0.099 brought by the moderator variable of organization staffs (as shown in Table 13).

Table 12. Relationships between achievement evaluation and constructs of various successful factors

Variable	Achievement evaluation				
	Direct effect	Indirect effect	Sum of effect	Spurious correlation	Total correlation
Leadership	0	0.061	0.061	0.074	0.135
Organization staffs	0.223**	0	0.223	0.271	0.494
Organizational culture	0.401***	0.116	0.517	0.035	0.552
Information technology	0	0	0	0.329	0.329
R^2	0.381				

Note: * p<0.05; ** p<0.01; *** p<0.001

Table 13. Relationships between information technology and various constructs of successful factors

Variable	Information technology				
	Direct effect	Indirect effect	Sum of effect	Spurious correlation	Total correlation
Leadership	0	0.099	0.099	0.061	0.160
Organization staffs	0.363***	0	0.363	0.223	0.286
Organizational culture	0.430***	0.188	0.618	0.032	0.650
Achievement evaluation	0	0	0	0.329	0.329
R^2	0.549				

Note: * p<0.05; ** p<0.01; *** p<0.001

Organizational appears to be the most influential factor for the three types of relationships mentioned above. The conclusion of Sarvary's [40] analysis on KM and competitive ecology of advisory industry suggested that the success of KM system lies in the execution, which is determined by the commercial style, organizational culture and history of the company. The leading KM systems (for instance, the systems of McKinsey and of Ernst & Yong) adopted in advisory industry was all naturally evolved from the organizational culture and procedures of the companies. The present study supports the Sarvary's view that organizational culture influences the success of a company's KM. Moreover, Marchand *et al.* [37] conducted a correlational analysis between business achievement and technology, between information management and human behaviors as well as values using 1009 higher order executives from 98 companies through structural equation modeling (SEM). The result showed that there is a strong correlation between information orientation and business outcome, which is opposite to what the present study found. The reasons for this might due to that most of the study target in Marchand's study were international large enterprises, which need to rely on information technology not only for communication, in order to reduce the cost as well

as to respond as quickly as possible, information technology is indispensable for achieving business ends. On the contrary, the sample population of the present study was of SMEs in Taiwan, and the study is limited in the human resources as well as financial resources, thus was the difference between the studies.

4.8 Empirical Results for Study Hypotheses

After the analyses of the three major hypotheses of the present study (as shown in Table 14), it was found that there is a significant difference between hypotheses H1a and H1b. This indicates that there are significant differences between SMEs and large enterprises in the

Table 14. Empirical results for study hypotheses

Hypothesis	Study hypothesis	Empirical outcome
H1a	There are no significant differences in the perception of successful factors in terms of leadership and the development of KM system between SMEs and large enterprises.	reject
H1b	There are no significant differences in the perception of successful factors in terms of organization staffs and the development of KM system between SMEs and large enterprises.	reject
H1c	There are no significant differences in the perception of successful factors in terms of organizational culture and the development of KM system between SMEs and large enterprises.	support
H1d	There are no significant differences in the perception of successful factors in terms of information technology and the development of KM system between SMEs and large enterprises.	support
H1e	There are no significant differences in the perception of successful factors in terms of achievement management and the development of KM system between SMEs and large enterprises.	support
H2a	There are no differences in the perception of successful factors in terms of leadership and the development of KM system between different types of industries.	support
H2b	There are no differences in the perception of successful factors in terms of organization staffs and the development of KM system between different types of industries.	support
H2c	There are no differences in the perception of successful factors in terms of organizational culture and the development of KM system between different types of industries.	support
H2d	There are no differences in the perception of successful factors in terms of information technology and the development of KM system between different types of industries.	support
H2e	There are no differences in the perception of successful factors in terms of achievement management and the development of KM system between different types of industries.	support
H3a	Leadership, organization staffs, organizational culture, information technology and achievement evaluation influence expected results.	partially support
H3b	Leadership, organization staffs, and organizational culture influence achievement evaluation.	partially support
H3c	Leadership, organization staffs, and organizational culture influence information technology.	partially support
H3d	Leadership and organizational culture influence organization staffs.	support

perception of leadership and organization staffs when developing KM. However, in hypotheses H1c, H1d and H1e, the perceptions of enterprises with different scales on organizational culture, information technology and achievement evaluation are similar when developing KM.

In the five hypotheses of H2, it was proved that the perceptions of SMEs of different industries on all constructs in developing KM are similar, with no significant differences. The study outcomes for hypotheses H3a, H3b and H3c was that SMEs regard leadership, organization staffs, and organizational culture have positive influences on the expected results of KM practice, and that information technology and achievement evaluation have no significant influence on expected result. As for achievement evaluation, the more organization staffs and organizational culture are valued, the bigger the effect these two factors is on achievement evaluation, whilst the influence of leadership is not significant. As for information technology, the study outcome is the same as that for achievement evaluation. Hypothesis H3d clearly supports the positive influence of leadership and organizational culture on organization staffs.

5. Conclusions and Suggestions

5.1 Conclusion

Accompanied by the progress of technology, wisdom assets of enterprises and employees are continuously aroused, which consequently made KM the latest management task for enterprise operations. Anyone who is able to effectively maintain and apply knowledge will be the winner of management. The expectation for KM is not only found in large enterprises, rather, it is also pursued by SMEs for the hope of keeping pace with the times. The following recommendations have been generated by the present study for SMEs:

1. The enterprises participated in the present study all agreed on the successful factors for KM generated by the present study. Taking these 26 successful factors into account when developing KM will reduce wastes of time and resources.
2. The analysis on five constructs of successful factors in SMEs and large enterprises, as well as the difference analysis on practically expected result and system interfaces found that SMEs are more supportive for "leadership", "organization staffs" and "expected result" than the large enterprises, indicating a higher expectation for the KM executives and the expected results by the SMEs.
3. There are differences between different industries due to different industrial structures, business styles, human resource requirements, and operational style. The present study used SMEs of manufacturing industry, trade industry and service industry as the study sample, and analyzed the differences in the KM frameworks. The result showed no sig-

nificant differences between these three industries, and the result has a high supportive level. Therefore, the KM model developed by the present study is suitable for SMEs of all industries.

4. The results of the path analysis of KM models show that "leadership", "organization staffs" and "organizational culture" are the three constructs that have positive influences on "expected result", whilst "information technology" and "achievement evaluation" have no significant influences. This is similar to thee viewpoint proposed by Hauschild *et al.* [30] in their study of KM measures of 40 companies. It was concluded that successful companies understand that KM and information technology are not the same thing, and that successful companies adopt long-term KM projects, which include all levels of the company, and closely match with other strategic decisions. Therefore, the development of KM systems should not be dependent solely on information technology.

Combining all the results from the empirical analyses, the suggestions of previous researchers are supported. Thus, in order to obtain the efficacy of practicing KM, the present study recommends enterprises to enhance the creation of a knowledge sharing organizational culture, KM flow of the organization, an environment encourages learning in employees, as well as the strategic practices and high authorizations of the higher order executives when practicing KM.

5.2 The Meaning of Management

The present study is centered by the practice of KM, and provides meanings of management in SMEs through theories and empirical outcomes, with the hope that the study would serve as a reference for enterprises in practicing KM.

1. The present study analyzed the causal relationship of information technology on the expected result of practicing KM in enterprises. The result suggests no significant influence, and this can be interpreted in terms of an organization's scale and the knowledge type. Nonaka and Takeuchi [38] categorized knowledge into implicit knowledge and explicit knowledge. The characteristics of implicit knowledge are experience-based, practicality and subject; implicit knowledge is shared through communication, as if an analogous process. The characteristics of explicit knowledge are rationality, and the readiness for verbal transmission; it is a type of knowledge created through the so-called digital activity. As for the transforming models of knowledge, normalization refers to the process of transforming implicit knowledge into implicit knowledge, and it is often mentioned in theories of group procedures and organizational culture; combination refers to the transformation of explicit knowledge into explicit knowledge, and it is rooted on

information technology; internalization refers to the transformation of explicit knowledge into implicit knowledge, and it is closely related to organizational learning. Large enterprises often have better performances in the management systems, the application of information technology in systemize job flows, and are efficient in saving knowledge contents as the company's knowledge. This is a performance of explicit knowledge. The wisdom assets of SMEs are the long-term experience accumulation of the employees, and belong to the employees, thus could not be performed through documents or information technology. Therefore, appropriately managing the implicit knowledge of the employees would aid to the knowledge use of the company.

2. Amongst interview participants from the SMEs, over 60% of the enterprises have already or planned to practice KM, suggesting the realization of the coming of knowledge economic age by the enterprise owners. Facing a market in which new products continuously being brought through the old, the incessant innovation of manufacturing technologies, and the vast amount of false and true information scattered inside a company and on the internet, the question of how to capture information and make it into something useful could only be answered by practicing KM.
3. The successful factors generated in the present study are actually the management methods used in successful practice of KM by large enterprises, the fruits of incessant problem solving, and hard works recognized by the public. It is recommended that by following the example of successful companies would give SMEs a clear direction of practice, reduce the time spent learning through trial and error, and yield twice the result with half the effort. Nevertheless, whether to transform every single bit of a successful example or adapting characteristics and competitive strategies of the enterprises are issues to be considered when practicing KM.
4. The constructs influencing expected result of KM practicing in the present study are leadership, organization staffs, and organizational culture. These three constructs are all highly related to factors involving "people". How should higher order executives plan and promote KM, how to make employees willing to share knowledge and obtain knowledge, and how should an organization develop a knowledge-oriented organizational culture, are all key factors for enterprises to elevate its human resources.

5.3 Directions for Further Studies

1. The main direction of the present study is correlational analyses of successful KM factors for development of KM in SMEs. Further studies could focus on the ways of using these successful factors in the practice of KM procedures.
2. The present study found that organizational culture has significant influence on expected result, information technology and achievement evaluation of KM practices, suggesting

organizational culture has the key influence on the success and the failure in KM. Future studies could focus on how to strengthen the use of organizational culture to increase the success of KM.

3. Future studies could use SMEs that have already practiced KM in the correlational analysis between practice methods and practical achievement, and serve as a best practical reference for SMEs that have similar scale yet have not practiced KM.

References

1. Yu, Cong-shian and Wang, Jin-li(2000), "The growth of small and medium-sized enterprises in Taiwan," Linking, Taiwan.
2. You, Ke-chiang(2001), "Knowledge management and innovation," Commonwealth, Taiwan.
3. Wang, Chian-chuan and Sun, Ke-nan(2001), "Application of knowledge management for small and medium-sized enterprises," SMEA Ministry of Economic Affairs, Chung Hua Institution Economic Research, Taiwan.
4. SMEA Ministry of Economic Affairs(2001), "Year 1979 White Book for Small and Medium-sized Enterprises," Ministry of Economic Affairs, Taiwan.
5. Wu, Cheng-feng(Trans.), Morita Matsutarou, Tomohiro Takanash(2000), "Foundations and Examples for Knowledge Management," Wisdom Books, Taiwan.
6. Wu, Si-hua and Wen, Chao-tung(1999), "The industrial innovation of the century of knowledge: issues and solutions," Graduate Institute of Technology and Innovation Management, Taiwan.
7. Chiou, Hao-cheng(2000), "Quantitative research and statistical analysis: demonstrations of data analysis of Chinese SPSS," Wu-Nan Books, Taiwan.
8. Sun, Cheng(2001), "Taiwan's journey of knowledge economy development," Sanmin Books, Taiwan.
9. Mofei(Trans.), Sveiby, K. E.(1999), "The Success Strategies of Intangible Assets~ the New Assets of Microsoft, Netscape, Sun," Yuan Chi Culture, Taiwan.
10. Hsu, Shi-jin(Trans.), written by Andersen Consulting(2001), "practical knowledge management," Business Weekly, Taiwan.
11. Chen, Sin-hong(2001), "Upgrading strategies for enterprises in the time of knowledge economy," article for the third sub-topic for the Sixth National Technology Conference, Taiwan.
12. Chen, Hui-mei(2002), "Year 2002 enterprise IT establishment research," *Information and Computers*, Taiwan, 259, pp. 38-42.
13. Yeh, Jing-hua(2001), "Applications and solutions for knowledge management," HP Services, Taiwan.

14. Liu, Jin-wei(Trans.), written by Andersen Consulting(2000), "The First Book for Knowledge Management," Business Weekly, Taiwan.
15. Liu, Chang-yung(2001), "The basic understandings for knowledge management," Chang-yung Liu Website for knowledge management and learning http://www.cme.org.tw/know/start.htm.
16. Alice, Laplante(1997), "Sharing the wisdom," *Computerworld*, Vol. 31, Iss. 22, Jun 2, pp. 73-74.
17. Asher, H. B.(1983), *Causal Modeling*, Beverly Hills, Sage Publication.
18. Bennis, Warren G. and Burt Nanus(1997), *Leaders: Strategies for Taking Charge*, 2nd edition, Harper Business.
19. Brint company(2001), http://www.brint.com.
20. Buren, Mark E. Van(1999), "A yardstick for knowledge management," *Training & Development*, Vol. 53, Iss. 5, pp. 71-78.
21. Cuieford, J. P.(1965), *Fundamental Statistics in Psychology and Education*, 4th Edition, McGraw Hill.
22. Davenport, Thomas H. and Laurence Prusak(1997), "Working knowledge: How organizations manage what they know," Harvard Business School Press.
23. Davenport, Thomas H., David De Long, and Machael C. Beers(1998), "Successful knowledge management projects," *Sloan management review*, Vol. 39, Iss. 2, pp. 43-57.
24. Davenport, Thomas H., Jeanne G. Harris, and Ajay K. Kohli(2001), "How do they know their customers so well?," *MIT Sloan Management Review*, Vol. 42, Iss. 2, pp. 63-73.
25. Dixon, Nancy M.(2000), *Common knowledge: how companies thrive by sharing what they know*, 1st edition, Harvard Business School.
26. Drucker, Peter F.(1999), "Knowledge-worker productivity: The biggest challenge," *California Management Review*, Vol. 41, Iss. 2, pp. 79-94.
27. Ewing, Jack(2001), "How Siemens is using knowledge management to pool the expertise of all its workers," *Business Week*, Iss. 3724, Industrial/technology edition, pp. EB36.
28. Goffee, Robert and Gareth Jones(1998), *The Character of a Corporation: How Your Company's Culture Can Make or Break Your Business*, 1st edition, Hardcover.
29. Gupta, Anil K. and Vijay Govindarajan(2000), "Knowledge management's social dimension: Lessons from Nucor stell," *MIT Sloan Management Review*, Vol. 42, Iss. 1, pp. 71-80.
30. Hauschild, Susanne, Thomas Licht and Wolfram Stein(2001), "Creating a knowledge culture," *The McKinsey Quarterly*, Iss. 1, pp. 74-81.
31. Healey, Joseph F.(1990), *Statistics: A Tool for Social Research*, 2nd Edition. Wadsworth Publishing Company.
32. Hodgetts, R. M. and Kuratko, D. F.(1995), *Effective small business management*, 5th edition, International Thomson Publishing.

33. Jurisica, Igor(2000), "Systematic knowledge management and knowledge discovery," *Bulletin of the American Society for Information Science*, Vol. 27, Iss. 1, pp. 9-12.
34. Knowledgespace(2001), http://www.knowledgespace.com.
35. Koulopoulos, Thomas M. and Carl Frappaolo(1999), *Smart things to know about knowledge management*, 1st edition, Capstone Pub.
36. Lotus and IBM(2001), "Knowledge management products-An introduction to Lotus and IBM technologies," A Lotus development corporation white paper, Jan.
37. Marchand, Donald A., William J. Kettinger, and John D. Rollins(2000), "Information orientation: People, technology and the bottom line," *Sloan Management Review, Summer*, Vol. 41, Iss. 4, pp. 69-80.
38. Nonaka, Ikujiro and Hirotaka Takeuchi(1995), "The Knowledge-Creating Company," Oxford University Press.
39. Quinn, James Brian, Jordan J. Baruch, and Karen Anne Zien(1997), "Innovation Explosion: Using Intellect and Software to Revolutionize Growth Strategies," Free Press.
40. Sarvary, Miklos(1999), "Knowledge management and competition in the consulting industry," *California Management Review*, Vol. 41, Iss. 2, pp. 95-107.
41. Storck, John and Patricia A. Hill(2000), "Knowledge diffusion through "strategic communities," *Sloan Management Review*, Vol. 41, Iss. 2, pp. 63-74.
42. Tapscott, Don(1997), *The Digital Economy: Promise and Peril in the Age of Networked Intelligence*, McGraw-Hill Professional Publishing.
43. Thurow, Lester C.(1999), "Building Wealth: The New Rules for Individuals, Companies, and Nations in a Knowledge-Based Economy," Harper Collins.
44. Wortzel(1979), *Multivariate Analysis*, Prentice Hall.
45. Zack, Michael H(1999), "Managing codified knowledge," *Sloan Management Review*, Vol. 40, Iss. 4, pp. 45-58.