
Factors affecting knowledge management adoption of Taiwan small and medium-sized enterprises

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Abstract: Knowledge Management (KM) has become a critical component for maintaining competitive advantages. Most existing research looks at individual industries or general concepts; few studies have investigated KM use in Small and Medium-Sized Enterprises (SMEs). This research empirically investigates factors affecting the adoption of KM. Results indicate that important factors maturing of Information Technology (IT) applications, the complexity of management and marketing, and the degree of formal documentation and knowledge acquisition mechanisms. Finally, different characteristics of enterprises have diverse influences on the adoption of KM.

Keywords: adoption process; Knowledge Management (KM); knowledge management adoption; Small and Medium-Sized Enterprises (SMEs).

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1 Introduction

With the growing importance of the knowledge economy, the internet has brought its users grand and abundant information. Enterprises have transformed from traditional competition to knowledge competition. Research has shown that knowledge has become an important tool for strengthening an enterprise's competitive advantage. However, a critical key in whether an enterprise can succeed or not, is its ability to efficiently acquire and apply knowledge, transfer and preserve knowledge, or furthermore, create knowledge. (Drucker, 1986). For example, problems encountered when managing projects tend to occur due to the paucity of information available to the decision-makers (Czuchry and Yasin, 2003). It is not necessarily the case that the information does not exist. More likely, it is because information is not easily accessible or carefully managed. The growth of Knowledge Management (KM) has helped to address these issues.

Generally speaking, larger enterprises are considered to have more characteristics relevant for the knowledge economy and have received much attention, while the importance of the knowledge economy to SMEs has been relatively ignored, creating an opportunity to look at KM as it relates to SMEs. SMEs have several characteristics that provide advantages in the area of KM. For example, SMEs typically operate on a smaller scale and are able to have more intimate interactions among people (customers, suppliers, employees, etc.). Knowledge produced through the mechanism of these communication interactions could produce knowledge to help improve the quality of work and success of the firm. Also, because of the flexibility and agility in decision-making for SMEs due to their size, establishing KM processes could improve the possibility of solving the enterprise's difficulties increase.

According to a government's survey of the Fortune 1000 of Taiwan in 2004, more than 40% of Fortune 1000 companies have a position for Chief Knowledge Officer

(CKO) Since SMEs tend to have less capital and a higher flow rate of personnel, it may be more difficult to develop KM systems. However, enterprises that wish to improve efficiency must control and manage important organisational knowledge, which mainly comes from employees. Through the KM process of innovation, collection, sharing, preservation, and reusing, knowledge can become a crucial asset to enterprises. For this reason, enterprises, especially SMEs, need to adopt KM mechanisms for each step in the KM process. SMEs who adopt a KM mechanism within their firm should improve the potential for strengthening their competitive position.

This study looks at the KM adoption behaviour of small and medium size firms using Taiwanese SMEs as the sample population of the study. Specifically, an empirical study was carried out to investigate the influence of different industrial characteristics, enterprise management, and the degree of IT application, affects KM adoption in SMEs. Additionally, the depth and range of KM, the intention to promote KM, and business performance are compared. More specifically, this research attempts to gain insight into the following research:

- The influence of industrial characteristics (e.g. type of industry) on KM adoption.
- The influence of enterprise management on KM adoption and the intent to increase the use of KM.
- The influence of the degree of Information Technology (IT) application (e.g. use of IT within the firm) on KM adoption and the intent to increase the use of KM.
- The influence of the degree of KM adoption on enterprise performance.

2 Literature review

2.1 The coverage of knowledge management

Managing information and knowledge is important to a firm's competitiveness in today's global environment. As a result, the process and components of KM have gained substantial research attention. KM focuses on "the understanding and exploitation of the processes that are associated with the optimisation of the exploitation and development of the business' knowledge assets" (Rowley, 2004, p.150–151). Kotnour et al. (1997) views KM as an aid to learning for an organisation by devoting a crew, workflow, and tools to help innovate, acquire, propagate, and apply knowledge. O'Dell and Grayson (1998) view KM as an ongoing process that involves several components including: knowledge innovation, confirmation, collection and preservation by categories, sharing, accessing, improvement and elimination.

Nonaka, Toyama and Nagata (1995) articulates the difference between tacit knowledge (implicit knowledge embedded in the organisation) and explicit knowledge (form of knowledge that is communicated, shared, and stored). The cycle of the process of moving tacit knowledge to explicit knowledge, then back to tacit knowledge (of other individuals) creates a system that positions knowledge as an innovative tool and an asset, which results in value added to the firm. In a broad sense of KM includes four categories: purpose and lesson, knowledge innovation, knowledge assets, and value (Nonaka, Toyama and Nagata 2000).

An important component of KM is the process of KM. Several studies have investigated KM systems. Andersen and The American Productivity and Quality Centre (1996) identified a seven-step procedure for establishing a KM system. These steps include: innovation, confirmation, collection, adoption, organisation, practice, and sharing. Beckman (1997) identified eight sequential steps of KM: knowledge definition, knowledge collection, knowledge selection, knowledge preservation, knowledge sharing, knowledge application, knowledge innovation and knowledge sales.

Alavi (1997) studied the internal KM procedure of KPMG, a consulting company, to look at their structure of KM. He suggested that the so-called knowledge is the activity of an individual repeatedly creating, evaluating, and sharing knowledge inside an organisation in order to enhance service to customers. Thus, in the service procedure of KPMG, the main activities of KM included: acquiring, indexing, filtering, connecting, distributing and applying.

Finally, Bose and Ranjit (2004) used the following steps to identify KM systems: create knowledge, capture knowledge, refine knowledge, store knowledge, manage knowledge, and disseminate knowledge. In all adoption processes, the enterprise must decide its core competence and determine its knowledge domain and related core abilities. Next, knowledge systematically needs to be collected from both internal and external sources. The knowledge must then be documented in a consistent manner that facilitates the use of the information. Additionally, the organisation must evaluate and judge the value of the collected knowledge and select the most appropriate (useful) knowledge for the firm's needs. Over time, knowledge must be preserved, usually in the form of databases, in a manner that allows the firm to use the stored information for its competitive benefit. For a KM system to be effective, its content must be shared with the appropriate people to be used in the decision-making process. As part of the KMS, users must know the 'background' of the information: the what, where, why how, and who.

In other words, the mechanics of a KMS is only part of the KM adoption process. Just as important is the integration of the knowledge and information contained in the system into the competitive decision processes of the enterprise. Information should be used to openly discuss, brainstorm, and share knowledge with each other. This of course, is the ultimate benefit of a KM study, the application and utilisation of knowledge to execute tasks, solve problems, develop strategies, create ideas and learn new skills. In the phase of knowledge innovation, an organisation can use a KM system to probe new knowledge, determine which is important and relevant. For example a KM system can aid in observing consumer behaviour, searching for the best market segment, testing different products, and analysing information. Ultimately, an organisation should benefit from its knowledge to promote new products and services in the market, and in turn, develop a positive relationship and public praise with its customers and suppliers to elevate its competitive advantage.

2.2 Knowledge management adoption

The application and adoption of KM penetrates each functional area of an enterprise. Therefore, the depth and range of KM in different enterprises may vary. As for the adoption level of KM, Galbraith (1979), and Kraemer and King (1981) studied the adoption process of enterprise information system and communication technology using general management activities, while Brancheau and Wetherbe (1990) use the diffusion of innovations theory to study the introduction process of End-User Computing. Markus

(1987) studied the adoption mode of interactive media with the critical mass theory, while Nolan (1973, 1979) and McFarlan (1983) looked at the adoption procedure of IT from a view of the evolution of organisations. When KPMG investigated the condition of enterprise KM system adoption in Europe and the USA, it divided enterprises into four levels of KMS development: no plans so far, under investigation and research, will undergo a project soon, and already completed a project. As for the adoption methods of KM, so far there are two basic methods: self-development and outsourcing development. Examples of outsourcing development application are Due (1992) and Gordon (1994). Due (1992) identified outsourcing as transferring partial or full information processing, hardware, software, communication network and system operation of the organisation to a third party, including hardware suppliers, consulting companies and software factories. Gordon (1994) viewed outsourced KM as contracting out for one or more IT functions, including the development and maintenance of application software, operation of the data centre, research in IT, management of communication network, management of database, damage recovery support and maintenance training of IT application, etc.

3 Elements affecting the adoption process of knowledge management

3.1 Industrial characteristics

As with many business functions, firm-specific factors may influence the way in which an enterprise views and uses that business function. Form KM, there are several factors that warrant attention as they relate to KM. According to Kotler (1976), an industry consists of a group of companies providing similar and replaceable products or services. Porter and Millar (1985) suggests that an industry is a group of manufacturers producing identical or similar, and highly replaceable products, which they sell to their customers. Industrial competition includes five competitive factors:

- 1 the threat of new comers
- 2 the competitive strength of present competitors
- 3 the threat of replacement
- 4 buyers' bargain ability
- 5 suppliers' bargain ability.

These five competitive motivations encompass industrial competition. KM becomes an important tool in supporting and improving the competitive position of an enterprise. Additionally, the perceived ease of use of a KM system is important in determining the perceived usefulness of the system; the greater the ease of use, the more likely the system will be used (Lin and Wu, 2004).

Walker and Weber (1984) analysed and set up a multiple-indicator structural equation model based on the transaction cost theory. With this model, they assessed the indicators of competition of suppliers, experience of buyers, the volume uncertainty, the production cost advantage of suppliers and the technological uncertainty to predict the factors effecting make-or-buy decisions. Williamson (1985) suggested that the three components of transaction uncertainty, transaction frequency, and asset specialty explained the transaction characteristics of knowledge. Products, producing technology and the value

chain have an intimate relationship because management of the value chain may enhance the exchange and sharing of knowledge among the flow of producing, manufacturing, and distributing, while constructing the best 'entire flow of enterprises'. Porter (1980) also suggests that the logic of the value chain is to pursue the most appropriateness of each task collocated with one another and try to lower the costs while promoting the efficiency. Furthermore, Porter and Millar (1985) suggests the main purpose of the value chain is to show the needs of various degrees of the differences in the manufacturers, and to integrate activities and functions.

Managing knowledge in a manufacturing firm is important for improving efficiency of the value-added chain. Enterprises must create KM systems that optimise the access to and use of knowledge held by the various specialists working within the firm. Using a software tool called Tool for Action Plan Selection (TAPS), Tan and Platts (2004) looked at the benefit of such a KMS. TAPS allowed managers to visualise the linkages between their respective knowledge bases, helping them to better solve manufacturing problems. They found that TAPS could help improve collective understanding among managers, facilitate discussion and provide organisational memory.

Also focusing on Knowledge Management System (KMS) for manufacturing, Wang, Lexhoj and Johansen (2004) introduced a KMS using case-based reasoning. They demonstrated that this type of system provided a structure for integration of organisational knowledge, information sharing, and communicating information. Both cases illustrate that efficiency in a KMS is needed in order to enhance the value of the information contained within the system and organisation for the competitive benefit of the enterprise.

3.2 The factors of enterprise operation

Various enterprise management methods may create different KM intentions. Generally speaking, possible factors include enterprise cultures, leadership styles and support, and levels of market orientation, etc. Diverse enterprise cultures may lead enterprises to a different management pattern. In a recent study looking at KM adoption and SMEs, Wong and Aspinwall (2005) identified the top three factors affecting the adoption of KMS: senior management support, a knowledge-friendly culture, and a clear strategy for managing knowledge. These findings support much of the past research done in this area, which is briefly described in this section.

Important to the adoption of KMS is the organisational culture regarding the importance and use of information. This may be the most difficult component to be fully executed (Davenport and Prusak, 1999). William and Ouchi (1981) defines an enterprise culture as representing a company's values, which become the norms of its employees' activities, opinions and conduct. Looking at the behaviour pattern of using computer systems, Schewe (1976) suggested that the user's knowledge of a system and the user's sense of individual situations becomes the user's attitude toward computerisation. Therefore, many scholars have taken an individual knowledge and attitude approach toward computerisation as the key element to whether the computerised information system could be operated successfully (Cerullo, 1980; Moran, 1981; Lin and Lin, 1994). Other scholars contend that a user's participation is key to system use (Mutschler and Hoefel, 1990; Monnickendam and Eaglstein, 1993).

In numerous studies, top management support has been found to be crucial to the development of a KMS. The strength of upper supervisor and management support and

participation in KM are the key factors to success (Wong and Aspinwall, 2005). Lane (1985) suggested that high-ranking supervisors' positive participation in IT may bring substantial competitive power for a company. The research of Reich and Benbasat (1990) showed that 80% of strategic information systems are the results of high-ranking supervisors' participation. Jarvenpaa and Ives' (1991) research indicates that if a company wishes to pursue competitive advantages, it needs high-ranking supervisors' support and participation in IT; Thackray's study (1994) showed that high-ranking supervisor support for IT was definitely a crucial principle that determined whether the system development or the plan of information transforming succeeded or not. Lin and Lin (1997) discovered in his research that a high-ranking supervisor's knowledge about IT is the most effective element that determines whether the supervisor supports IT or not.

As for the styles of enterprise leadership, Child (1972) reveals the significance of high-ranking supervisors within an enterprise. He contends that a high-ranking supervisor's knowledge of environment and unique personal styles determine the guiding principles of enterprise strategy, organisation structure and management system and enterprise culture. Based on various leadership theories among the scholars, there are different patterns of classification. Wallach (1983) divides enterprise culture into three types: bureaucratic, innovative and supportive culture. Wang, Lexhoj and Johansen (2004), in his research of enterprise culture of domestic main groups, categorises enterprise culture styles as: innovative teamwork style, stable feedback style and harmonious ethics style. White and Lippett (1953) distinguish enterprise culture into autocratic style, democratic style and laissez-faire style, while Likert (1967) classifies it as exploitative-authoritative, non-violent-authoritative, consultative and participative. Blake and Mouton (1964) divide it into concern for people and concern for production. Van de Ven (1976) and Fredrickson (1984) indicate formalisation, complexity, and centralisation as the most agreed upon structural elements of many of the studies on organisational structure. In any case, leadership style influences the organisation's culture and its attitude towards the adoption of KMS.

Market orientation includes the obtainment and propagation of market information and the reaction to market information (Kohli and Jaworski, 1990). Slater and Narver (1995) suggest that market orientation involved the strategy of a company to create superior customer values and provide norms of conduct related to organisational development and the reaction to market information. In other words, market orientation not only emphasises the commitment of viewing customers as a top priority, but also focuses on transforming externally acquired information into the knowledge of the organisation. Thus, a strong KMS helps develop strong relationships with customers (Rowley, 2004) and in turn, strengthens the market orientation of the enterprise.

Hurley and Hult (1998) suggested that market information could be created through using every formal and informal channels. Market knowledge created through formal channels includes information from studies on market research, competitors' activities, or surveys of customer satisfaction. Shared information can help obtain market knowledge enterprises need. Day (1994) brings up a market-driven theory about information content. He purported that market related information is the volume of information collected from consumers and competitors. To disseminate the obtained market information, understand each other's comprehension of information among departments, and possess exclusive easy-to-fetch memory of an organisation, are the ways to fully understand changes in the external environment and unite the resources of the company to deal with these changes.

3.3 Information technology and knowledge management

The role of IT in KMS and processes continues to increase in importance. McFarlan (1983) warned that IT, such as computers, was not just a support that provided an enterprise with information in different areas from behind the scenes. It was becoming a necessity in enterprise management. Almost 15 years later, Evan and Whomas (1997) agree that IT has come to continuously to be a revolutionary transition. Rockart and Short (1989) suggested that the development of IT has allowed enterprises to connect with consumers and suppliers. Flows of different organisations can now be closely combined together, which largely increases the circulation of information and blurs the boundaries of organisations. Instead of considering how to finish the job faster, better and cheaper, an organisation's consideration for IT now shall focus on how products and services move on the value-added chain.

According to Davenport and Prusak (1999) research on successful cases of KM, the KMS constructed by enterprises includes: a specialty knowledge base, an online assistant inquiring system, a knowledge database, an expert network, an online technological document inquiry and a case-by-case experience database. To achieve success of KM, humans and technology must cooperate with each other. Humans need to comprehend and interpret knowledge, then integrate various forms of non-structural knowledge, while the effective preservation, transform, and sharing of knowledge need to be processed by computers and communication systems.

3.4 Knowledge management and performance

If KM has become a competent weapon, it should inevitably have influence on business performance. Thus, the strength, efficiency, and usefulness of a KMS should influence enterprise performance evaluation. Drucker (1986) suggests the domain of enterprise performance evaluation includes: market positions, innovation, productivity and contribution values, material and financial resources, beneficial ability, capability and cultivation of managers, capability and attitude of employees and responsibilities for society. He thinks the scope to evaluate enterprise activities must include: financial conditions, operation, productivity, market positions, relationship of service and customers, relationship towards the public and government, relationship of employees and development of human resources and relationship of shareholders.

Fortuin (1988) defined the indicator of performance as a variable to assess the efficiency and potency of the entire system with approaches of ratio analysis, modulus and fluctuation. Pelham (2000) synthesised with Covin and Slevin (1989) to come up with evaluation variables of performance as:

- 1 Indicator of marketing and sales: comparative product quality, success rate of new products, and maintenance rate of customers.
- 2 Indicator of growth rate and possessing rate: sales amount level, sales growth rate, target market possessing rate.
- 3 Profit Rate: Return on Equity (ROE), margin profits and Return On Information (ROI). Dess and Robinson (1984) believe it is more common to use economical ROA (Return On Assets) and sales amount growth rate to assess performance in strategy management. Vickery (1991) considered manufacturing performance as a

reflection on financial and marketing performance and could be assessed with ROA before tax, market possessing rate and growth rate. We define the performance evaluation including management and financial based on above description.

4 Research structure and hypotheses

The structure of this research consists of three dimensions: the depth and range of KM adopted by SMEs, the impact of the intention of promoting KM, and the key factors that affect an enterprise's performance. The first dimension focuses on industrial characteristics which are the relevant environmental factors of the main industry itself and the situation of products and manufacturing technology. The second dimension focuses on enterprise operation, looking at an enterprise's internal market orientation and leadership style, and the degree of how an enterprise supports KM adoption. The third dimension focuses on IT. Because of the intimate relationship between KM adoption and IT application, this research also analyses the depth, range and intention of KM adoption of SMEs from conditions of IT application. Among all, the depth of adoption is analysed on the basis of the degree of KM adoption and the depth of coverage. Figure 1 shows the correlation between each dimension. According to this research structure, the following research hypotheses were established:

Hypothesis 1: Industrial characteristics (e.g. type of industry) will influence the extent of KM adoption and the intent to increase the use of KM.

Hypothesis 2: Enterprise firm management will influence the extent of KM adoption and the intent to increase the use of KM.

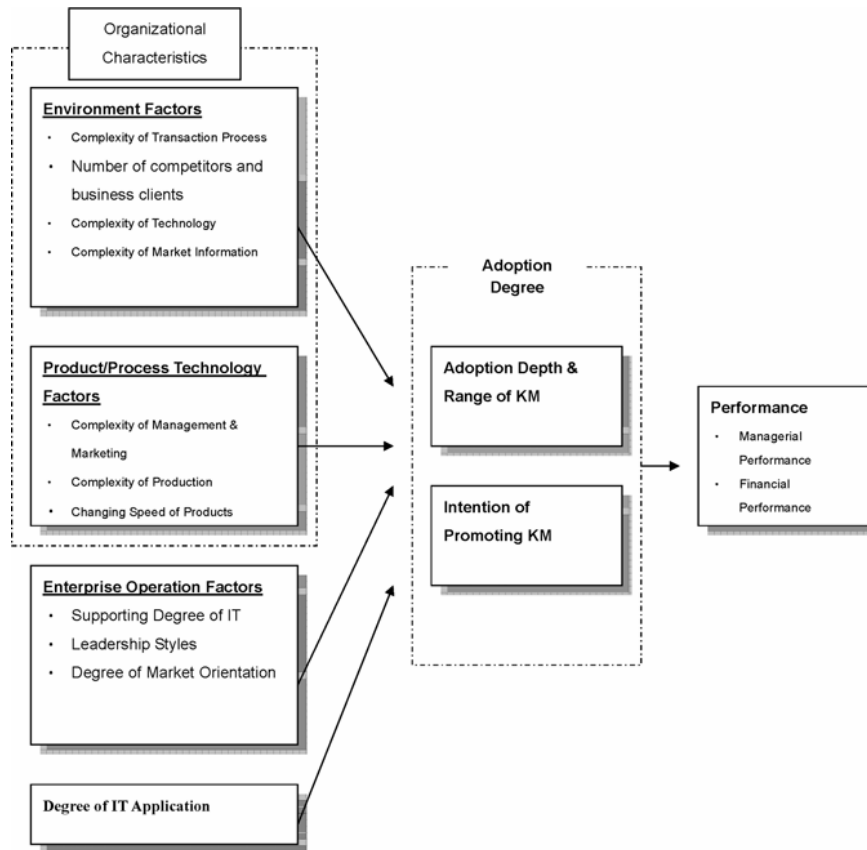
Hypothesis 3: The degree of IT application (e.g. use of IT within the firm) will influence the extent of KM adoption and the intent to increase the use of KM.

Hypothesis 4: The degree of KM adoption will influence enterprise performance.

5 Research design

5.1 Sample and collection of data

The target of the questionnaires for this research is the SMEs of all kinds of industries in Taiwan, which include traditional industry, traditional manufacturing, high technology manufacturing, construction industry, mining industry, quarrying industry, agriculture, forestry, fishing and animal husbandry, electricity, gas and water, transport and storage industry, communication service industry, social and individual service industry, industrial and commercial service industry, commerce industry and finance, insurance and real estate industry.

Figure 1 Structure of this research

Data for this study was collected through printed questionnaires and internet questionnaires. Printed questionnaires were distributed via mail and at seminars relevant to SMEs (participants of seminars were asked to mail responses back to researchers). The questionnaires consisted of six parts: the basic data, industrial characteristics, the IT application condition of the company, performance and the degree of promoting KM. Due to the difficulty of collecting a complete list of names of Taiwan SMEs, a convenience sampling of SMEs was used. Questionnaires were sent to SMEs, including members of National Association of Small & Medium Enterprises R.O.C., the name list of honorable SMEs, and the list of factories in Kaohsiung City. Of the 597 mailed questionnaires, 124 useable completed questionnaires were returned; a response rate of 19.8%. A 7.1% response rate was obtained from the questionnaires distributed through seminars (55 useable questionnaires out of 778 questionnaires distributed). Only 39 completed questionnaires were received as a result of the internet distribution.

Thus, the total effective research samples of this project were 218 questionnaires. The basic characteristics of the questionnaires received via the mail were compared to those received via the internet to determine consistency of the sample populations. After undergoing the χ^2 test under a level of significance at 5%, the result showed that the basic characteristics (business types, capital amount) between the two groups had no marked

difference, indicating questionnaires retrieved through various channels are representative of the population being studied (Armstrong and Overton, 1997).

5.2 Variables evaluation

The operational definition of the variables of the primary components of this research is presented in Table 1, along with the type of measurement scale used for each. Additionally, previous research supporting the variables being used is identified.

Table 1 Operational definition of variables

<i>Concepts / dimensions</i>	<i>Variables</i>	<i>Measurement</i>	<i>Major operational references</i>
Organizational Characteristic			
Industry Environment Factor	Complexity of the Transaction Process	Purchase and the amount of consideration factors	Likert 5-point scale Walker and Weber (1984); Williamson (1985)
	Competitors and business clients	Number of competitors	
		Number of customers & suppliers	
	Complexity of Technology	Possibility of similar replacement Changing degree of technology Difficult degrees for competitors to learn and imitate	
Product & Process Technology Factor	Complexity of Market Information	Fluctuation of market needs Difficult degrees to acquire information of competitors	Likert 5-point scale Porter (1980); Porter and Millar (1985)
	Complexity of Management & Marketing	Marketing, customer service, quality management, product application, product strategy	
	Complexity of Production	Degrees of Knowledge needed for product using, material purchasing, product development & design, production	
Enterprise Operation Factor	Product changing speed	Speed of new products or new services entering the market Length of product life cycle	Likert 5-point scale Mutschler and Hoefler (1990); White and Lippett (1953)
	Supporting Degrees of IT	Fast control the latest IT	
		Supporting degrees of high-ranking supervisors toward IT	
	Leadership Styles	Reject degree of employees toward new IT Employees can freely express their opinions; knowledge exchange is valued and encouraged; company's strategy and policy are set according to the discussion of all departments; employees comply with company's present rules.	

Table 1 Operational definition of variables (continued)

<i>Concepts / dimensions</i>	<i>Variables</i>		<i>Measurement</i>	<i>Major operational references</i>
Enterprise Operation Factor	Degrees of Market Orientation	Value and analyse the need of customers; responding to the actions of competitors; discuss activities of the market, customers, and competitors periodically.		
Application Degrees of IT		Networking connections, electronic database, establishment of communication tools, establishment of analysing and decision making systems, management of supply chain	Likert 5-point scale	Davenport and Prusak (1999)
Adoption Degrees	Adoption degrees of KM	Adoption degree	5 levels	This research Beckman (1997)
		Documentation, computerisation, knowledge acquisition mechanisms and sharing knowledge	Likert 5-point scale	
	Adoption range of KM	Based on department types		This research
	Intention of promoting KM	Importance of KM	5 levels	This research
	Intention of KM	5 levels		
		Timing of promoting KM	7 levels	
	Adoption methods	Self adopting, outsourcing, both		Due (1992)
Performance	Managerial performance	Innovation of products and services; changes of product process and flow, changes in patent amount, satisfaction degree of customers	Likert 5-point scale	Drucker (1986)
	Financial performance	Changes in operation amount Changes in profits	Likert 5-point scale	Pelham (1990)

5.3 Validity and reliability of dimension test

A content validity of the questionnaire was performed. The questionnaire design was developed in accordance with previous research (cite). Through symposiums of scholars and representatives of SMEs, and based on the opinions of proprietors, experts and scholars, the research structure and variables included in the questionnaires were adapted in order to improve the content validity of the questionnaire. To assess and distinguish validity, the subjects in the inventory are analysed with factor analysis. After extracting common factors with eigenvalues greater than 1, in accordance with the principal component analysis, a varimax rotation was performed to enhance the factor loadings

within each common factor, improving the ability to distinguish and name the common factors and to establish a simplified factor structure.

Cronbach α was used to assess the reliability value of each dimension. Detailed reliability values of each dimension are demonstrated in Table 2. Since all values are higher than 0.60, they are all considered to be in the acceptable range.

Table 2 Dimensions and reliability of the questionnaires

	<i>Dimensions</i>	<i>Reliability</i>
Industry environment	Complexity of Transaction Process	0.6696
	Complexity of Technology	0.6581
	Complexity of Transaction Process	0.6696
	Complexity of Technology	0.6581
Products & Process Technology	Complexity of Product Management & Marketing	0.8530
	Complexity of Production	0.7496
	Changing speed of new products	0.8303
Organisational culture	Supporting degrees of IT	0.6506
	Leadership styles	0.6929
	Degrees of Market Orientation	0.7982
IT application		0.8425
Business performance	Management Performance	0.7446
	Financial Performance	0.8427
Adoption range of KM	Formal documentation	0.8524
	Computerisation	0.8364
	Knowledge acquisition mechanisms	0.8589
	Mechanisms of Sharing Knowledge	0.8588

6 Data analysis and results

6.1 *Sample characteristics*

Table 3 presents the general characteristics of the firms analysed in this study. Characteristics collected include the type of business, capital size of the firm, ISO status, and awareness of the importance of KM for acquiring subsidies from the government. The proportion of the 218 effectively retrieved questionnaires for each level of each characteristic is indicated.

6.2 *Depth of knowledge management adoption (Hypothesis 2)*

The depth analysis of SMEs' adoption of KM in this research is based on the degree of SMEs' adoption of KM and the depth of coverage. The coverage depth of KM has four levels, from low to high: knowledge acquisition mechanisms, formal documentation, knowledge sharing mechanisms, and computerised KM. Of the 218 responses, 70

enterprises (32.19%) answered ‘no adoption’ to the degree of adoption. Enterprises whose ‘partial departments have adopted’ totaled 71 enterprises (32.6%). Only five enterprises (2.3%) had completed the adoption, gained apparent profits, and had seen the performance being promoted (see Table 3). As for the coverage depth of KM, 75.8% of the enterprises had knowledge acquisition mechanisms, while 30.5% of the enterprises had no proper capability of computerised KM, supporting Hypothesis 2.

Table 3 Frequency distribution table of basic organisational data from the questionnaires ($n = 218$)

<i>Business type</i>	<i>Items/category frequency (%)</i>	<i>Capital (millions \$)</i>	<i>Frequency (%)</i>
Traditional industry	123 (56.4)	0–10 million	53 (24.3)
High technology manufacturing	30 (13.8)	10– 80 million	60 (27.5)
Commerce industry	16 (7.3)	80–150 million	41 (18.8)
Service industry	44 (18.8)	Above 150 million	54 (24.8)
Other	2 (0.9)	Missing value	10 (4.6)
Missing value	3 (1.4)		
		<i>If knowing that promoting KM may obtain subsidies from the government</i>	
<i>If passed ISO certificate</i>	<i>Frequency (%)</i>		<i>Frequency (%)</i>
Yes	113 (51.8)	No	151(69.3)
No	104 (47.7)	Yes	65(29.8)
Missing value		Missing value	2 (0.9)

6.3 Degree of knowledge management adoption (Hypothesis 1)

The degree of KM adoption was analysed through multiple stepwise regression. The analysis showed that in each factor, only the factor of ‘technology application condition’ was supportive, with an entire explanatory power of 0.146, which indicates that technology application condition has a positive influence on SMEs’ adoption of KM. In other words, enterprises with higher levels of technology application might also have a higher degree of KM adoption. Further analysis of the factors affecting different mechanisms of KM through multiple stepwise regression analysis showed that IT application situations, market orientation degrees, and technology supporting degrees had positive effects on knowledge acquisition mechanisms. Additionally, IT application situations and market orientation degrees had positive effects on formal documentation while having negative effects on the complexity of the transaction process. IT application situations and market orientation degrees had a positive influence on knowledge sharing mechanisms. IT application situations had the most positive impact on computerised KM, which supports Hypothesis 1. See Table 4 for each affecting coefficient and explanatory variable value.

Table 4 Multiple stepwise regression table of factors affecting SMEs on KM adoption

	<i>Dependent variables</i>	<i>Independent variables</i>	<i>SD. B</i>	<i>Individual coefficient t-value</i>	<i>R²</i>	<i>F</i>
Depth	Adoption Depth of KM	Condition of IT application	0.382	5.701***	0.146	32.501***
Depth	Knowledge acquisition mechanisms	Condition of IT application	0.385	6.082***	0.300	27.520***
		Degree of market orientation	0.211	3.262***		
		Supporting degree of technology	0.143	2.165*		
	Degrees of formal documentation	Condition of IT application	0.454	7.637***	0.349	34.101***
		Degrees of market orientation	0.325	5.296*		
		Complexity of transaction process	-0.138	-2.272*		
Mechanism of sharing knowledge	Condition of IT application	0.686	13.344***	0.487	92.052***	
	Complexity of technology	0.109	2.125*			
Intention	Computerised KM	Condition of IT application	0.589	10.153***	0.347	103.087***
	Importance of KM towards a company's development	Complexity of product management & marketing	0.184	2.573*		
		Degrees of market orientation	0.168	2.344*		
	Degree of adoption intention	Condition of IT application	0.228	3.277**	0.105	11.340***
		Complexity of product management & marketing	0.188	2.707**		
	Timing when a company is willing to promote KM	Condition of IT application	0.339	5.063**	0.168	13.968***
Complexity of product management & marketing		0.233	3.123**			
Complexity of transaction process		-0.154	-2.091*			
Performance	Managerial performance	Degrees of formal documentation	0.274	3.173**	0.241	29.302***
		Knowledge acquisition mechanisms	0.263	3.043**		
	Financial performance	Degrees of formal documentation	0.246	3.270**	0.127	14.465***
		Computerised KM	0.167	2.224*		

PS*p<0.05**p<0.01***p<0.001

6.4 Range of knowledge management adoption (Hypothesis 3)

Besides the depth, we can also take the number of departments of SMEs that have adopted KM to analyse the range of adoption. In light of the departments of 68 enterprises that have adopted KM and filled out the questionnaires correctly, we can see that mainly accounting and management departments of most enterprises have adopted KM. If assuming that enterprises with more departments adopting KM have a larger

range of adoption, after applying multiple stepwise regression analysis, we discovered that statistically, an assumption is near the level of significance. IT application situations have positive influences on the range of KM adoptions, while having negative influences on the complexity of technology, which supports Hypothesis 3.

6.5 Intention and importance of knowledge management adoption (Hypothesis 4)

In this research, the analysis of the intention of SMEs to adopt KM can be discussed in five aspects which are: the importance of KM to a company's development, adoption intention of KM, time to be spent on promoting KM, budget to be put into promoting KM, and choice of method for promoting. The results show that over 80% of the enterprises considered KM to be crucial to the company's development and were willing to promote KM, while around 40% of the enterprises had already begun promoting KM. About 45% of the enterprises wished that the government would provide partial subsidies, indicating they were willing to adopt KM.

Of the four dimensions of adoption intention only the complexity of product management and marketing and market orientation degrees were found to be affecting factors. The entire explanatory power for this finding was 0.078. (See Table 4)

Two factors achieved the statistic level of significance after applying multiple stepwise regression analysis: IT application situations and the complexity of product management and marketing. The entire explanatory power was 0.105, which means enterprises with higher technology application degrees and higher complexity of product management and marketing also would have higher intentions of adopting KM. These findings support Hypothesis 4.

Factors affecting the timeline of adoption of KM: The results of the stepwise regression analysis for the timeline of adoption of KM show that three factors achieved the statistical level of significance. These include IT application situations, the complexity of transaction process and the complexity of product management and marketing. The explanatory power of regression equation is 0.168, which means enterprises with higher degrees of IT application, more complicated transaction process, and less complicated product management and marketing are willing to adopt KM as soon as possible.

6.6 Correlation between km adoption and performance (Hypothesis 5)

In order to comprehend whether the depth, range and intention of KM adoption would affect performance, this research used factor analysis to study performance-related problems and extracted two factors, the financial factor and the managerial factor. Moreover, using these two factors to process the regression analyses of the degree of adoption, coverage depth and intention. It was discovered from the research results of performance (Table 4) that the degree of formal documentation and knowledge acquisition mechanisms have better prediction power over enterprise managerial performance, while the degree of formal documentation and computerised KM have better prediction power over financial performance. In other words, if an enterprise can make each workflow more efficient, elevate the degree of market and technological information documentation, increase more opportunities for employees to receive

training, absorb new knowledge, and organise and apply knowledge more systematically, the performance of the enterprise will get better as well, which supports Hypothesis 5.

7 Organisational characteristics and the degree and intention of KM adoption

7.1 Industry types and adoption degree of KM

In this research, we generally divide industries into five categories: traditional industries (including traditional manufacturing, construction industry, mining and quarrying industry, agriculture, forestry, fishing & animal husbandry electricity, gas & water industry, transport & storage industry), high technology industry, commerce industry, service industries (including finance, insurance & real estate industry, communication service industry, information service industry, social and individual service industry, industrial and commercial service industry), and other industries (including tourism, publishing industry, joint venture industry). From Table 5, in light of industry types, the adoption degrees, the acknowledgment of the importance and the intention among different industries have no obvious diversity. As for the timing of promoting KM, enterprises that had begun promoting and enterprises that temporarily had no promotion of KM were mostly traditional industries. Enterprises with a higher degree of knowledge acquisition mechanisms and computerised KM were also traditional industries.

Table 5 Impact of organisational characteristics on the adoption of KM

<i>Dependent Variables</i>	<i>Industry type</i>		<i>Enterprise scale</i>		<i>Government subsidy</i>		<i>With ISO certificate</i>	
	<i>F value</i>	<i>p value</i>	<i>F value</i>	<i>p value</i>	<i>F value</i>	<i>p value</i>	<i>F value</i>	<i>p value</i>
Degrees of KM Adoption	0.891	0.488	3.416	0.018*	2.546	0.112	5.418	0.021*
A Company recognises the importance of KM to development	1.246	0.289	2.932	0.035*	0.450	0.503	0.022	0.881
Companies' intentions of KM adoption	1.791	0.116	0.759	0.518	4.711	0.031*	0.013	0.910
Timing when a company is willing to promote KM	2.350	0.042*	1.281	0.282	2.337	0.128	0.005	0.946
Adoption range of KM	0.519	0.761	0.573	0.635	0.573	0.635	0.018	0.894
Knowledge acquisition mechanisms	2.811	0.018*	3.582	0.015*	0.967	0.326	11.290	0.001**
Degrees of formal documentation	2.217	0.054	5.926	0.001**	0.961	0.328	65.723	0.000***
Computerised sharing mechanisms	2.671	0.430	5.424	0.002**	0.007	0.933	11.762	0.001**
Computerised KM	0.982	0.023*	2.737	0.045*	0.316	0.933	3.193	0.075

PS * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

7.2 Effects the enterprise scale on the adoption degree of KM

Based on the amount of capital, the enterprise scale is categorised into four types: 0–10 million, 10–80 million, 80–150 million, and over 150 million. The results showed that enterprises with higher capital had a higher intention of adopting KM and thought KM to be important to the company's development. They also had a higher degree of knowledge acquisition mechanisms, formal documentation, knowledge sharing mechanisms and computerised KM.

7.3 Government's subsidies

In order to determine whether government subsidies would have an influence on the promotion of KM, we divide the enterprises into not comprehensive, comprehensive but never applied, comprehensive and ready to apply, comprehensive and have applied, and have received government subsidies. The results showed that government subsidies had an obvious impact only on the intention of KM adoption, but not on other factors. That is to say, whether the government gives subsidies or not has no impact on the degree of adoption of KM.

Companies adopting ISO have more influence on the promotion of KM. According to research results, enterprises that had passed relevant ISO certification had remarkable effects on the adoption of KM.

7.4 Conclusion and suggestions

The critical variables affecting the adoption of KM collected in this research are in accordance with the suggestions provided by domestic experts and scholars at the symposiums and relevant reference dissertations and documents. Based on these variables, the survey questionnaires were designed. The results of the analysis show:

The study chose factors related to industries and enterprises to examine the relationship between adoption depth, range, and intention of KM. The factor affecting performance was limited to various enterprises' subjective opinions of adopting KM. No other indirect factors are included in the framework.

In Hypotheses 1 and 2, this research suggests that industrial characteristics, enterprise operational factors, and the application of IT may have an impact on the adoption depth of KM. However, the analysed results indicated that IT application has major and significant influence on the adoption depth of KM. This proves that various industries and structures of the value chain have different degrees of complexity and environmental factors, but enterprises must have enough application ability of IT to truly adopt KM.

In Hypothesis 3, IT application and the complexity of product management and marketing have a positive and direct impact on an enterprise's acknowledgement of the importance of KM, the adoption intention, and the adoption timing deemed appropriate. This result indicates that the IT ability and the mechanism of product management and marketing that an enterprise has, are vital considerations of the enterprise's intention of KM adoption.

The examined result of Hypothesis 4 shows that the depth and range of KM are affected positively by IT application, while effected negatively by the complexity of industrial technology. Therefore, generally IT is the essential tool of the adoption of KM.

However, the more complicated the industrial technology, the harder it is for KM to extend to more departments.

The examined result of Hypothesis 5 shows that the adoption depth, range, and intention of KM had absolutely no influence on managerial and financial performance. However, partial coverage depth factor of KM affects the promotion of performance. A higher relevant degree of formal documentation and better knowledge acquisition mechanisms have more positive influences on managerial performance, while higher relevant degree of formal documentation and better ability of using computers to analyse information, knowledge and assist making decisions give more benefits to financial performance.

Based on the analysis of the data in this study, some of the important findings can be interpreted as follows:

- In the 218 questionnaires with the answers to the adoption of KM, 88 enterprises (about 44.4%) have already started promoting KM; 74 enterprises (33.9%) think highly of the adoption of KM. Among all, 151 enterprises (about 69.3%) do not know that promoting KM can help them receive subsidies from the government. IT application has a striking impact on the adoption of KM.
- A leader's style may influence the acknowledgment of the importance of adoption. Degrees of complexity of the transaction process and sales management and the ability of IT application will influence the intention of KM adoption, while the acknowledgement of the expected time period of the adoption of KM is affected mostly by the ability of IT application.
- In the 218 questionnaires with the answers to the adoption of KM, 120 enterprises (around 55%) promote the adoption by themselves and outsource consulting companies to assist adoption and consolidation of KM.
- The better abilities of documentation management and the knowledge acquisition mechanisms and collection data of an enterprise have more positive effects on the enterprise's performance.

The above research results have comparative values for both conductors of SMEs and the government when making policies. As for the conductors of SMEs, we know that the adoption of KM has a remarkable influence on business performance. In other words, SMEs can introduce KM through an appropriate channel to promote the competitive advantage and profitability. In order to successfully introduce KM, the ability of IT application has to be enhanced due to its powerful impact. Additionally, the present traditional industry has a strong intention to adopt KM, which is synchronised with the goal of the government to elevate the traditional industry.

In light of the government's policies, although we find the government's subsidies have little influence on an enterprise's adoption intention of KM, there are still a certain amount of enterprises, which expect to decrease the risk of the adoption through the government's subsidies. Enterprises with higher adoption intentions mostly are those with high complexity of productions and sales and stronger IT ability. Therefore, when promoting KM of SMEs in the future, the government shall be able to focus on this type of enterprise to improve the leading efficacy.

7.5 Limitations

We also discovered some limitations in the research. Due to the speciality of the samples, a random sampling technique was not practical. Therefore, generalisation of the findings must be carried out carefully. At last, due to the variety of the factors affecting the adoption of KM, the ones this research considers are only a part of the numerous possible factors. Identifying and measuring the influences of other factors not taken into account in this study, should be studied in the follow-up research. Additionally, subsequent research may want to analyse variables by different business types and assess diversity among different businesses in each variable. This research stream can give enterprises more substantial assistance in understanding the importance of KM to the growth and success of small and medium sized firms.

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