Contextual factors affecting knowledge management diffusion in SMEs

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Abstract

Purpose – Based on the knowledge management (KM) perspective, innovation diffusion theory and technology-organization-environment framework, the purpose of this paper is to develop a research model to investigate the influence of technological (information technology (IT) support and IT effectiveness), organizational (top management support, sharing culture, and reward system) and environmental (competitive pressure) contexts on the two-stage KM diffusion (KM adoption and implementation) in small and medium enterprises (SMEs).

Design/methodology/approach – Data gathered from 119 SME senior managers (including owner, vice president, and business manager) in Taiwan were employed to test the relationships between the research model constructs using the partial least squares approach.

Findings – The results showed that technological, organizational, and environmental factors have different effects on KM adoption and implementation stages. Specially, IT support has the strongest effect on KM adoption stage, while sharing culture has the strongest effect on KM implementation stage.

Practical implications – IT support continues to be positively related to the level of KM implementation after adoption. KM diffusion requires managers to invest time and effort to link specific IT support and knowledge-based work activities, since effective IT deployment for KM can help SMEs move toward a knowledge society, which is vital in the contemporary knowledge economy.

Originality/value – Theoretically, the findings of this study contribute to empirical research on contextual factors that influence KM diffusion using a broad data set rather than a few isolated SME cases. From the managerial perspective, given the importance of KM diffusion in modern SMEs and also in the future, the findings of this study are designed to enable owner-managers and practitioners to understand how SMEs KM diffusion is influenced by contextual factors, and how the effects may vary across different stages.

Keywords Small and medium enterprises, Knowledge management diffusion

Paper type Research paper

1. Introduction

Since small and medium enterprises (SMEs) generally lack the resources of larger firms, it is crucial that they formulate knowledge management (KM) activities (Cantu *et al.*, 2009; Coyte *et al.*, 2012; Edvardsson and Durst, 2013; McAdam and Reid, 2001). KM activities involve the creation, capturing, sharing, and utilization of knowledge to enhance the impact of knowledge on the performance of SMEs (Durst and Edvardsson, 2012; Soon and Zainol, 2011). To facilitate the participation of SMEs in knowledge-intensive activities, SMEs will be encouraged to create market value through knowledge exploitation in novel circumstances via effective management of a highly qualified workforce (Swart and Kinnie, 2003). In most countries, the majority of firms are SMEs; they have a critical role in driving economic growth, employment and wealth creation. For example, in Taiwan, SMEs represent around 97 percent of all

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enterprises, contributing up to 60 percent of Taiwan's gross domestic products, 78 percent of the total employment and 17 percent of the total exports of the country (Ministry of Economic Affairs, 2011). Hence, it is vital for the Taiwanese SMEs to upgrade and transform into knowledge-intensive industries to maintain their competitiveness and facilitate Taiwan's continuous growth (Lee *et al.*, 2008).

KM highlights the continuous reconfiguration of firm knowledge-based assets, and adapts to changing market conditions to achieve organizational renewal and innovativeness. Thus, KM diffusion is necessary because of environmental changes such as diversification of KM strategy, increasingly globalized competition, limited useful life of knowledge, and the dynamics of both product and service innovations (Greiner *et al.*, 2007). In this study, KM diffusion defines as a series of stages from firm initial evaluation of KM activities, to their formal adoption, and finally to such activities becoming institutionalized as daily activities throughout the organization. The KM diffusion literature tends to focus on large firms (Lee and Kim, 2001; Lin, 2007, 2011a; Xu and Quaddus, 2012). However, fundamental differences between large firms and SMEs mean that findings of studies on KM in large firms cannot be fully applied to SMEs (Cantu *et al.*, 2009; McAdam and Reid, 2001; Wong, 2005). Research on KM diffusion in SMEs remains limited, and more research is needed to better understand this phenomenon (Chan and Chao, 2008; Chong *et al.*, 2014; Durst and Edvardsson, 2012; Massa and Testa, 2011).

The need for SMEs to facilitate KM diffusion originates from several salient reasons. While SMEs might be constrained by insufficient financial and human resources, their know-how and knowledge are the most crucial of the resources they may have or use (DeSouza and Awazu, 2006). Promoting KM diffusion thus is particularly crucial in SMEs, as knowledge is the most important resource in such organizations (Dotsika and Patrick, 2013). Additionally, compared to large enterprises, SMEs generally have flat and flexible organizational structures, elastic and adaptable processes, and strong innovation potential (Hudson *et al.*, 2001; Wong and Aspinwall, 2004). These characteristics endow SMEs with organizational flexibility and adaptability that is critical to successful KM diffusion (Cantu *et al.*, 2009). Finally, increasing competitive pressure forces SMEs to rethink their existing competitive strategies. Indeed, knowledge and its management are considered the most valuable sources of growth and competitiveness (Salojarvi *et al.*, 2005). Scholars have emphasized that the advantages of KM to SMEs mostly related to cost reduction, improved decision making, and increased productivity, market share, innovation, and profitability (Lee *et al.*, 2008; Wang *et al.*, 2010). Consequently, it is worth examining key enablers for the stage-based KM diffusion in SMEs.

Previous studies had proposed that two aspects should be considered in examining KM diffusion in SMEs (Lee *et al.*, 2008; Massa and Testa, 2011; Palacios-Marques *et al.*, 2015; Wong and Aspinwall, 2005). First, most studies focus on assessing the linkage between contextual antecedents (such as strategy and leadership, culture, technology, reward system, and competitive pressure), and a single stage of KM diffusion in SMEs, such as KM adoption decisions (Fink and Ploder, 2009; Nunes *et al.*, 2006; Wong, 2005), KM implementation (Alegre *et al.*, 2013; Cantu *et al.*, 2009; Durst and Edvardsson, 2012), and KM effectiveness (Lee *et al.*, 2008; Wang *et al.*, 2010). KM diffusion goes through a series of stages, starting from the initial evaluation of KM projects by an SME at the pre-adoption stage, and progressing through the adoption decision, and finally to formal implementation (post-adoption stage). The literature reviewed by Lee and Kim (2001) and Lin (2007) also stated that stage-based KM diffusion analysis would provide insights to help understand KM diffusion over time.

Second, despite increasing realization and acceptance that KM is crucial for SMEs (Pillania, 2008a, b), KM diffusion still presents several challenges for SMEs. For example, the technological challenge facing SMEs is to build computer-based knowledge storage systems. The nature of the work performed in SMEs operating in high knowledge intensity sectors requires increased use of information technology (IT) that improved learning at the organizational level (Mercader *et al.*, 2006). Therefore, KM diffusion can be boosted through investing in IT applications in SMEs. Nurach *et al.* (2012) also concluded that KM implementation not only includes investment in IT applications, but also depends on IT effectiveness. The organizational challenge is to further strengthen management support and monitoring of KM visions and goals. In the SME context, management responsibilities in KM include motivating employees, designing adequate rewards systems, and fostering the sharing culture required for effective KM diffusion (Chan and Chao, 2008; Pillania, 2008b). The environmental challenge faced by SMEs is to closely connect with competitive pressure and a turbulent business environment, and this motivates KM adoption and diffusion. Previous researchers have observed that the main goal of a SME is not simply to promote KM projects, but to do so effectively and efficiently to reduce competitive pressure (Filippini *et al.*, 2012; Wong and Aspinwall, 2004).

We know of no prior empirical studies that directly explored the influence of technological, organizational, and environmental factors on the stage-based KM diffusion in the SME context. Motivated by the issues mentioned, this study aims to bridge the gap in the existing literature by examining the influence of technological (IT support and IT effectiveness), organizational (top management support, sharing culture, and reward system) and environmental (competitive pressure) contexts on a multi-staged KM diffusion in SMEs. The research model and hypothesized relationships are tested by data collected from SME senior managers (including owner, vice president, and business manager) in Taiwan. Furthermore, the findings of this study contribute to empirical research on contextual factors that influence KM diffusion using a broad data set rather than a few isolated SME cases. From the managerial perspective, given the importance of KM diffusion in modern SMEs and also in the future, the findings of this study are designed to enable owner-managers and practitioners to understand how SMEs KM diffusion is influenced by contextual factors, and how the effects may vary across different stages.

2. Theoretical background
The two main areas of research that provide theoretical foundations for this study are KM diffusion stages and contextual factors affecting KM diffusion. Key research on these areas is briefly reviewed below.

2.1 KM diffusion stages
Since the combination of existing and new knowledge can be viewed as one example of organizational innovation, firms that involve both leveraging existing knowledge and learning new knowledge are likely to be successful innovators (Kamara *et al.*, 2002). Scholars mostly focus on describing the variation in the adoption of organizational innovation, and particularly how innovation diffuses and expands (Ahire and Ravichandran, 2001; Ehigie and McAndrew, 2005; Sisaye and Birnberg, 2010). Innovation diffusion theory suggests organizational innovation diffusion occurs in stages, it is a process through which an organization passes from first knowledge of a specific management innovation to the implementation of new organizational policies

and procedures (Rogers, 1995). Previous researchers have usually conceptualized organizational innovation as pertaining to organizational initiation, adoption, and implementation of new methods, techniques, and practices, or newly altered products or services (Damanpour and Gopalakrishnan, 1998; Damanpour and Schneider, 2006; Fichman, 2001). The growth of KM, as a gradual and evolutionary process, encompasses the various evolutionary stages of KM, from the development of the KM project to its successful implementation (Lee and Kim, 2001). To better understand KM diffusion problems and their solutions, multi-stage rather than single-stage analysis provides better insights into KM activities (Lin, 2007).

The literature considers the organizational innovation diffusion as a longitudinal process that can be divided into a number of stages, from awareness of the organizational innovation to its full deployment throughout the organization (Damanpour and Schneider, 2006; Klein and Sorra, 1996). Rogers (1995) originally proposed a two-stage model for organizational innovation diffusion: adoption and implementation. In the context of KM, Lee and Kim (2001) propose that organizational capability of KM grows through the following four stages: initiation, propagation, integration, and networking. Lin (2007) suggests a KM evolution stage model which consists of three stages: KM initiation, development, and mature stages. Lin (2011b) categorized the KM implementation level into five stages: initiation, pilot implementation, organic growth, organizational implementation, and institutionalization. While the various organizational innovation diffusion models with distinct number of stages, inherently follow a similar evolution pattern. This pattern can be described as follows: first, an adoption stage classified for initiation, pilot implementation, and adoption; and second, an implementation stage classified for implementation, integration, and institutionalization.

Based on the above discussion, this study adopts KM adoption and KM implementation stages in a study of KM diffusion in the SME context. KM adoption is defined as the decision to investment in KM activities and the preparation of enterprise-wide KM efforts. Financial and technical resources are allocated at this stage to facilitate KM. KM implementation, the last stage of KM diffusion, is defined as the degree to which the activities of knowledge acquisition, dissemination, application, integration, absorption, and protection are implemented within the organization. This is the stage at which the firm has successfully implemented KM to facilitate and motivate knowledge-related activities.

2.2 Contextual factors affecting KM diffusion

At the firm level, the technology-organization-environment (TOE) framework was used to guide the examination of the diffusion of organizational innovation (Tornatzky and Fleischer, 1990). The TOE framework suggests that the technological, organizational, and environmental contexts are three important influences on the diffusion process by which organizations implement innovations (Tornatzky and Fleischer, 1990). Technological contexts relate to extant technologies and the technical skills available to the firm; organizational context embodies organizational characteristics and resources; and environmental context describes the industrial settings in which an organization conducts its business (Thong, 1999; Tornatzky and Fleischer, 1990).

After reviewing the TOE framework and considering the context of KM, this study proposes those factors that expected to influence KM diffusion in SMEs. First, SMEs reportedly have limited IT competence, and typically lack the necessary managerial expertise to plan, organize, and direct the implementation of IT applications (Maguire *et al.*, 2007). IT competence refers to the firm's ability to utilize IT applications (such as

groupware, online databases, intranet, and virtual communities) that support the business functions and provide effective means for improving organizational performance (Ravichandran and Lertwongsatien, 2005). SMEs effectively use IT applications as they produce a synergetic effect on individual learning and help businesses search, access and use knowledge more effectively (Mercader *et al.*, 2006; Nurach *et al.*, 2012). Kulkarni *et al.* (2006) proposed that firms require a high-quality IT application that is accessible and able to easily leverage KM activities. SMEs with greater IT competence (including IT support of KM and higher IT effectiveness) thus are more likely to achieve sustainable growth and pursue KM best practices (Nurach *et al.*, 2012; Tan, 2011). Therefore, this study incorporates IT support and IT effectiveness within the technological context.

Second, based on the review of literatures undertaken, three organizational factors that are considered critical to the success of the KM adoption in SMEs: top management support, sharing culture, and reward system (Lee *et al.*, 2008; Tan, 2011; Wong and Aspinwall, 2004; Alam *et al.*, 2009). Top management support is critical in SMEs to create a supportive climate and provide adequate resources to facilitate KM success. Such support ensures limited resources are allocated to support the essential needs of KM initiatives (Pillania, 2008b). A sharing culture is important to the generation of new ideas, knowledge, and solutions (McDermott and O'Dell, 2001). In a SME with a sharing culture, employees share ideas and exchange knowledge with colleagues because the culture make such behavior natural, rather feeling forced to engage in such sharing. Additionally, SMEs that provide reward systems will definitely encourage employees to donate and collect knowledge (Alam *et al.*, 2009). Thus, it is important that management promote KM using formal structures that exhibit a formal reward system and incentives. This study includes top management support, sharing culture, and reward system within the organizational context.

Third, because the environment presents both opportunities and constraints for organizational innovation process, KM is influenced by environmental factors related to external pressures (Wong, 2005). Competitive market pressures will force SMEs to revise their knowledge assets and seek ways to create business value. That is, competitive pressures are causing companies to reconsider their knowledge assets. Therefore, competitive pressure is critical factor that should be examined within the environmental context.

Additionally, in the context of KM, Lee *et al.* (2009) and Ryan *et al.* (2000) used the TOE framework to explain the adoption of KM technologies. The applicability of the TOE framework for investigating the determinants of innovation adoption and assimilation in SMEs is exemplified in the existing literature (Iacovou *et al.*, 1995; Ifinedo, 2011; Kuan and Chau, 2001; Ramdani *et al.*, 2009; Thong, 1999). These studies successfully utilized the TOE framework to organize selected contextual factors, and found it to be a relevant framework that can be used to study the adoption of different types of organizational innovation by SMEs. Drawing on the empirical evidence, combined with the literature review and theoretical perspectives discussed above, this study hypothesized that the TOE framework is appropriate for studying KM diffusion in SMEs, because KM diffusion is enabled by the integration of IT applications, driven by organizational readiness, and influenced by environmental factors, especially environmental and competitive pressure.

3. Research model and hypotheses
Grounded in the two stages of KM diffusion and the TOE framework discussed above, this study develops the research model as shown in Figure 1. This study posits that

Figure 1.
Research model
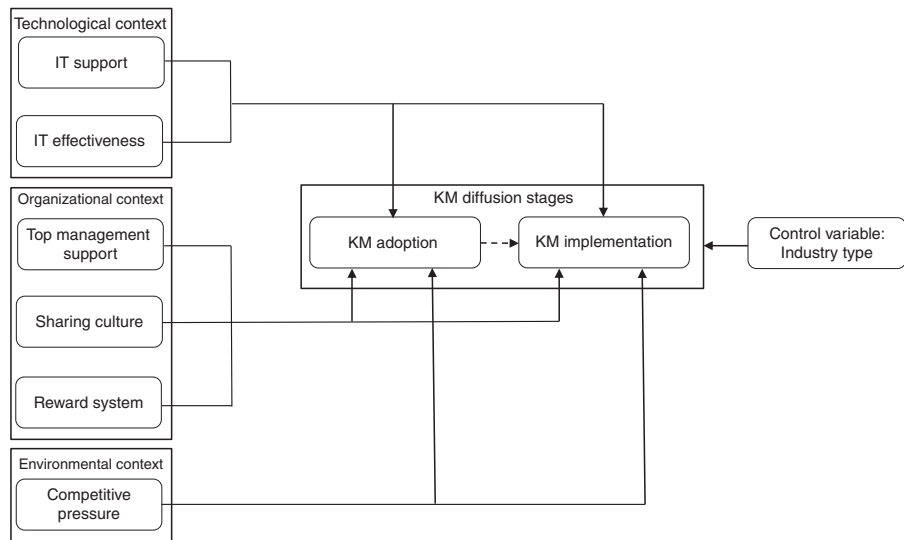
Notes: ⟶ Explanation --→ Diffusion

KM adoption and KM implementation are dependent variables. The research model also incorporates technological (IT support and IT effectiveness), organizational (top management support, sharing culture, and reward system) and environmental (competitive pressure) contexts as important determinants of two-stage KM diffusion in SMEs.

Considering that it was not possible to include all potential factors affecting the two-stage KM diffusion in SMEs, the choice of theoretical constructs in the current study was determined through an extensive literature review as well as informal conversations with various KM executives. First, IT competence (IT support and IT effectiveness) in supporting KM activities is an essential requirement at the initial KM adoption stage and across the KM maturity stages (Hsieh *et al.*, 2009). This study chose IT support and IT effectiveness as important antecedents of two-stage KM diffusion because such applications enable the rapid search, access, and retrieval of knowledge, and support collaboration and communication among employees (Hislop, 2002; Wang *et al.*, 2007). Second, this study attempts to examine three organizational factors (top management support, sharing culture, and reward system) as the determinant of two-stage of KM diffusion in SMEs these factors appear often in our informal conversations with KM practitioners. Third, as for environmental context, this study included competitive pressure in the research model. Such a construct is not commonly investigated in KM diffusion studies, so it is included here, as this study aimed to test its applicability in a different national context (Taiwan). These contextual factors were chosen because they were believed to be important in understanding and explaining the predictors of stage-based KM diffusion. The variables in the research model and hypotheses are detailed below.

3.1 Technological context
Zack (1999) categorizes IT support for KM based on three critical KM activities: obtaining knowledge; defining, storing, categorizing, indexing, and linking knowledge-related digital items; and seeking and identifying related content. Based

on two case studies from knowledge-intensive SMEs, Nunes *et al.* (2006) concluded that greater use of IT applications may inevitably help SMEs increase their overall KM efficiency. In SMEs, IT facilitates KM activities by enhancing the initial knowledge base that employees can draw on problem solving and decision making (Dotsika and Patrick, 2013; Fink and Ploder, 2009; Tan, 2011). Therefore, IT support for KM is more likely to increases the knowledge base available to individual employees and enables employees to work together, thus facilitating KM diffusion in SMEs. The above arguments lead to the following hypothesis:

H1. IT support is positively related to KM adoption and KM implementation.

IT effectiveness refers to the extent to which the knowledge provided by IT applications is relevant, up-to-date, and reliable (DeLone and McLean, 2003; Nelson *et al.*, 2005). SME employees are very busy by nature, and thus the ability to effectively use IT to help analyze information and knowledge is crucial. Lack of effective IT applications forces employees to spend most of their time searching and accessing knowledge. IT effectiveness thus helps SMEs improve the quality of their KM, which will ultimately contribute to SME growth and performance (Nurach *et al.*, 2012; Wong, 2005). In situations involving high IT effectiveness, employees can better search for and access knowledge, helping SMEs gain exposure to the benefits of KM adoption and exploitation. It is argued, therefore, that:

H2. IT effectiveness is positively related to KM adoption and KM implementation.

3.2 Organizational context

Top managers in SMEs, such as company owners, directors, or chief executive officers, are usually owners who have the ultimate power of control, and who commonly oversee every aspect of the business. In this study, top management support refers to the active engagement of top management with KM activities. Previous research indicates that top management support generally bodes well for successful KM implementation in SMEs (Chawan and Vasudevan, 2013; Lee *et al.*, 2008; Pillania, 2008b; Wong and Aspinwall, 2005). This is because top management acts as change agents in the diffusion of organizational innovations (Damanpour and Schneider, 2006). When top managers in SMEs understand the importance of KM activities, they tend to play a crucial role in encouraging voluntary employee participation in donating and collecting important knowledge. Strong top management support may result in more mature KM activities and facilitate KM diffusion. It therefore is posited that:

H3. To management support is positively related to KM adoption and KM implementation.

Sharing culture in this study refers to a set of shared understandings related to providing employees with access to relevant information and building and using knowledge networks within organizations (Hoegl *et al.*, 2003). Previous studies indicate that sharing culture is critical to the effect of KM activities (McDermott and O'Dell, 2001; Wong and Aspinwall, 2005). SMEs can successfully promote KM activities not only by directly incorporating knowledge in their business strategy, but also by creating a sharing culture (Egbu *et al.*, 2005; Lee *et al.*, 2008). A case study by Flectcher

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and Prashantham (2011) demonstrated that alignment of knowledge sharing strategy with organizational culture contexts is necessary for KM diffusion. They are able to do this because a sharing culture encourages employees to engage in KM activities voluntarily, establish a learning environment and promote employee thirst for knowledge. Therefore, it was reasonable to believe that sharing culture will help motivate SMEs to adopt and implement KM activities. Based on the above, it is suggested that:

H4. Sharing culture is positively related to KM adoption and KM implementation.

To promote KM projects, SMEs may provide various forms of organizational reward such as salary incentive, bonuses, promotion incentive, or job security (Alam *et al.*, 2009; Wong, 2005). Previous researchers suggest that reward systems can facilitate knowledge exchange among employees (Al-Alawi *et al.*, 2007; Hariharan and Cellular, 2005; Syed-Ikhsan and Rowland, 2004). Accordingly, this study expects a positive relationship between organizational reward system and the two stages of KM diffusion in SMEs. It is argued, therefore, that:

H5. Reward system is positively related to KM adoption and KM implementation.

3.3 Environmental context
SMEs typically exhibit high environmental uncertainty, such as competitive pressure and product market competition (Fink and Kazakoff, 1997; Parnell *et al.*, 2012). Indeed, intense competition can cause firms to look at new ways of doing business, including utilizing organizational innovations for survival (Damanpour and Schneider, 2006). Competitive pressure in this study refers to the pressure resulting from a threat of losing competitive advantage, forcing firms to adopt and implement KM. KM can be viewed as a form of organizational innovation able to revolutionize organizational functions, reduce costs and ultimately create competitive advantage. Firms that are first-movers in deploying KM have tended to derive the greatest advantages. Hence, KM is expected to be adopted and implemented most successfully in highly competitive environments. Based on the above, it is suggested that:

H6. Competitive pressure is positively related to KM adoption and KM implementation.

3.4 Control variable
Industry type is used to control for industry-specific differences that may affect the KM diffusion, as service and manufacturing industries differ in their KM styles implementation (Choi and Lee, 2003). The use of this variable in the research model helps control for industry-level differences that might affect KM adoption and implementation.

4. Research methodology
4.1 Sample and data collection
Empirical data to test the hypothesized relationships were obtained by using a mail survey to SMEs in Taiwan. The questionnaire items were refined through rigorous

pre-testing to establish content validity. The pre-testing focusses on instrument clarity, question wording and validity. During the pre-testing, three KM field experts were invited to comment on the questions and wordings. The comments of these three individuals then provided a basis for revisions to construct measures.

The sampling frame or sources used for data in this study were identified from the Small and Medium Enterprise Administration of the Ministry of Economy (MOE) in Taiwan. The SMEs in Taiwan is defined as a: for manufacturing industry with < 200 employees or capital < 2.5 million US dollars; for service industry with less 100 employees or sales revenue less than 3.2 million US dollars (Ministry of Economic Affairs, 2011). A total of 355 questionnaires are distributed among senior managers of the sampled firms. KM is critical in any SME and senior managers (including owner, vice president, and business manager) require a good understanding of the conditions for successful KM implementation. SME senior managers, the key decision makers, were selected because they often have the most knowledgeable and reliable informants within a company to answer the survey (Wong and Aspinwall, 2005).

After one follow-up mailing, 311 questionnaires were returned in total. Based on self-reported KM implementation (my organization has implemented various KM activities such as generation, exploitation, dissemination, and accumulation of knowledge), the sample was split between adopters and non-adopters. Respondents whose companies had implemented KM were classified as KM adopters, whereas respondents whose companies had not implemented KM were classified as KM non-adopters. After eliminating the invalid questionnaires (those with incomplete answers or firms that were KM non-adopters), 119 respondents were considered valid which are KM adopters. The overall valid questionnaire return rate was 33.5 percent. Although the number of respondents is not large, it is still acceptable and comparable to other studies about KM implementation in SMEs (e.g. Cantu *et al.*, 2009; Salojarvi *et al.*, 2005). Basic information of respondents and companies are depicted in Table I.

4.2 Measures
Measurement items were developed on the basis of a comprehensive review of the literature and modified to suit the KM context. The definitions for all measurement items are listed in the Appendix and discussed below.

4.2.1 Independent variables. IT support was assessed with three items based on Lee and Choi (2003). The items measured the extent to which the organization provides IT applications for employees to contribute to the knowledge with colleagues. IT effectiveness was measured by the three items that reflect the extent to which the knowledge provided by IT applications is relevant, up-to-date, and reliable (DeLone and McLean, 2003; Nelson *et al.*, 2005). The five-item scale of top management support measured the extent to which top management involved and provided the resources for KM activities and was adapted from Lee and Kim (1992) and Taylor and Wright (2004). Sharing culture was designed to capture willingness and ability of employees to share knowledge and experience and was assessed by a six-item scale adapted from Gold *et al.* (2001). Five items for measuring reward system was taken from Davenport and Prusak (1998) and Hargadon (1998) and designed to express the extent to which employees believe that they will receive extrinsic incentives (such as salary incentive, bonuses, promotion incentive, or job security) through their knowledge contribution. Finally, two items measuring competitive pressure were adapted from Premkumar and Ramamurthy (1995) and designed to measure the degree of pressure exerted by competitors on the KM implementation.

	Frequency	%
Basic information of respondents		
Education level		
High school or below	2	1.7
College/university	106	89.1
Graduate school or above	11	9.2
Working experience (*years*)		
<5 year	14	11.8
6-10	60	50.4
11-15	24	20.2
>16 year	21	17.6
Job position		
Owner	45	37.8
Vice president	12	10.1
Business manager	62	52.1
Basic information of companies		
Industry type		
Manufacturing	50	42.0
Service	39	32.8
Wholesale and retail	26	21.8
Other	4	3.4
Number of employees		
<50	60	50.4
51-100	42	35.3
>101	17	14.3
Note: $n = 119$		

Table I.
Basic information
of respondents and
companies

4.2.2 Dependent variables. There are two measures for the dependent variable. The first measure of KM diffusion stages, KM adoption, was measured with five items adapted from Hazen *et al.* (2012). The measure focussed on the extent to which organizational needs and structure are adjusted to accommodate KM adoption. The second measure, KM implementation, was assessed using six items adapted from Gold *et al.* (2001) and Lee and Lee (2007). Survey respondents were asked to indicate the extent to which their firms currently implemented various KM activities. KM activities consisted of generating knowledge, distributing knowledge, applying knowledge, integrating knowledge, absorbing knowledge, and protecting knowledge assets.

4.2.3 Control variable. Industry type contains two categories, that is, service-oriented (including retail/wholesale distribution and financial services) and manufacturing industries.

5. Data analysis and results

The partial least squares (PLS) approach was employed to analyze the research model of this study. A variance-based PLS approach was chosen over covariance-based methods such as LISREL because PLS does not impose sample size and distribution restrictions (Chin *et al.*, 2003). PLS is a structural equation modeling technique that simultaneously assessed the measurement model and the theoretically constructed structural model (Wold, 1982). Although measurement and structural parameters are estimated together, a PLS model is analyzed and interpreted in two stages. The measurement model was

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estimated using confirmatory factor analysis to assess reliability and validity of theoretical constructs, and the structural model was analyzed to examine the associations hypothesized in the present research model. In this study, raw data were used as input to the PLS software program (PLS-Graph Version 3.0), and path significances were estimated using the bootstrapping resampling technique with 500 subsamples.

5.1 Common method bias
Since the data were self-reported, common method variance (CMV) is a possible concern (Podsakoff and Organ, 1986). Following Podsakoff *et al.* (2003), this study applied a single-informant approach to collect survey data, which makes it necessary to examine for the possibility of common method bias. Harman's single-factor test was employed to examine whether a single factor emerges from principal component analysis, or if one factor overwhelmingly accounts for the majority of covariance among the variables in an unrotated factor analysis (Podsakoff *et al.*, 2003). All construct items were subjected to principal components factor analysis. The results indicated that multiple factors emerged to explain the data variance. Therefore, CMV does not appear to be a serious concern for this study. This is consistent with previous research (Carlo *et al.*, 2012) showing that CMV does not significantly affect KM studies based on single-source survey data.

5.2 Measurement model
The measurement model proceeded in two phases: convergent validity and discriminant validity analyses. Convergent validity of measurement items was assessed using three criteria suggested by Fornell and Larcker (1981): first, all items factor loadings should be significant and exceed 0.7, second, composite reliabilities for each construct should exceed 0.8, and third, average variance extracted (AVE) for each construct should exceed 0.5 (or the square of AVE should exceed 0.71). For the current measurement model, all factor loadings were significant at $p < 0.001$ and exceeded the 0.7 threshold (see Table II). The composite reliabilities of the constructs ranged between 0.89 and 0.96 (see Table II). Further, browsing the principal diagonal elements in Table II, the square of AVE ranged from 0.83 to 0.93. Hence, all the three conditions for convergent validity were met.

Discriminant validity of the constructs was assessed using the guideline suggested by Fornell and Larcker (1981): the square root of AVE for each construct should exceed the correlations between that and all other constructs. Table II lists the correlations among the constructs, with the square root of the AVE on the diagonal. All the diagonal values exceed the inter-construct correlations; hence the discriminant validity criterion was also met for the data sample.

5.3 Structural model
The proposed research model was assessed by examining the significant of paths in the structural model. Table III shows the results of the structural model analysis. The model explains 42 percent of the variance in KM adoption and 65 percent of the variance in KM implementation. The R^2 values of the three endogenous variables are larger than 25 percent, indicating that significant amounts of variance in these variables are well explained by the proposed independent variables.

Within the technological context, IT support has significant and positive paths to KM adoption ($\beta = 0.26$; $p < 0.05$) and KM implementation ($\beta = 0.14$; $p < 0.10$).

Table II.
Results of the measurement model

Construct	Range of standardized loadings	Composite reliability	Inter-construct correlations[b]								
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) IT support	0.79-0.91	0.89	0.86								
(2) IT effectiveness	0.87-0.92	0.92	0.73	0.89							
(3) Top management support	0.85-0.91	0.94	0.47	0.62	0.87						
(4) Sharing culture	0.82-0.85	0.93	0.54	0.69	0.76	0.83					
(5) Reward system	0.81-0.94	0.95	0.26	0.35	0.44	0.47	0.88				
(6) Competitive pressure	0.93-0.94	0.93	0.38	0.54	0.51	0.50	0.47	0.93			
(7) KM adoption	0.88-0.95	0.91	0.52	0.55	0.49	0.46	0.43	0.45	0.91		
(8) KM implementation	0.73-0.90	0.96	0.60	0.72	0.65	0.71	0.40	0.58	0.67	0.83	
(9) Industry type	na[a]	na	0.01	-0.08	-0.10	-0.04	-0.23	-0.26	-0.08	-0.11	na

Notes: [a]na: loadings, composite reliability, and average variance extracted (AVE) are not applicable to the single-item constructs; [b]diagonal elements represent square root of AVE for that construct

Path from	Path to	
	(a) KM adoption	(b) KM implementation
H1: IT support	0.26**	0.14*
H2: IT effective	0.20**	0.27**
H3: top management support	0.17*	0.11*
H4: sharing culture	0.08 (ns)	0.29***
H5: reward system	0.21**	0.01 (ns)
H6: competitive pressure	0.10 (ns)	0.19**
Control variable:		
Industry type	0.02 (ns)	−0.02 (ns)
R^2 (%)	42	65

Notes: ns, nonsignificant. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

Table III.
Results of the structural
model

Thus, the findings support *H1a* and *H1b*. IT effectiveness has significant and positive paths to KM adoption ($\beta = 0.20$; $p < 0.05$) and KM implementation ($\beta = 0.27$; $p < 0.05$), leading support for *H2a* and *H2b*.

Within the organizational context, top management support has significant and positive paths to KM adoption ($\beta = 0.17$; $p < 0.10$) and KM implementation ($\beta = 0.11$; $p < 0.10$). Thus, the results support *H3a* and *H3b* Sharing culture has no significant paths to KM adoption, while it has significant and positive path to KM implementation ($\beta = 0.29$; $p < 0.01$) Thus, *H4a* is not supported, while *H4b* is supported. Reward system has significant and positive paths to KM adoption ($\beta = 0.21$; $p < 0.05$) (*H5a* is supported). But the standardized path from reward system to KM implementation is not found to be significant (*H5b* is not supported).

Within the environmental context, competitive pressure has no significant paths to KM adoption, thus H6a is not supported. However, competitive pressure has a significant and path to KM implementation ($\beta = 0.19$; $p < 0.05$). Thus, *H6b* is supported by the data.

Regarding the control variable, industry type has no significant effect on two stages of KM diffusion. A possible explanation is that the level of KM diffusion across all respondent companies was high, so that the industry effect was not apparent.

6. Discussion and implications

The results showed that technological, organizational, and environmental factors have different effects on KM adoption and implementation stages. Specially, IT support has the strongest effect on KM adoption stage, while sharing culture has the strongest effect on KM implementation stage. The discussion about the key findings and practical implications are presented in the following sections.

6.1 Technological context

6.1.1 IT support. IT support has a significant and positive impact on KM adoption and KM implementation. As previous studies found (Dotsika and Patrick, 2013; Fink and Ploder, 2009), IT is often cited in the SME literature as an important KM infrastructural capability, enabling or supporting core KM activities. The result also found that IT support tends to be the most influential drivers in a SME's KM adoption decisions. SMEs that have more compatible IT applications are more likely to be early adopters of KM. In the KM adoption stage, SMEs must ensure the availability of IT support (e.g. IT team, training, resources), to ensure that KM is adopted successfully. This suggests

that SMEs need to have IT resources ready as they start to promote adoption and deployment of KM initiatives.

IT support continues to be positively related to the level of KM implementation after adoption. KM diffusion requires managers to invest time and effort to link specific IT support and knowledge-based work activities, since effective IT deployment for KM can help SMEs move toward a knowledge society, which is vital in the contemporary knowledge economy. Due to the lack of resources, SMEs are often weak in terms of financing, planning, training and the use and exploitation of advanced IT. Managers thus should carefully match their IT investment decisions to their desired KM goals.

6.1.2 IT effectiveness. The results also support Kulkarni *et al.*'s (2006) argument that higher IT quality increases the usefulness of KM by enhancing the fit between IT-based system output and employee knowledge requirements. Thus, SMEs that have adopted KM are concerned with the knowledge quality provided by IT applications. SMEs must also ensure that IT applications can provide relevant, up-to-date and reliable knowledge, and that IT effectiveness can facilitate their adoption of KM. Furthermore, an IT strategy developed to maximize the benefits of KM in SMEs needs to be reliable, practical and user-friendly. That is, employees find IT to be a useful means of facilitating KM diffusion when IT is a reliable and easy means of system access that provides relevant and up-to-date knowledge content.

6.2 Organizational context

6.2.1 Top management support. Top management support was found to have a significant influence on the KM adoption stage. As mentioned by researchers such as Wong and Aspinwall (2005), in SMEs, top management personality, skills, responsibilities, attitudes, and behavior decisively influence KM initiatives. In the SME context, driving KM adoption and incorporating it into business processes is a difficult managerial task, and thus top managers must be aware of their obligation to provide KM projects with adequate resources. That is, SMEs with a more active management team would be more successful at KM adoption. In contrast, a lack of leadership and support from top management can be a significant barrier when SMEs are adopting KM.

Top management support continues to be positively associated with KM implementation stage. Top management support can take various forms, such as exhibiting a willingness to collect knowledge from and donate knowledge to colleagues, to continuously learn, and to search for new knowledge and ideas (Lin and Lee, 2004). Top management can also demonstrate to employees that KM diffusion is not just management jargon, but a course of action to identify and share skills and experience within the organization to foster organizational competence. Through this approach they can further influence other employees to imitate them and increase the extent of KM diffusion.

6.2.2 Sharing culture. Contrary to the expectation, sharing culture does not significantly influence the KM adoption stage. Hutchinson and Quintas (2008) emphasized that the biggest challenge for most KM efforts lies in facilitating formal knowledge sharing activities in SMEs. The KM diffusion process is an integrated and complex social network that involves culture, people, behavior, and business processes as its core. Thus, cultivating effective sharing culture in SMEs is not easy during the early stage of KM diffusion.

The result demonstrates sharing culture to be the most important variable to facilitate the success of KM implementation. Sharing culture has the potential to both

enable knowledge flows and, simultaneously, allow a SME to increase trust among employees. The presence of a sharing culture helps eliminate resistance barriers to KM implementation, while in the absence of such a culture, successful KM diffusion might not exist. SMEs should strive to enable employees to propose ideas for new opportunities and foster a more proactive and open knowledge sharing culture for KM implementation.

6.2.3 Reward system. In an interesting finding to practitioners, reward system strongly influences the KM adoption stage. This result is consistent with that of Syed-Ikhsan and Rowland (2004), who argued that both monetary and non-monetary incentives could be incorporated into a reward system that fosters KM initiatives. By designing adequate reward systems for KM diffusion, SMEs are likely to have high organizational readiness to adopt KM. The important point for managers is that organizational rewards are preconditions for initiating successful KM diffusion in SMEs. SMEs thus should focus on providing adequate reward systems (such as salary incentive, bonuses, promotion incentive, or job security) to stimulate and reinforce attitudes and behaviors to support effective KM. This means effective KM requires formal reward systems that value and encourage learning and innovation and provide incentives for engaging in the adoption of KM initiatives. Additionally, although previous studies have stated that reward system is a smaller consideration for KM development in large enterprises (Lin, 2011a), the results suggest that this is not the case with the studied SMEs. Reward system is also a concern for many SMEs, especially in relation to their KM evaluation and adoption decisions.

However, contrary to the expectation, this study did not support the hypothesis that reward system significantly influences the KM implementation stage. One possible explanation is that extrinsic rewards merely secure temporary compliance (Kelman, 1958; Kohn, 1993). When treating KM activities as necessary criteria in an employee assessment system, extrinsic rewards will attract less attention and the focus of KM implementation will shift to other intrinsic motivations, such as openness in communication and sharing culture.

6.3 Environmental context

In the environmental dimension, competitive pressure did not facilitate SMEs to adopt KM. One possible explanation for the insignificant relationship between competitive pressure and the early stage of KM diffusion is that adoption decisions may be more affected by factors other than environmental considerations, such as internal or company specific objectives and concerns. Additionally, the result shows that competitive pressure plays an important role in the KM implementation stage. This finding supports the arguments of Wong and Aspinwall (2004), who suggested that environmental factors such as competitive pressure are crucial for SMEs to implement successful KM activities. The emergence of competitive pressure as a key variable emphasizes the need to view KM diffusion as a long-term business development strategy. Especially, SMEs must understand the value of deploying KM solutions as a key business driver rather than a resource-intensive additional initiative. As competition intensifies, SMEs may feel the need to implement KM more extensively to leverage existing knowledge and create new knowledge, which in turn boosts competitive advantage with limited resources. Competitive pressure creates a need for effective KM implementation. SMEs should rapidly respond to changes in the competitive environment, and may consider KM a strategic and necessary competency to continuously enlarge the scope of innovation.

7. Conclusion

Although previous research has suggested the existence of significant technological, organizational, and environmental challenges facing the KM development, few studies have empirically examined these effects in SMEs (Dotsika and Patrick, 2013; Wong and Aspinwall, 2004). To the best of our knowledge, this study is the first study to theoretically specify or empirically test the determinants of KM diffusion stages in SMEs by integrating the KM perspective, innovation diffusion theory and TOE framework. Additionally, compared with previous SMEs KM research, this study empirically uses a representative sample which consists of several senior managers (including owner, vice president and business manager) in the Taiwanese SMEs. The findings of this study identified significant contextual factors shaping the KM diffusion, and revealed their differential effects across different stages (including KM adoption and implementation). As the results show the utility of the proposed model, which is potentially a theoretical framework for studying other types of organizational innovation in SMEs such as business intelligence management and cloud computing services.

The empirical evidence also obtains several key findings and implications about the determinants of KM diffusion stages in SMEs. These key findings are as follows. First, whether the SME adopts and implements KM dependents on the firm's technological, organizational, and environmental contexts. Second, IT support, IT effectiveness, top management support, and reward system were significant predictors of KM adoption stage. Third, IT support, IT effectiveness, top management support, sharing culture, and competitive pressure were found to be significant antecedents of KM implementation stage. Fourth, IT support has the strongest effect on the KM adoption stage, while sharing culture has the strongest effect on the KM implementation stage. The results of this study have implications on how to facilitate stage-based KM diffusion in SMEs.

This study has some significant limitations that should be recognized to help produce higher quality work on the same area in the future. First, since the dataset are cross-sectional and not longitudinal, the posited casual relationships could only be inferred rather than proven. Future research should collect longitudinal data to determine the causal links more explicitly. Second, this study focusses only on the KM diffusion of SMEs. To gain a holistic understanding of KM diffusion in the SME context, the impacts of KM diffusion on firm performance should be examined. Third, besides the factors proposed here, numerous other technological, organizational, and environmental factors also affect KM diffusion stages. Employee motivation, social interaction, and KM strategy have all been identified as potential antecedents of KM implementation level (Lin, 2011b). Future studies can test whether these variables also affect the stage-based KM diffusion in SMEs. Fourth, this study uses 119 SMEs in Taiwan as the research subjects. Hence, the research model should be tested further using samples from other countries, since the findings may be influenced by cultural differences between Taiwan and other countries, and further testing thus would provide a more robust test of the hypotheses. Although this study has its limitations, it still provides a basis for further research on the determinants of stage-based KM diffusion in SMEs.

References

Ahire, S.L. and Ravichandran, T. (2001), "An innovation diffusion model of TQM implementation", *IEEE Transactions on Engineering Management*, Vol. 48 No. 4, pp. 445-464.

Al-Alawi, A.I., Al-Marzooqi, N.Y. and Mohammed, Y.F. (2007), "Organizational culture and knowledge sharing: critical success factors", *Journal of Knowledge Management*, Vol. 11 No. 2, pp. 22-42.

Alam, S.S., Abdullanh, Z., Ishak, N.A. and Zain, Z.M. (2009), "Assessing knowledge sharing behavior among employees in SMEs: an empirical study", *International Business Research*, Vol. 2 No. 2, pp. 115-122.

Alegre, J., Sengupta, K. and Lapiedra, R. (2013), "Knowledge management and innovation performance in a high-tech SMEs industry", *International Small Business Journal*, Vol. 31 No. 4, pp. 454-470.

Cantu, L.Z., Criado, J.R. and Criado, A.R. (2009), "Generation and transfer of knowledge in IT-related SMEs", *Journal of Knowledge Management*, Vol. 13 No. 5, pp. 243-256.

Carlo, J.L., Lyytinen, K. and Rose, G.M. (2012), "A knowledge-based model of radical innovation in small software firms", *MIS Quarterly*, Vol. 36 No. 3, pp. 865-895.

Chan, I. and Chao, C.K. (2008), "Knowledge management in small and medium-sized enterprises", *Communications of the ACM*, Vol. 51 No. 4, pp. 83-88.

Chawan, A.N. and Vasudevan, H. (2013), "Modeling knowledge management barriers in the Indian manufacturing SMEs using ISM approach", *The IUP Journal of Knowledge Management*, Vol. 4 No. 4, pp. 36-52.

Chin, W.W., Marcolin, B. and Newsted, P. (2003), "A partial least squares latent variable modeling approach for measuring interaction effects: results from a monte carlo simulation study and an electronic-mail emotion/adoption study", *Information Systems Research*, Vol. 14 No. 2, pp. 189-217.

Choi, B. and Lee, H. (2003), "An empirical investigation of KM styles and their effect on corporate performance", *Information and Management*, Vol. 40 No. 5, pp. 403-417.

Chong, A.Y.L., Ooi, K.B., Bao, H. and Lin, B. (2014), "Can e-business adoption be influenced by knowledge management? An empirical analysis of Malaysian SMEs", *Journal of Knowledge Management*, Vol. 18 No. 1, pp. 121-136.

Coyte, R., Ricceri, F. and Guthrie, J. (2012), "The management of knowledge resources in SMEs: an Australian case study", *Journal of Knowledge Management*, Vol. 15 No. 5, pp. 789-807.

Damanpour, F. and Gopalakrishnan, S. (1998), "Theories of organizational structure and innovation adoption: the role of environmental change", *Journal of Engineering and Technology Management*, Vol. 15 No. 1, pp. 1-24.

Damanpour, F. and Schneider, M. (2006), "Phases of the adoption of innovation in organizations: effects of environment, organization and top managers", *British Journal of Management*, Vol. 17 No. 3, pp. 215-236.

Davenport, T. and Prusak, L. (1998), *Working Knowledge*, Harvard Business School Press, Cambridge, MA.

DeLone, W.H. and McLean, E.R. (2003), "The DeLone and McLean model of information systems success: a ten-year update", *Journal of Management Information Systems*, Vol. 19 No. 4, pp. 9-30.

Desouza, K.C. and Awazu, Y. (2006), "Knowledge management at SMEs: five peculiarities", *Journal of Knowledge Management*, Vol. 10 No. 1, pp. 32-43.

Dotsika, F. and Patrick, K. (2013), "Collaborative KM for SMEs: a framework evaluation study", *Information Technology & People*, Vol. 26 No. 4, pp. 368-382.

Durst, S. and Edvardsson, I.R. (2012), "Knowledge management in SMEs: a literature review", *Journal of Knowledge Management*, Vol. 16 No. 6, pp. 879-903.

Edvardsson, I.R. and Durst, S. (2013), "The benefits of knowledge management in small and medium-sized enterprises", *Procedia-Social and Behavioral Sciences*, Vol. 81 No. 28, pp. 351-354.

Egbu, C.O., Hari, S. and Penukappa, S.H. (2005), "Knowledge management for sustainable competitiveness in small and medium surveying practices", *Structural Survey*, Vol. 23 No. 1, pp. 7-21.

Ehigie, B.O. and McAndrew, E.B. (2005), "Innovation, diffusion and adoption of total quality management (TQM)", *Management Decision*, Vol. 43 No. 6, pp. 925-940.

Fichman, R.G. (2001), "The role of aggregation in the measurement of IT-related organizational innovation", *MIS Quarterly*, Vol. 25 No. 4, pp. 427-455.

Filippini, R., Guttel, W. and Nosella, A. (2012), "Dynamic capabilities and the evolution of knowledge management projects in SMEs", *International Journal of Information Technology*, Vol. 60 No. 3, pp. 202-220.

Fink, D. and Kazakoff, K. (1997), "Getting IT right", *Australian Accountant*, Vol. 67 No. 10, pp. 50-52.

Fink, K. and Ploder, C. (2009), "Balanced system for knowledge process management in SMEs", *Journal of Enterprise Information Management*, Vol. 22 No. 1, pp. 36-50.

Flectcher, M. and Prashantham, S. (2011), "Knowledge assimilation processes of rapidly internationalising firms: longitudinal case studies of Scottish SMEs", *Journal of Small Business and Enterprise Development*, Vol. 18 No. 3, pp. 475-501.

Fornell, C. and Larcker, D.F. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research*, Vol. 18 No. 1, pp. 39-50.

Gold, A.H., Malhotra, A. and Segars, A.H. (2001), "Knowledge management: an organizational capabilities perspective", *Journal of Management Information Systems*, Vol. 18 No. 1, pp. 185-214.

Greiner, M.E., Bohmann, T. and Krcmar, H. (2007), "A strategy for knowledge management", *Journal of Knowledge Management*, Vol. 11 No. 6, pp. 3-15.

Hargadon, A.B. (1998), "Firms as knowledge brokers: lessons in pursuing continuous innovation", *California Management Review*, Vol. 40 No. 3, pp. 209-227.

Hariharan, A. and Cellular, B. (2005), "Critical success factors for knowledge management", *Knowledge Management Review*, Vol. 8 No. 2, pp. 16-19.

Hazen, B.T., Overstreet, R.E. and Cegielski, C.G. (2012), "Supply chain innovation diffusion: going beyond adoption", *The International Journal of Logistics Management*, Vol. 23 No. 1, pp. 119-134.

Hislop, D. (2002), "Mission impossible? Communicating and sharing knowledge via information technology", *Journal of Information Technology*, Vol. 17 No. 3, pp. 165-177.

Hoegl, M., Parboteeah, K.P. and Munson, C.L. (2003), "Team-level antecedents of individuals knowledge networks", *Decision Sciences*, Vol. 34 No. 4, pp. 741-770.

Hsieh, P.J., Lin, B. and Lin, C. (2009), "The construction and application of knowledge navigator model (KNMTM): an evaluation of knowledge management maturity", *Expert Systems Applications*, Vol. 36 No. 2, pp. 4087-4100.

Hudson, M., Smart, A. and Bourne, M. (2001), "Theory and practice in SME performance measurement systems", *International Journal of Operations & Production Management*, Vol. 21 No. 8, pp. 1096-1115.

Hutchinson, V. and Quintas, P. (2008), "Do SMEs do knowledge management? Or simply manage what they know?", *International Small Business Journal*, Vol. 26 No. 2, pp. 131-154.

Iacovou, C.L., Benbasat, I. and Dexter, A.S. (1995), "Electronic data interchange and small organizations: adoption and impact of technology", *MIS Quarterly*, Vol. 19 No. 4, pp. 465-485.

Ifinedo, P. (2011), "An empirical analysis of factors influencing internet/e-business technologies adoption by SMEs in Canada", *International Journal of Information Technology & Decision Making*, Vol. 10 No. 4, pp. 731-766.

Kamara, J.M., Anumba, C.J. and Carrillo, P.M. (2002), "A clever approach to selecting a knowledge management strategy", *International Journal of Project Management*, Vol. 20 No. 3, pp. 205-211.

Kelman, H.C. (1958), "Compliance, identification, and internalisation: three processes of attitude change", *Journal of Conflict Resolution*, Vol. 2 No. 1, pp. 51-60.

Klein, K.J. and Sorra, J.S. (1996), "The challenge of innovation implementation", *Academy of Management Review*, Vol. 21 No. 4, pp. 1055-1080.

Kohn, A. (1993), "Why incentive plans cannot work", *Harvard Business Review*, Vol. 71 No. 5, pp. 54-63.

Kuan, K.Y. and Chau, P.Y.K. (2001), "A perception-based model for EDI adoption in small business using a technology-organization-environment framework", *Information & Management*, Vol. 38 No. 8, pp. 507-512.

Kulkarni, U.R., Ravindran, S. and Freeze, R. (2006), "A knowledge success model: theoretical development and empirical validation", *Journal of Management Information Systems*, Vol. 23 No. 3, pp. 309-347.

Lee, C.L., Ho., C.T. and Chiu, Y.L. (2008), "The impact of knowledge management enablers on non-financial performance in small and medium enterprises", *Journal of Technology Management*, Vol. 43 No. 1, pp. 266-283.

Lee, H. and Choi, B. (2003), "Knowledge management enablers, processes, and organizational performance: an integrative view and empirical examination", *Journal of Management Information Systems*, Vol. 20 No. 1, pp. 179-228.

Lee, J.N. and Kim, S. (1992), "The relationship between procedural formalization in MIS development and MIS success", *Information & Management*, Vol. 22 No. 2, pp. 89-111.

Lee, J.H. and Kim, Y.G. (2001), "A stage model of organizational KM: a latent content analysis", *Expert Systems with Applications*, Vol. 20 No. 4, pp. 299-311.

Lee, O.K., Wang, M., Lim, K.H. and Peng, Z. (2009), "Knowledge management systems diffusion in Chinese enterprises: a multistage approach using the technology-organization-environment framework", *Journal of Global Information Management*, Vol. 17 No. 1, pp. 70-84.

Lee, Y.C. and Lee, S.K. (2007), "Capabilities, processes, and performance of knowledge management: a structural approach", *Human Factors and Ergonomics in Manufacturing*, Vol. 17 No. 1, pp. 21-41.

Lin, H.F. (2007), "A stage model of knowledge management: an empirical investigation of process and effectiveness", *Journal of Information Science*, Vol. 33 No. 6, pp. 643-659.

Lin, H.F. (2011a), "Antecedents of the stage-based knowledge management evolution", *Journal of Knowledge Management*, Vol. 15 No. 1, pp. 136-155.

Lin, H.F. (2011b), "The effects of employee motivation, social interaction, and knowledge management (KM) strategy on KM implementation level", *Knowledge Management Research & Practice*, Vol. 9 No. 3, pp. 263-275.

Lin, H.F. and Lee, G.G. (2004), "Perceptions of senior managers toward knowledge-sharing behaviour", *Management Decision*, Vol. 42 No. 1, pp. 108-125.

McAdam, R. and Reid, R. (2001), "SME and large organization perceptions of knowledge management: comparisons and contrasts", *Journal of Knowledge Management*, Vol. 5 No. 3, pp. 231-241.

McDermott, R. and O'Dell, C. (2001), "Overcoming cultural barriers to sharing knowledge", *Journal of Knowledge Management*, Vol. 5 No. 1, pp. 76-85.

Maguire, S., Koh, S.C.L. and Magrys, A. (2007), "The adoption of e-business and knowledge management in SMEs", *Benchmarking: An International Journal*, Vol. 14 No. 1, pp. 37-58.

Massa, S. and Testa, S. (2011), "Knowledge domain and innovation behaviour: a framework to conceptualize KMSs in small and medium enterprise", *VINE: The Journal of Information and Knowledge Management Systems*, Vol. 14 No. 4, pp. 483-504.

Mercader, J.R., Cerdan, A.L.M. and Sanchez, R.S. (2006), "Information technology and learning: their relationship and impact on organizational performance in small business", *International Journal of Information Management*, Vol. 26 No. 1, pp. 16-29.

Nelson, R.R., Todd, P.A. and Wixom, B.H. (2005), "Antecedents of information and system quality: an empirical examination within the context of data warehousing", *Journal of Management Information Systems*, Vol. 21 No. 4, pp. 199-235.

Nunes, M.B., Annansingh, F., Eaglestone, B. and Wakefield, R. (2006), "Knowledge management issues in knowledge-intensive SMEs", *Journal of Documentation*, Vol. 62 No. 1, pp. 101-119.

Nurach, P., Thawesaengskulthai, D. and Chandrachai, A. (2012), "Factors that improve the quality of information technology and knowledge management systems for SME(s) in Thailand", *China-USA Business Review*, Vol. 11 No. 3, pp. 359-367.

Palacios-Marques, D., Soto-Acosta, P. and Merigo, J.M. (2015), "Analyzing the effects of technological, organizational and competition factors on Web knowledge exchange in SMEs", *Telematics and Informatics*, Vol. 32 No. 1, pp. 23-32.

Parnell, J.A., Lester, D.L., Long, Z. and Koseoglu, M.A. (2012), "How environmental uncertainty affects the link between business strategy and performance in SMEs: evidence from China, Turkey, and the USA", *Management Decision*, Vol. 50 No. 4, pp. 546-568.

Pillania, R.K. (2008a), "Information technology strategy for knowledge management in SMEs", *Knowledge and Process Management*, Vol. 15 No. 3, pp. 203-210.

Pillania, R.K. (2008b), "Strategic issues in knowledge management in small and medium enterprises", *Knowledge Management Research & Practice*, Vol. 6 No. 4, pp. 334-338.

Podsakoff, P.M. and Organ, D.W. (1986), "Self-reports in organizational research: problems and prospects", *Journal of Management*, Vol. 12 No. 4, pp. 531-544.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y. and Podsakoff, N.P. (2003), "Common method biases in behavioral research: a critical review of the literature and recommended remedies", *Journal of Applied Psychology*, Vol. 88 No. 5, pp. 879-903.

Premkumar, G. and Ramamurthy, K. (1995), "The role of interorganization and organizational factors on the decision mode for adoption of interorganizational systems", *Decision Science*, Vol. 26 No. 3, pp. 303-336.

Ramdani, B., Kawalek, P. and Lorenzo, O. (2009), "Predicting SME's adoption of enterprise systems", *Journal of Enterprise Information Management*, Vol. 22 No. 1, pp. 10-24.

Ravichandran, T. and Lertwongsatien, C. (2005), "Effect of information systems resources and capability on firm performance: a resource-based perspective", *Journal of Management Information Systems*, Vol. 21 No. 4, pp. 237-276.

Rogers, E. (1995), *Diffusion of Innovation*, Free Press, New York, NY.

Ryan, S.D., Abitia, G.R. and Windsor, J.C. (2000), "Factors affecting the adoption of knowledge management technologies: an international perspective", *proceedings of the 6th Americas Conference on Information Systems (AMCIS 2000), Long Beach, CA*, pp. 1201-1294.

Salojarvi, S., Furu, P. and Sveiby, K.E. (2005), "Knowledge management and growth in Finnish SMEs", *Journal of Knowledge Management*, Vol. 9 No. 2, pp. 103-122.

Sisaye, S. and Birnberg, J. (2010), "Extent and scope of diffusion and adoption of process innovations in management accounting systems", *International Journal of Accounting and Information Management*, Vol. 18 No. 2, pp. 118-139.

Soon, T.T. and Zainol, F.A. (2011), "Knowledge management enabler, process and organizational performance: evidence from Malaysian enterprises", *Asian Social Science*, Vol. 7 No. 8, pp. 186-202.

Swart, J. and Kinnie, N. (2003), "Knowledge-intensive firms: the influence of the client on HR systems", *Human Resource Management Journal*, Vol. 13 No. 3, pp. 37-55.

Syed-Ikhsan, S.O.S. and Rowland, F. (2004), "Knowledge management in a public organization: a study on the relationship between organizational elements and the performance of knowledge transfer", *Journal of Knowledge Management*, Vol. 8 No. 2, pp. 95-111.

Tan, C.N.L. (2011), "Knowledge management acceptance: success factors amongst small and medium-size enterprises", *American Journal of Economics Administration*, Vol. 3 No. 1, pp. 73-80.

Taylor, W.A. and Wright, G.H. (2004), "Organizational readiness for successful knowledge sharing: challenges for public sector managers", *Information Resources Management Journal*, Vol. 17 No. 2, pp. 22-37.

Thong, J.Y.L. (1999), "An integrated model of information systems adoption in small businesses", *Journal of Management Information Systems*, Vol. 15 No. 4, pp. 187-214.

Tornatzky, L.G. and Fleischer, M. (1990), *The Processes of Technological Innovation*, Lexington Books, Lexington, MA.

Wang, E., Klein, G. and Jiang, J.J. (2007), "IT support in manufacturing firms for a knowledge management dynamic capability link to performance", *International Journal of Production Research*, Vol. 11 No. 1, pp. 2419-2434.

Wang, Y.L., Wang, Y.D. and Horng, R.Y. (2010), "Learning and innovation in small and medium enterprises", *Industrial Management & Data Systems*, Vol. 110 No. 2, pp. 175-192.

Ministry of Economic Affairs (2011), *White Paper Book: Small and Medium Enterprises in Taiwan*, Taiwan Medium and Small Business Administration, Taipei, (in Chinese).

Wold, H. (1982), "Systems under indirect observation using PLS", in Fornell, C. (Ed.), *A Second Generation of Multivariate Analysis*, Praeger, New York, NY, pp. 325-347.

Wong, K.Y. (2005), "Critical success factors for implementing knowledge management in small and medium enterprises", *Industrial Management & Data Systems*, Vol. 105 No. 3, pp. 261-279.

Wong, K.Y. and Aspinwall, E. (2004), "Characterizing knowledge management in the small business environment", *Journal of Knowledge Management*, Vol. 8 No. 3, pp. 44-61.

Wong, K.Y. and Aspinwall, E. (2005), "An empirical study of the important factors for knowledge-management adoption in the SME sector", *Journal of Knowledge Management*, Vol. 9 No. 3, pp. 64-82.

Xu, J. and Quaddus, M. (2012), "Examining a model of knowledge management systems adoption and diffusion: a partial least square approach", *Knowledge-Based Systems*, Vol. 27 No. 1, pp. 18-28.

Zack, M.H. (1999), "Enveloping a knowledge strategy", *California Management Review*, Vol. 41 No. 3, pp. 125-145.

Further reading

Edvardsson, I.R. (2006), "Knowledge management in SMEs: the case of Icelandic firms", *Knowledge Management Research & Practice*, Vol. 4 No. 4, pp. 275-282.

Quinn, J.B., Anderson, P. and Finkelstein, S. (1996), "Managing professional intellect: making the most of the best", *Harvard Business Review*, Vol. 74 No. 2, pp. 71-80.

Appendix. Measurement items
Part I: Independent variables
IT support – Source: Lee and Choi (2003)
IS1: My organization has adopted IT applications for employees to collaborate with colleagues.

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IS2: My organization has adopted IT applications for employees to communicate with colleagues.

IS3: My organization has adopted IT applications for employees to search and access necessary knowledge.

IT effectiveness – Source: DeLone and McLean (2003), Nelson *et al.* (2005)

IQ1: The knowledge provided by IT applications is relevant to my job.

IQ2: The knowledge provided by IT applications is always up to date.

IQ3: The knowledge provided by IT applications is dependable.

Top management support – Source: Lee and Kim (1992), Taylor and Wright (2004)

TS1: Top management actively participates in the KM.

TS2: Top management has high perception of importance of KM.

TS3: Top management has allocated adequate financial and other resources to support KM.

TS4: Top management has a vision to project in my organization as a leader in the KM.

TS5: Top management is much concerned with the performance of KM.

Sharing culture – Source: Gold *et al.* (2001)

SC1: In my organization, high levels of participation are expected in sharing knowledge.

SC2: The atmosphere of my organization facilitates informal interaction among employees.

SC3: My organization encourages employee sharing new values and thoughts.

SC4: My organization encourages employee sharing knowledge to solve new problems.

SC5: In my organization, benefits of sharing knowledge outweigh the cost.

SC6: My organization encourages employee learning and tolerates their mistakes.

Reward system – Source: Davenport and Prusak (1998) and Hargadon (1998)

RS1: Employees will receive a higher bonus in return for their knowledge contribution.

RS2: Employees will receive a higher salary in return for their knowledge contribution.

RS3: Employees will receive increased promotion opportunities in return for their knowledge contribution.

RS4: Employees will receive a better work assignment for their knowledge contribution.

RS5: Employees will receive increased job security in return for their knowledge contribution.

Competitive pressure – Source: Premkumar and Ramamurthy (1995)

CP1: My organization experienced competitive pressure to implement KM.

CP2: My organization would have experienced a competitive disadvantage if KM had not been implemented.

Part II: Dependent variables

KM adoption – Source: Hazen *et al.* (2012)

KA1: My organization hires highly specialized or knowledgeable personnel for KM adoption.

KA2: My organization establishes formal regulations and governing ordinance for KM adoption.

KA3: My organization invests resources to adopt KM.

KA4: My organization considers adopting KM to increase business efficiency.

KA5: My organization considers adopting KM to integrate across multiple functional areas.

KM implementation – Source: Gold *et al.* (2001) and Lee and Lee (2007)

KI1: My organization stresses generating knowledge form existing knowledge.

KI2: My organization stresses distributing knowledge throughout the organization.

KI3: My organization stresses applying accessible knowledge in decision making.

KI4: My organization stresses integrating different sources and types of knowledge.

KI5: My organization stresses absorbing valuable knowledge from external sources.

KI6: My organization stresses building appropriate policies and procedures to protect knowledge assets.

Note: items for all constructs were measured using five-point Likert scales anchored between "strongly disagree" and "strongly agree."

About the author
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