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THE CONSTRUCTION OF AN IT INFRASTRUCTURE FOR KNOWLEDGE MANAGEMENT

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ABSTRACT

This study empirically investigated the relationships among the use of strategic performance measurement systems (SPMS), organisational learning, information systems (IS) strategic alignment, the information technology (IT) infrastructure for knowledge management (KM), competitive applications of knowledge resources, and organisational performance. The empirical data were collected from questionnaires and interviews with 117 sample firms. The collected data were statistically analysed with the statistical package for social science (SPSS). The results of this paper show that SPMS significantly and positively influences organisational learning and IS strategic alignment. The strategic communications and dialogues between the employees of an organisation, which are the mechanisms provided by SPMS, enhance the degrees of the IS strategic alignment. According to the results, it was observed that organisational learning and the IS strategic alignment have significant and positive effects on the construction of IT infrastructure for KM. Thus, the clear directions of IT development, which are formed with the integration between IS strategy and business strategy, seem to shape the goal orientations of the members in a firm and to enhance their collaborations in the construction of the IT infrastructure.

Keywords: Strategic Performance Measurement Systems (SPMS), Information Systems (IS) strategic alignment, Information Technology (IT) infrastructure for Knowledge Management (KM), organisational learning, competitive applications of knowledge resources

INTRODUCTION

Information technology (IT) infrastructure that usually supports the activation of knowledge management (KM) processes in a firm is known as KM systems (Kuo & Lee, 2009). IT infrastructure for KM is defined as the firm's basic IT platform and features, which comprise the diverse IT applications that are needed for implementing effective KM (Chua, 2004). The positive effects of IT infrastructure on the various activities of KM, such as knowledge acquisition, storage and transfer, have been empirically demonstrated (e.g., Hartono, Li, Na,

& Simpson, 2010; Mehta, Hall, & Byrd, 2014; Dong & Yang, 2015). However, the prior studies have mostly focused on the form of specific elements or parts of IT infrastructure, which is linked with the activation of particular KM activities (i.e., creation, transfer and sharing) (e.g., Chalmeta & Grangel, 2008; Yaghoubi, Yazdami, Ahoorani, & Banihashemi, 2011; Jaradat & Maani, 2014).

The main context for determining the kinds of knowledge required in a firm is the firm's business strategy. The firm's competitive strategy provides a blueprint for predicting the need of future knowledge resources and further determining the activities of KM to effectively support the firm's strategic objectives (Choe, 2014). IT infrastructure for KM can assist and facilitate the KM activities, through which the types of knowledge demanded in a firm can be created, stored and shared (Fink & Neumann, 2009). IT infrastructure for KM can support the creation and sharing or transfer of the kinds of knowledge required for the realisation of a firm's business strategy. However, to develop the suitable IT infrastructure for KM, which can satisfy the knowledge requirements of a firm's competitive strategy, the information systems (IS) strategy that comprises detailed planning or directions about the construction of the IT infrastructure must be aligned with the firm's business strategy (Bechor, Neumann, Zviran, & Glezer, 2010). Through IS strategic alignment, the firm's strategic missions or objectives that determine the knowledge demands of a firm can be reflected in the design and development of the IT infrastructure.

Previous research have indicated the influence factors, such as top management support, communications between general managers and IS managers, participation in strategic planning and understanding of business strategy, on the degrees of IS strategic alignment (Avison, Jones, Powell, & Wilson, 2004; Johnson & Lederer, 2010; Wagner, Beimborn, & Weitzel, 2014). However, to set up IS strategic planning, which concretely backs up the implementation of the business strategy, the organisational members have to understand and identify various strategic-related matters, such as business strategic missions or goals, tactics to realize competitive strategy and interrelationships among the diverse tactics of functional departments (Chen, Mocker, & Preston, 2010). For organisational members to recognise and learn about business strategic matters, strategic performance measurement systems (SPMS) are required in an organisation (Li & Tang, 2009; Artz, Homburg, & Rajab, 2012).

A distinctive feature of SPMS is that it is designed to present functional managers with financial and nonfinancial measures covering different perspectives (e.g., financial, customers, internal processes and innovation) which, in combination, provide a way of translating business strategy into a coherent set of performance measures (Chenhall, 2005). SPMS provides information that allows the firm to identify the functional tactics or strategies (e.g., IS strategy) offering the highest

potential for achieving the firm's strategic objectives and aligns management processes (e.g., IS strategic planning) with the achievement of the chosen business strategic goals (Artz et al., 2012). Through the functions of strategic dialogues or communications and learning among members, which are provided by SPMS, the alignment between IS strategy and business strategy can be successfully attained in an organisation.

In this study, the research purposes are suggested as follows; first, we empirically examine and show the impact of the IS strategic alignment on the active development of the IT infrastructure for KM in a firm. Through this investigation, we can find practical ways to construct a suitable IT infrastructure that satisfies the knowledge demands of a firm's business strategy. Second, both the direct effects of SPMS and the mediation effects of organisational learning on the degrees of IS strategic alignment are empirically investigated. The empirical results demonstrate the roles of SPMS and organisational learning in the IS strategic planning processes of a firm. Finally, we empirically show the positive impact of the IT infrastructure on the competitive application of knowledge resources, and find the effects of their applications on organisational performance. These findings indicate the previous assertion that IT infrastructure can improve the performance of a firm through effective KM.

THEORETICAL UNDERPINNINGS AND HYPOTHESES

SPMS and IS Strategic Alignment

SPMS supplements traditional financial measures with a diverse mix of non-financial measures that are believed to provide better information on business strategic progress and success (Chenhall, 2005). SPMS, which combines financial, strategic (e.g., customers and innovations) and business processes or operating measures, is a useful tool to gauge how well a firm meets its strategic targets. Because of this combination or integration characteristic of SPMS, SPMS can enhance the understanding of the cause-effect linkages between operations and business strategy and goals, and between various aspects of the value chain including suppliers and customers (Li & Tang, 2009; Hall, 2011). SPMS, which focuses on integrating business operations or functional processes with business strategy, is defined as a system that translates competitive strategy into deliverable results and shows ways to achieve business strategic objectives.

IS strategy includes major planning and tactics in the adoption, use and management of IS to achieve strategic objectives of a firm (Chen et al., 2010). The IS of an organisation consists of IT infrastructure, data, application systems, and personnel that employ IT to deliver information and communications

services in an organisation. IS strategy that is a kind of functional strategy has to be aligned with overall business strategy to contribute to the achievement of strategic goals of a firm (Chen et al., 2010; Tallon & Pinsonneault, 2011). When the IS strategy is linked with the established business strategy, the adopted IT (IS) can support the implementation of the business strategy and can become the source for acquiring competitive advantages.

SPMS reflects business strategic objectives and plays the role of linking functional or operational strategies with them. The strategic dialogues and communications throughout an organisation by means of applying SPMS help organisational members to identify and learn about the business strategic missions or goals and the methods to realise strategic objectives (Ferreira & Otley, 2009). Through these dialogues and interactions, employees of a firm can clearly recognise and understand the firm's business strategy and strategic targets, and thus, they can easily reflect them in their functional or operational strategic planning processes (i.e., IS strategic planning process). With SPMS, these are also possible to evaluate whether the directions or trends of the present functional strategies are well fitted with the overall business strategy and to adjust and revise the details of the current functional strategies when they are not matched with the firm's competitive strategy (Henri, 2006). Accordingly, it is likely that SPMS enhances the alignment between IS strategy and business strategy. Based on the above arguments, we can propose that:

H1: SPMS has a positive impact on the alignment between IS strategy and business strategy.

SPMS, Organisational Learning and IS Strategic Alignment

Virany, Tushman and Romanelli (1992) defined organisational learning as a form of informational updating through which managers develop an understanding of the relationships between organisation actions and outcomes. Many researchers have indicated that the provision of information is the beginning and a necessary condition of organisational learning. Information is a flow of messages or meanings, which might add to, restructure or change knowledge (Machlup, 1983). Nonaka (1994) also argued that information is a necessary medium or material in organisational learning. Individuals obtain and interpret information and learn by updating their mental models. Mental models are the interpretive schemes or cognitive models of the world on which managers rely in order to understand various environments (Bartunek, 1984). Through mutual interactions and communications, individuals share information and beliefs, resulting in organisational learning, which forms the organisation's shared mental models.

SPMS, which comprises diverse measures across financials, customers, processes and long-term innovation, provides an important formal mechanism to collect or produce information that can be used to develop organisational learning (Chenhall, 2005; Hall, 2011). The information provided by SPMS is prerequisite for organisational members' learning about the strategic targets of a firm, the action plans for realising them and the ways to revise action plans according to the actual outcomes (Henri, 2006). Ahn (2001) asserted that SPMS is a kind of comprehensive information providing mechanism which supports for organisational members to understand overall business strategy and to establish operational strategies fitted with competitive strategy through organisational learning.

The organisational learning functions of SPMS make organisational members clearly recognise the business vision and goals, and thus, when they set up low-level operational strategies, these low-level strategies can be linked with the high-level corporate strategy. With a case study, Hass and Kleingeld (1999) showed that strategic performance measurements cause strategic dialogues and interactions among the employees of a firm and, as a result, the members' understandings of the corporate strategy through organisational learning are enhanced. Chenhall (2005) also empirically indicated that SPMS has an indirect effect on the manufacturing firm's strategic performance through organisational learning. Based on the above arguments and the prior studies, we can propose the followings.

H2: SPMS has a positive impact on the organisational learning of a firm.

H3: Organisational learning has a positive impact on the alignment between IS strategy and business strategy.

In H1, a direct impact of SPMS on the levels of IS strategic alignment is suggested. H2 and H3 show the positive effects of SPMS on organisational learning and the positive impact of organisational learning on the degrees of IS strategic alignment. According to the reasoning used to develop H1, H2 and H3, it is likely that organisational learning has a mediation impact on the levels of IS strategic alignment. Therefore, we can suggest that:

H4: Organisational learning has a mediation impact on the alignment between IS strategy and business strategy.

IS Strategic Alignment, Organisational Learning, and IT Infrastructure for KM

IT infrastructure for KM is generally classified into three broad types: knowledge storage, search and transfer or cooperation infrastructure (Ko, Kirsch, & King, 2005; Dulipovici & Robey, 2013). IT infrastructure for knowledge storage utilises a common database or electronic knowledge repository that stores codified and text-based knowledge as well as video, audio and graphics. The search infrastructure helps knowledge seekers to locate and retrieve requisite knowledge. It includes IT tools such as powerful search engines and intelligent filters. The transfer and collaboration IT are employed to communicate information or knowledge between individuals, and to promote cooperation among employees of a firm and other related firms. To electronically exchange or share various kinds of knowledge between individuals, e-mail and other Internet-based technologies, such as electronic discussion groups, chat facilities and electronic data interchange, are adopted and utilised.

The business strategy specifies the positioning of the organisation with respect to its customers and competitors. To support and realise the strategic position of a firm, some sets of intellectual resources and capabilities are inevitably required (Wu & Lin, 2009; Choe, 2014). The strategic choices that companies make have a profound impact on the types and volume of knowledge demanded to survive and excel in an industry (Abou-zeid & Cheng, 2004). When a firm adopts a differentiation strategy, both the KM activities and the kinds of knowledge for product innovations are emphasised (Donate & Guadamillas, 2011). However, if a low-cost strategy is followed, a company focuses on the management of the types of knowledge about process innovations or cost reduction.

Accordingly, IT infrastructure for KM that can facilitate active KM processes for acquiring a certain type of knowledge demanded in a firm must be constructed with reflecting the strategic business objectives. To develop the IT infrastructure for KM, which supports the realisation of a business strategy, IS strategy that includes detailed planning and directions for the construction of an IT infrastructure has to be aligned with the corporate competitive strategy (Cui, Ye, Teo, & Li, 2015). If the IS strategy is not aligned with the business strategy, the orientations or directions of the development of the IT infrastructure seem to be unclear, and as a result, dissonance or conflict in the forms of the IT infrastructure, which certainly deters or hinders the construction processes of an IT infrastructure, may occur among the members of an organisation (Newkirk & Lederer, 2006).

The construction of an IT infrastructure that can promote the activation of KM processes into the direction demanded by the business strategy basically requires

for organisational members to fully understand the firm's strategic missions or positions (Levy & Powell, 2000; Kearns & Sabherwal, 2007). In the development processes of the IT infrastructure, the cooperation and harmony between the managers of diverse departments are also needed and required (Johnson & Lederer, 2010). The members' understandings on strategic objectives as well as collaborations for the construction of the IT infrastructure can be obtained through organisational learning which is caused by the SPMS. With organisational learning, business strategic missions can be carved into the organisational members' memory, and consequently, all employees of a firm can maintain a consistent business strategic orientation, which can also contribute to the enhancement of cooperation among the members of an organisation. Therefore, it is likely that organisational learning itself positively influences the adoption of an IT infrastructure. Based on the above reasoning, the followings can be proposed.

H5: The alignment between IS strategy and business strategy has a positive impact on the adoption degrees of IT infrastructure for KM.

H6: Organisational learning has a positive impact on the adoption degrees of IT infrastructure for KM.

IT Infrastructure for KM, and Competitive Applications of Knowledge Resources

IT infrastructure for KM has to be constructed and adopted in such a way that a firm can respond to the various demands of corporate strategies in KM activities. IT infrastructure for KM that is well matched with the requirements of business strategies eventually activates the creation, transfer and application of knowledge that is prerequisite for the achievement of competitive advantages. The various types of knowledge acquired, transferred and shared are utilised in a company diverse tasks and, especially, innovations, and such utilisation brings about the competitive applications of knowledge resources, which can lead to the realisation of corporate strategy or strategic targets (Greiner, Bohmann, & Krcmar, 2007). The competitive applications of knowledge resources are also realised into such diverse forms as the enhancement of organisational creativity and innovation capability (DeGroote & Marx, 2013; Cui et al., 2015), and the acquisition of dynamic capabilities (Prieto & Easterby-Smith, 2006).

Under the firm's enhanced innovation or dynamic capabilities, a firm can respond and adapt in a timely manner to a fast-changing environment. A firm's speedy response and adaptation to environmental uncertainties are linked to its increased competitiveness, which gives rise to improved organisational performance and

increased business value. Thus, the competitive applications of knowledge resources, which bring about heightened innovation or dynamic capabilities, contribute to the improvement of organisational performance. Lee and Choi (2003) empirically showed that organisational creativity, which is the result realised through the competitive applications of knowledge resources, has a positive effect on organisational performance. Based on the above arguments, we can suggest the followings.

H7: The adoption degrees of IT infrastructure for KM have a positive impact on the competitive applications of knowledge resources.

H8: The competitive applications of knowledge resources have a positive impact on the organisational performance of a firm.

The research model employed in the current study, which describes the relationships among SPMS, organisational learning, IS strategic alignment, IT infrastructure, competitive applications of knowledge resources and organisational performance, is presented in Figure 1.

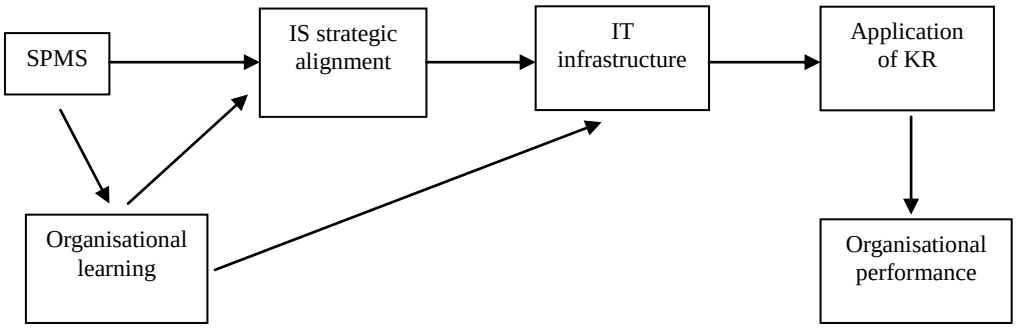

Figure 1. Research model

RESEARCH METHOD

Data Collection

Data for this study were drawn from a survey of the current status of SPMS and IT infrastructure used in Korean manufacturing firms. In total, 340 organisations were randomly selected from a population of about 1,000 firms that are listed on the Korean stock market. The manufacturing firms listed are medium to large in size and consequently, are likely to have more experience with SPMS and IT

applications than are smaller firms. First, the chief production managers or executives of the selected firms were contacted to ask for their participation in the research. At the beginning, 127 organisations responded to the request for information. However, during the survey, 10 firms withdrew from the survey, and as a result, 117 firms were finally included in the study.

In order to collect data, this research both administered questionnaires and conducted interviews with the participating firms. Only chief production managers or plant executives were selected as respondents. Before mailing the questionnaire, through an initial telephone interview with the respondent, the researcher of this study roughly asked him the firm's present conditions, such as SPMS usage and adoption degree of IT infrastructure. The results of the first interview generally concurred with the results of the questionnaire response. A questionnaire with a cover letter was mailed to each respondent. After distributing the questionnaire, through a second telephone interview, the contents of the questionnaire and the answering method were explained. The survey was conducted during a three-month period between October 2013 and January 2014. Table 1 summarises the sample characteristics according to the industrial type of the firms.

Table 1
Sample characteristics

Type of industry	Chemical	Machine	Auto mobile	Electronic	Textile	Food	Paper & pulp	Non-metal	Metal	Rubber	Total
No. of firms	19	16	19	17	5	5	4	14	16	2	117
No of employees	Below 100		100 – 300		300 – 500		500 – 1000	Above 1000	Total		
No. of firms	11		31		29		16	30	117		

Measurements

The adoption levels of SPMS were measured by considering the inclusion of strategic orientations in performance measures, the links between business strategy and management activities, the reflection of strategic objectives in business processes, and the relationships with customers and suppliers in performance evaluations (Chenhall, 2005). Twelve question items, developed by Chenhall (2005), were utilised to measure the adoption degree of SPMS. It was measured on a seven-point Likert-type scale that ranged from "strongly disagree"' to "strongly agree". The 12 items include the documented form, links between operating performance and business strategies, linking business activities with strategic goals, effects of one business unit on other units, providing of warning signals and past indicators, linking to suppliers and customers, and providing financial, customers, business processes and innovation measures.

The direct results or final phase of organisational learning are changes in shared mental models (Virany et al., 1992). Therefore, the degree of organisational learning can be measured by the degrees of change in shared mental models. Based on the measures of Vandenbosch and Higgins (1995), five questionnaire items to measure the changes in the mental models of business strategic objectives were used. They are: employees' understanding about the strategic goals and the ways to achieve them, maintaining current levels of understanding, staying close to, identifying new strategic targets and new methods, and dramatic changing and improving. The first three items focus on the mental model's convergent nature. The last two items centre on the divergent nature of the mental model. Changes in shared mental models were measured on a seven-point Likert-type scale ranging from "strongly disagree" to "strongly agree".

IS strategic alignment implies the degrees of the integration between business strategic planning and strategic IS development and application planning (Segars & Grover, 1998). Using eight questionnaire items developed by Segars and Grover (1998), IS strategic alignment was measured on a seven-point Likert-type scale, anchored by "strongly disagree" and "strongly agree". The eight items are: strategic priorities of top management, linking IS strategies with business strategic plan, adapting the objectives of IS to changing business goals, mutual understanding with top management, identifying IT-related opportunities, educating top management, assessing strategic importance, and adapting IT to strategic change.

The types of IT infrastructure are grouped into three kinds: transfer or cooperation, storage and search infrastructure. Based on previous studies (Chua, 2004), 14 question items were constructed to measure the adoption and usage levels of IT infrastructure. For the transfer or cooperation IT, 6 items were used. They include usage of IT in collaboration with other people inside and outside the organisation, use of IT for communication with other people inside and outside the firm, and IT usage for employees to learn from a single source as well as multiple sources. The three items, which measure the storage infrastructure, are clear rules for knowledge classification, use of database or data warehouse and systematic storage (Chua, 2004). The five items used for measuring search IT represent usage of IT to seek out new knowledge, to find the location of an individual and the specific area of a database for obtaining knowledge, and to retrieve knowledge about a firm's products and markets or competition. The usage levels of the IT infrastructure were measured on a seven-point Likert-type scale, anchored by "strongly disagree" and "strongly agree".

The levels of the competitive applications of knowledge resources refer to the degrees of the utilisation of knowledge assets in obtaining competitive benefits or positions (Kearns & Lederer, 2000; Liao, Wu, Hu, & Tsui, 2010). This study

used the five question items of Kearns and Lederer (2000) to measure the degree of the competitive applications of knowledge resources. It was measured on a seven-point Likert-type scale ranging from "strongly disagree" to "strongly agree". The items are: lower costs or product differentiation, buyer's decision, unique firm capabilities, business strategies, and creating new strategies.

Organisational performance was measured by asking whether the firm's average performance indicators for three years are higher than those of the industry that firm belongs to (Duh, Chow, & Chen, 2006). The eight question items, developed by Duh et al. (2006), were utilised. It was measured on a seven-point Likert-type scale, anchored by "very low" and "very high". The eight items include profitability, growth rate, morale, financial strength, public image, innovativeness, improvement, and overall performance. In this study, we also collected the financial performance measures of sample firms, such as return on assets (ROA; operating income/ total assets), return on sales (ROS; net profit/total sales), and sales amount per employee (SAE), to prove the external validity of the subjective performance measurement. Accounting data to compute the ROA, ROS and SAE were collected from the firm's balance sheets and income statements in 2013, which were provided in the Korean annual report of listed companies.

In this study, the organisation size and age were considered as control variables since size and age may have significant effects on IS strategic alignment and competitive applications of knowledge resources. Size is the number of employees of a firm in the year 2013, and the organisational age is measured by counting the years elapsed since the founding of a firm. The industry type is a surrogate measure of knowledge-intensity or advancement (Park, Kim, & Lee, 1999). In Korean industries, food, textile and paper are relatively low knowledge-intensive industries, and on the other hand, chemical, electronic and automobile belong to high knowledge-intensity companies (Park et al., 1999). The other industries (i.e., non-metal, metal and machine) are classified into the middle group in knowledge advancement. To control the effects of the levels of knowledge-intensity on the other research variables, the low, middle and high levels were considered as a dummy variable in this study.

DATA ANALYSIS AND RESULTS

Reliability and Validity Test

Item analyses were performed with Cronbach Alpha coefficients for all multi-item scale measurements. All Alpha coefficients were above 0.9, which is satisfactory for the reliability of a multi-item scale. Principal component analysis with a varimax rotation was used to verify the construct validities of the

questionnaire items. Two separate joint factor analyses for the IS strategic alignment, SPMS and organisational learning, and the IT infrastructure, competitive applications of knowledge resources and organisational performance were carried out to acquire a more stable solution by increasing the ratio of the sample size to the number of items.

Using a 0.4 criterion for significant item loading on a factor, the results show that all items within each index except for IT infrastructure are represented by a single factor. In the case of IT infrastructure, two factors with Eigen values greater than one were extracted. However, item 4 (collaboration with other people) in the IT infrastructure and item 7 (improvement) in the performance were replicated with the items of other factors. Items 4 and 7 were removed, and the factor analysis was performed again. In the second factor analysis, the items of each factor did not confound with the items in another factor. Factor 1 includes both the items of the storage infrastructure and the question items for the search IT. Hence, Factor 1 is titled as 'the storage and search infrastructure'. Factor 4 is composed of the questionnaire items regarding the transfer IT. The results of this final factor analysis are presented in Table 2. Both the alpha coefficients and the values of the mean and standard deviation for the research variables were calculated and are summarised in Table 3.

Table 2
Factor loadings of research variables (Varimax rotation)

Variable	Factor				Variable	Factor		
IT infrastructure	1	2	3	4	SPMS	1	2	3
1	0.64				1	0.75		
2	0.69				2	0.80		
3	0.66				3	0.79		
4				0.77	4	0.74		
5				0.70	5	0.67		
6				0.82	6	0.75		
7	0.67				7	0.74		
8	0.63				8	0.62		
9	0.83				9	0.69		
10	0.77				10	0.69		

(continued on next page)

Table 2 (*continued*)

Variable	Factor				Variable	Factor		
IT infrastructure	1	2	3	4	SPMS	1	2	3
11	0.80				11	0.67		
12	0.79				12	0.70		
13	0.78				Learning			
KR					1			0.75
1			0.71		2			0.77
2			0.81		3			0.76
3			0.89		4			0.75
4			0.83		5			0.71
5			0.73		IS alignment			
Performance					1		0.76	
1		0.84			2		0.73	
2		0.83			3		0.83	
3		0.61			4		0.72	
4		0.73			5		0.76	
5		0.66			6		0.80	
6		0.59			7		0.83	
7		0.87			8		0.76	
Eigen value	6.58	4.63	4.01	2.94		7.65	6.61	4.62
% of variance	26.3	18.5	16.0	11.7		30.6	26.4	18.5

Note: * Factor loadings below 0.4 were not presented. KR: knowledge resources

Table 3
Summary statistics of research variables

Variables	Mean	Standard	Minimum	Maximum	Alpha
SPMS	4.8	1.03	2.1	7.0	0.96
Organisational learning	4.6	1.12	2.0	7.0	0.96
IS strategic alignment	4.9	1.06	2.0	7.0	0.95
Storage & search IT	4.8	1.04	2.2	6.8	0.94
Transfer IT	4.7	1.08	1.3	7.0	0.91
Competitive applications of knowledge resources	5.2	0.95	2.8	7.0	0.90
Organisational performance	5.1	0.96	2.0	7.0	0.91
ROA	0.05	0.104	–0.89	0.20	–
ROS	0.06	0.167	–0.92	0.86	–
SAE *	1.288	2.599	0.001	24.90	–

Note: * Million $

The Effects on the IS Strategic Alignment

To demonstrate the positive effects of SPMS and organisational learning on the IS strategic alignment, regression models were employed. In regression models 1 and 2, only the impact of SPMS was analysed. Table 4 shows the results of the analyses. In Table 4, the effects of SPMS on the IS strategic alignment and organisational learning are significant and positive. From these results, it is confirmed that SPMS contributes to the enhancement of the IS strategic alignment as well as the activation of organisational learning. Thus, Hypotheses 1 and 2, which suggest the impact of SPMS, are fully accepted. In regression model 3, the effects of organisational learning on IS strategic alignment were analysed. In Table 5, the results are presented. It is found that organisational learning significantly and positively influences. Therefore, it is concluded that through organisational learning, the alignment between IS strategy and business strategy is facilitated and activated. This result also supports Hypothesis 3, which indicates the positive impact of organisational learning on IS strategic alignment. Hence, it is suggested that both SPMS and organisational learning by SPMS are excellent mechanisms to increase the levels of IS strategic alignment.

Table 4
Multiple regression analyses (N=117)

Independent variables	SPMS	Size	Age	Level 1	Level 2	Level 3	R^2 (F)
Dependent variable	β coefficient (t-value)	β coefficient (t-value)	β coefficient (t-value)	β coefficient (t-value)	β coefficient (t-value)	β coefficient (t-value)	–
Organisational learning	0.77 (13.0 [a])	0.02 (0.42)	–0.01 (–0.26)	–	–	–	0.60 (57.8 [a])
IS strategic alignment	0.69 (10.3 [a])	0.08 (1.25)	0.02 (0.39)	0.05 (0.67)	0.00 (0.00)	–0.08 (–1.12)	0.51 (22.8 [a])

Notes: a: $p < 0.01$. The scores of VIF were below 1.3. Size and age: the organisation size and age. Level: levels of knowledge-intensity.

Table 5
Multiple regression analyses (N=117)

Independent variables	Organisational learning	Size	Age	Level 1	Level 2	Level 3	R^2 (F)
Dependent variable	β coefficient (t-value)	β coefficient (t-value)	β coefficient (t-value)	β coefficient (t-value)	β coefficient (t-value)	β coefficient (t-value)	–
IS strategic alignment	0.75 (11.9 [a])	0.07 (1.12)	0.03 (0.51)	–0.06 (–0.88)	0.00 (0.00)	0.12 (1.80 [c])	0.58 (30.3 [a])

Notes: a: $p < 0.01$, c: $p < 0.1$. The scores of VIF were below 2.7. Size and age: the organisation size and age. Level: levels of knowledge-intensity.

The Mediation Impact of Organisational Learning

To verify the mediating effects of organisational learning, mediated regression analysis was employed. In applying mediated regression analysis, two separate regression models were developed as follows:

$$Y = b_0 + b_1 \cdot x + b_2 \cdot \text{size} + b_3 \cdot \text{age} + b_4 \cdot \text{level1} + b_5 \cdot \text{level2} + b_6 \cdot \text{level3} \quad (1)$$

$$Y = b_0 + b_1 \cdot x + b_2 \cdot z + b_3 \cdot \text{size} + b_4 \cdot \text{age} + b_5 \cdot \text{level1} + b_6 \cdot \text{level2} + b_7 \cdot \text{level3} \quad (2)$$

Where, Y is the IS strategic alignment, b is the regression coefficients, x is SPMS (predictor variable), z is organisational learning (mediator variable), size and age is the organisation size and age, and level is levels of knowledge-intensity. As the decision criteria for the mediating impact of organisational learning, four basic rules were applied in the analysis as follows:

1. b_1, the beta coefficient for the original independent variable is statistically significant in regression (1)
2. b_2, the coefficient of the mediator variable is statistically significant in regression (2)
3. The adjusted R^2 of regression (2) is greater than that in regression (1)
4. The significance of b_1 in regression (2) is weaker than that in regression (1)

(Baron & Kenney, 1986)

The results of the mediated regression analysis are presented in Table 6. In Table 6, it is observed that the beta coefficient of SPMS in regression (2) is smaller than that of regression (1), the beta of organisational learning is significant, and the adjusted R^2 of regression (2) is greater than that in regression (1). Thus, it seems evident that organisational learning has mediation effects on the IS strategic alignment. From these results, Hypothesis 4 is supported. These results demonstrate the fact that SPMS gives rise to organisational learning, and through organisational learning, the members of an organisation can attain successful alignment between IS strategy and corporate strategy.

Table 6
Results of mediated regression analysis

Regression model 1		$Y = b_0 + b_{1*}x + b_{2*}$size+ b_{3*}age	Regression model 2			$Y = b_0 + b_{1*}x + b_{2*}z + b_{3*}$ size+ b_{4*}age
Dependent variable (Y)	b_1	Adjusted R^2	Mediator variable (Z)	b_1	b_2	Adjusted R^2
IS strategic alignment	0.69 [a]	0.49	Organisational learning	0.31 [a]	0.50 [a]	0.58

Note: a: $p < 0.01$

The Effect on IT Infrastructure for KM

The effects of IS strategic alignment and organisational learning on IT infrastructure for KM were examined with multiple regression analysis. The results of the regression analyses are presented in Table 7. In the case of storage and search IT, the effects of IS strategic alignment and organisational learning are significant and positive. In Table 7, it is seen that only IS strategic alignment has a significant and positive impact on the transfer infrastructure. These results support Hypotheses 5 and 6 that propose the positive impact of the IS strategic alignment and organisational learning. Thus, it seems that since the orientations or directions of the construction of the IT infrastructure can be clearly recognised and established through IS strategic alignment and organisational learning, the development of the IT infrastructure for KM can be activated.

Table 7
Multiple regression analyses (N=117)

Independent variables	Organisational	IS strategic alignment	Size	Age	Level 1	Level 2	Level 3	R^2 (F)
Dependent variable	β coefficient (t-value)	β coefficient (t-value)	β coefficient (t-value)	β coefficient (t-value)	β coefficient (t-value)	β coefficient (t-value)	β coefficient (t-value)	–
Storage & search IT	0.31 (3.65 [a])	0.54 (6.32 [a])	−0.01 (−0.23)	0.00 (0.12)	−0.01 (−0.19)	−0.01 (−0.17)	0.00 (0.00)	0.65 (34.8 [a])
Transfer IT	0.20 (1.63)	0.39 (3.16 [a])	−0.06 (−0.84)	−0.07 (−0.86)	0.00 (0.06)	0.08 (0.97)	0.00 (0.00)	0.31 (8.25 [a])

Notes: a: $p < 0.01$. The scores of VIF were below 2.5. Size and age: the organisation size and age. Level: levels of knowledge-intensity.

Competitive Applications of Knowledge Resources, and Organisational Performance

We adopted multiple regression analysis to investigate both the effects of the IT infrastructure for KM on the competitive applications of knowledge resources and the impact of competitive applications of knowledge resources on the

performance of a firm. In Tables 8 and 9, the results are presented. In Table 8, it is observed that the storage and search infrastructure significantly and positively influence the competitive applications of knowledge resources. This result confirms prior arguments that IT infrastructure facilitates the effective and efficient usage of the knowledge assets of a firm. Table 9 shows that the competitive applications of knowledge resources have a significant impact on the organisational performance of a firm. It is found that the effects on organisational performance, ROS and ROA are significant and positive. These results also support the previous assertions that the benefits realized with the competitive usage of knowledge assets, such as knowledge creativity, innovation capability and dynamic capability, contribute to the improvement of organisational performance. Thus, Hypotheses 7 and 8 are accepted.

Table 8

Multiple regression analyses (N=117)

Independent variables	Storage & search IT	Transfer IT	Size	Age	Level 1	Level 2	Level 3	R^2 (F)
Dependent variable	*β* coefficient (t-value)	*β* coefficient (t-value)	*β* coefficient (t-value)	*β* coefficient (t-value)	*β* coefficient (t-value)	*B* coefficient (t-value)	*B* coefficient (t-value)	–
Competitive applications of KR	0.48 (4.20[a])	0.05 (0.51)	0.07 (0.98)	0.07 (0.95)	−0.04 (−0.50)	0.14 (1.71[c])	0.00 (0.00)	0.32 (8.51[a])

Notes: *a*: $p < 0.01$, *c*: $p < 0.1$. The scores of VIF were below 2.2. KR: knowledge resources. Size and age: the organisation size and age. Level: levels of knowledge-intensity.

Table 9

Multiple regression analyses (N=117)

Independent variables	Competitive applications of KR	Size	Age	Level 1	Level 2	Level 3	R^2 (F)
Dependent variable	*β* coefficient (t-value)	*β* coefficient (t-value)	*β* coefficient (t-value)	*β* coefficient (t-value)	*β* coefficient (t-value)	*β* coefficient (t-value)	–
Organisational performance	0.49 (5.95[a])	0.02 (0.32)	0.02 (0.34)	0.19 (2.26[b])	0.18 (2.18[b])	0.00 (0.00)	0.28 (8.57[a])
ROS	0.23 (2.48[b])	0.06 (0.64)	–0.18 (–1.95[c])	–0.13 (–1.42)	0.06 (0.63)	0.00 (0.00)	0.12 (2.53[b])
ROA	0.17 (1.69[c])	–0.01 (–0.18)	0.02 (0.23)	–0.09 – (0.94)	–0.31 (–3.17[a])	0.00 (0.00)	0.13 (2.64[b])
SAE	0.10 (1.06)	–0.06 (–0.63)	–0.23 (–2.46[b])	–0.03 (–0.35)	–0.01 (–0.09)	0.00 (0.00)	0.07 (1.45)

Notes: a: $p < 0.01$, *b*: $p < 0.05$, *c*: $p < 0.1$. The scores of VIF were below 1.2. KR: knowledge resources. Size and age: the organisation size and age. Level: levels of knowledge-intensity.

The results of hypotheses testing are summarised in Table 10. H1, H2, H3, H4, H5 and H8 are fully accepted. However, H6 and H7 are partially accepted.

Table 10
Results of hypotheses testing

Hypotheses	Results of testing
H1: Impact of SPMS on IS strategic alignment	Fully accepted
H2: Impact of SPMS on organisational learning	Fully accepted
H3: Impact of organisational learning on IS strategic alignment	Fully accepted
H4: Mediation impact of organisational learning	Fully accepted
H5: Impact of IS strategic alignment on IT infrastructure for KM	Fully accepted
H6: Impact of organisational learning on IT infrastructure for KM	Partially accepted
H7: Impact of IT infrastructure for KM on competitive applications of KR	Partially accepted
H8: Impact of competitive applications of KR on organisational performance	Fully accepted

DISCUSSION AND CONCLUSION

SPMS promotes organisational learning through the functions of communications, dialogues, discussions and evaluations of the business strategic topics among the members of an organisation. The positive effects of SPMS on the alignment of management processes with business strategy or business strategic objectives were empirically demonstrated in prior research (e.g., Li & Tang, 2009; Hall, 2011; Wagner et al., 2014). However, their research mostly focused on the strategic alignment itself, and did not clearly uncover and confirm the learning facilitating roles of SPMS. This study empirically found a positive impact of SPMS on IS strategic alignment as well as on organisational learning. This research also empirically showed the mediation effect of organisational learning on IS strategic alignment. Previous IS research have suggested various influence factors on the degrees of IS strategic alignment, such as interactions and communications between IS managers and general managers, IS managers' understanding of business strategic goals, and general managers' identification of IS strategy (e.g., Avison et al., 2004; Johnson & Lederer, 2010; Wagner et al., 2014). On the whole, these influence factors reflect and comprise the mutual or shared understandings about the corporate and functional strategies and strategic objectives among IS managers and general managers. Thus, from the results of this study, it is concluded that SPMS may comprehensively contain the functions of the influence factors on IS strategic alignment.

According to the assertions of Wu and Lin (2009) and Choe (2014), broad guidelines to develop IT infrastructure for KM have been conceptually suggested. The guidelines simply include the notion that the architecture of IT infrastructure

for KM has to be constructed in ways that satisfy the knowledge demands of the business strategy or business strategic objectives in a firm. To develop IT infrastructure for KM, which is well matched with the knowledge requirements of corporate strategy, IS strategic planning that comprise detailed directions and blueprints for the construction of IT infrastructure must be integrated with the business strategic planning of the firm. In this study, the degrees of IS strategic alignment were considered as a primary influence factor on the development of IT infrastructure for KM. This study empirically demonstrated the positive effects of both the IS strategic alignment and organisational learning on the adoption degrees of IT infrastructure for KM. These results indicate that the consistent directions for the construction of IT infrastructure, which are provided by IS strategic alignment, and the atmosphere of collaborations among various departments, which is built through organisational learning, are likely to facilitate the adoption of IT infrastructure for KM.

Prior research empirically investigated and suggested a direct positive impact of IT on knowledge usage or application (e.g., Lopez-Nicolas & Soto-Acosta, 2010; DeGroote & Marx, 2013; Cui et al., 2015). According to our results, it was found that the effects of IT infrastructure for KM on the competitive applications of knowledge resources are significant and positive. Since the competitive applications of knowledge refer to the utilisation of knowledge, which can support the achievement of business strategic targets, IT infrastructure that is developed and constructed through the high degrees of IS strategic alignment seems to have a positive impact on the competitive applications of knowledge. This study also found that the competitive applications of knowledge positively influence the performance of a firm. This result supports the prior assertion about the contributions of knowledge applications to organisational performance.

In this study, IS strategic alignment was considered as a primary influence factor on the adoption of IT infrastructure for KM. However, other technical factors, such as technical capabilities of IS personnel, are also important for the development of IT infrastructure. Future studies can examine the interrelationships between technical factors and IS strategic alignment and their combined effects on IT construction. Because of insufficient sample size, this study did not investigate causal relationships among research variables. If a large number of sample firms can be obtained, structural equation modeling techniques can be employed to analyse causalities among research variables. In this study, subjective measures were mostly utilised to collect research data, which have a negative impact on the validity of research results. This is a limitation or weakness of this research. In future studies, objective measures have to be developed and applied to enhance the internal and external validities of research results.

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