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The Relationships among Strategic Performance Measurement Systems, IS Strategic Alignment, and IT Infrastructure for Knowledge Management

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ABSTRACT

Investigating how to develop information technology (IT) infrastructure that can effectively facilitate knowledge management (KM) activities has been an important research area. To contribute to the theoretical and practical developments in this research area, this study empirically examined the causal relationships among the use of strategic performance measurement systems (SPMS), organizational learning, information systems (IS) strategic alignment, IT infrastructure for KM, competitive applications of knowledge resources, and organizational performance. Through structured questionnaires, empirical data were collected from 117 Korean manufacturing firms that are listed on the Korean stock market. To analyze the empirical data, regression analyses were employed. The results of this study showed that SPMS significantly and positively influences organizational learning and IS strategic alignment. The strategic communications and dialogues between members of an organization, which are provided by SPMS, may enhance the degrees of IS strategic alignment. According to the results, it was found that both organizational learning and IS strategic alignment have significant and positive effects on the adoption of IT infrastructure for KM. Thus, the clear directions of IT development, which are formed through IS strategic alignment, seem to shape the goal orientations of members in a firm, and the organizational learning that is built with SPMS seems to enhance members' collaborations in the construction of IT infrastructure. This study also showed that when the degrees of IS strategic alignment are high, the effects of IT infrastructure on the competitive applications of knowledge resources are partially greater than under the low levels of IS strategic alignment. Finally, it was observed that the competitive usage of knowledge asset has a positive impact on the performance of an organization.

Keywords: Strategic performance measurement systems; Organizational learning; IS strategic alignment; IT infrastructure for knowledge management; Competitive applications of knowledge resources

I. Introduction

Investigating and empirically demonstrating how to construct information technology (IT) infrastructure, which can contribute to the facilitation of knowledge management (KM) activities, has been an important

research topic. Usually, IT infrastructure that supports the activation of KM processes is known as a KM system (Kuo and 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 (Gold et al., 2001; Chua, 2004). Many prior studies have empirically investigated and suggested the appropriate design types of IT infrastructure, which have a positive impact on the various activities of KM, such as knowledge acquisition, storage and transfer (e.g., Artail, 2006; Lopez-Nicolas and

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Soto-Acosta, 2010; Hartono et al., 2010). However, their research have not empirically confirmed and proposed broad guidelines that can be wholly adopted in the design and construction of IT infrastructure for KM. 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).

Broad or general guidelines for the development of IT infrastructure for KM can be taken from the works of Zack (1999) and Hansen et al. (1999). According to their assertions, it was indicated that 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 (Wu and Lin, 2009). To obtain competitive advantages, which are vital for a firm's survival and growth, the necessary knowledge resources and the required KM activities for the realization of organizational competitive strategies must be created, acquired and activated (Greiner et al., 2007; Choe, 2014). Thus, based on these arguments, the broad approach to construction of IT infrastructure for KM has to address the notion that basically, the architecture and components of IT infrastructure for KM must focus on the facilitation and activation of the KM activities through which the kinds of knowledge demanded for the implementation and achievement of the firm's competitive strategies can be created, stored and shared (Belanger and Allport, 2008; Fink and Neumann, 2009).

How, then, can a firm develop suitable IT infrastructure for KM to satisfy the knowledge requirements of its business strategy? To reflect and contain organizational strategic objectives in the design and construction of IT infrastructure, an information systems (IS) strategy that includes detailed planning or directions about the construction of the IT infrastructure must be aligned with the firm's competitive strategy (Byrd et al., 2006; Bechor et al., 2010). Through IS strategic alignment, the firm's strategic missions or goals, which determine its knowledge demands, can be reflected in the design and development of the IT infrastructure. Therefore, the degrees of IS strategic alignment in a firm may have significant effects on the adoption of IT infrastructure for KM. However, in prior studies, the impact of IS strategic alignment on

the active construction of IT infrastructure for KM has not been clearly demonstrated.

Previous research has indicated factors that influence the degrees of IS strategic alignment, such as top management support, communications between general managers and IS managers, participation in strategic planning, and understanding of business strategy (Avison et al., 2004; Johnson and Lederer, 2010). However, to set up IS strategic alignment, that concretely backs up the implementation of the business strategy, organization members have to understand and identify various strategic matters, such as the business's strategic missions or objectives, tactics to realize the competitive strategy and interrelationships among the diverse tactics of the functional departments (Kunnathur and Shi, 2001; Chen et al., 2010). For organization members to recognize and learn about strategic business matters, these matters must be communicated, discussed, measured and evaluated among the members of the organization (Broadbent and Laughlin, 2009; Ferreira and Otley, 2009). Strategic performance measurement systems (SPMS) in a firm can provide opportunities for and the functions of communications, discussions, measurement and evaluations of diverse strategic topics among the members of a firm (Hall, 2011; Artz et al., 2012). In view of the facilitators of IS strategic alignment, the concept of SPMS may comprise and reflect the influence factors, which have been suggested in previous IS research, on the degrees of IS strategic alignment.

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 supports the active sharing or transfer of various kinds of strategic-related information among organization members, which 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 thus, aligns management processes (e.g., the processes of IS strategy development) with the achievement of the chosen strategic business goals (Li and Tang, 2009; Artz et al., 2012). Through the functions of strategic dialogues or communications and learning among the employees of a firm, which are provided by SPMS, IS strategic alignment can be successfully attained in an organization.

However, the actual effects of SPMS on IS strategic alignment have not been empirically confirmed.

The research topics of SPMS, IS strategic alignment and IT infrastructure for KM are likely to be regarded as non-connected or different research areas. However, since a business's organizational systems are composed of numerous subsystems, and SPMS, IS strategic alignment and IT infrastructure are kinds of subsystems or sub-processes, there inevitably exist direct or indirect relationships among them. Thus, in this study, the research purposes are suggested as follows: first, both the direct effects of SPMS and the indirect effects of SPMS through organizational learning on the degrees of the IS strategic alignment are empirically demonstrated. The empirical results confirm the roles of SPMS in the IS strategic planning processes of a firm. Second, we empirically examine and show the impact of IS strategic alignment on the active development of 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. Finally, we empirically show the positive impact of IT infrastructure on the competitive applications of knowledge resources, and find the effects of their applications on organizational performance. These findings reinforce the previous assertions that IT infrastructure can improve the performance of a firm through effective KM.

II. Theoretical Underpinnings and Hypotheses

A. SPMS and IS Strategic Alignment

SPMS supplements traditional financial measures with a diverse mix of nonfinancial measures that are believed to provide better information on business strategic matters, such as strategic goals, and the ways, progresses and results of the implementation of business and functional strategies (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 and Tang, 2009). 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 reveals ways to achieve business strategic objectives. Generally, the effectiveness of SPMS depends on how well it aligns and harmonizes functional or operating strategies (e.g., IS strategy) with overall business goals or strategy (Hyvonen, 2007; Hall, 2011).

IS strategy includes major planning and tactics in the adoption, use and management of IS to achieve the strategic objectives of a firm (Chen et al., 2010). The IS of an organization consists of IT infrastructure, data, application systems, and personnel that employ IT to deliver information and communications services in an organization (Davis, 2000). The IS strategy, which is a kind of operational or functional strategy, has to be aligned with overall business strategy to contribute to the achievement of the strategic goals of a firm (Chen et al., 2008; Tallon and Pinsonneault, 2011). When the IS strategy is linked with the established business strategy, the adopted IS (IT) can support the implementation of the business strategy and can become the source for acquiring competitive advantages. The IS strategic alignment produces strategic IS and has a positive influence on IS (IT) effectiveness that can lead to greater business profitability.

SPMS reflects business strategic objectives and plays the role of linking functional or operational strategies with overall strategic goals. The close dialogues and communications throughout an organization achieved by means of applying SPMS help organization members to identify and learn about the business's strategic missions or goals and the methods to realize them (Haas and Kleingeld, 1999; Ferreira and Otley, 2009). Through these dialogues and interactions, the employees of a firm can clearly recognize and understand the firm's business strategy and strategic targets, and thus, they can easily reflect them in their development processes of functional or operational strategies (i.e., processes of IS strategy development). With SPMS, it is 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

overall strategy (Henri, 2006). Accordingly, it is likely that SPMS enhances the levels of IS strategic alignment. Based on the above arguments, the following Hypothesis 1 can be proposed.

H1. SPMS has a positive impact on the degrees of IS strategic alignment.

B. SPMS, Organizational Learning and IS Strategic Alignment

Virany et al. (1992) defined organizational learning as a form of informational updating through which managers develop an understanding of the relationships between organization actions and outcomes. Many researchers have pointed out that the provision of information is the beginning and a necessary condition of organizational 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 organizational 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 interactions and communications, individuals share various kinds of information and beliefs resulting in organizational learning which forms the organization's shared mental models (Kim, 1993).

SPMS, which comprises diverse measures across financials, customers, processes and long-term innovations, provides an important formal mechanism to collect or produce information that can be used to develop organizational learning (Chenhall, 2005; Hall, 2011). The information provided by SPMS is prerequisite for organizational members' learning about the strategic targets of the firm, the action plans for realizing 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 that supports for organization members to understand overall business strategy and to establish operational strategies well fitted with the overall strategy through organizational learning. The feed-back information produced by SPMS encourages organizational

learning. With this learning, the managers of a firm can evaluate whether current operational strategies are effective and, consequently, can decide or choose successful functional or operational strategies.

The organizational learning functions of SPMS allow organization members to clearly recognize 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' understanding of the corporate strategy is enhanced through organizational learning. Ittner et al. (2003) empirically found that SPMS that facilitates organizational learning can support organizational members' achievement of strategic objectives, and this achievement can lead to the improvement of a firm's performance. Chenhall (2005) also empirically demonstrated that SPMS has an indirect effect on manufacturing firms' strategic performance through organizational learning. Based on the above arguments and the prior studies, we can suggest the following Hypotheses 2 and 3.

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

H3. Organizational learning has a positive impact on the degrees of IS strategic alignment.

In Hypothesis 1, a direct impact of SPMS on the levels of IS strategic alignment is suggested. Hypotheses 2 and 3 show the positive effects of SPMS on organizational learning and the positive influence of organizational learning on the degrees of IS strategic alignment. According to the reasoning used to develop Hypotheses 1, 2 and 3, it is likely that SPMS indirectly affects the levels of IS strategic alignment through its impact on organizational learning. Hence, we can suggest the following Hypothesis 4.

H4. SPMS has an indirect impact on the degrees of IS strategic alignment through organizational learning.

C. IS Strategic Alignment, Organizational Learning, and IT Infrastructure for KM

1. IT Infrastructure for KM

IT infrastructure for KM is generally classified into three broad types: knowledge storage, search and transfer or cooperation infrastructure (Ko et al., 2005; Dulipovici and Robey, 2013). IT infrastructure for knowledge storage utilizes a common database or electronic knowledge repository that stores codified and text-based knowledge as well as video, audio and graphics. Search infrastructure helps knowledge seekers to locate and retrieve requisite knowledge. This includes IT tools such as powerful search engines and intelligent filters. 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 companies. 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 utilized. Through some kinds of IT tools, which comprise video-conferencing, on-line directories and knowledge maps, interpersonal networks and the ability to connect and communicate with one another can be extended.

2. Effects of IS Strategic Alignment and Organizational Learning

The business strategy specifies the positioning of the organization with respect to its customers and competitors. To support and realize the strategic position of a firm, some sets of intellectual resources and capabilities are inevitably required (Wu and 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 and Cheng, 2004). When a firm adopts a differentiation strategy, both the KM activities and the kinds of knowledge for product innovations are emphasized (Greiner et al., 2007; Donate and Guadamillas, 2011). However, if a low-cost strategy is followed, the company focuses on management of the types of knowledge about process innovations or cost reduction. Accordingly, IT infrastructure for KM that can facilitate effective and efficient KM for acquiring

a certain type of knowledge demanded by the business strategy of a firm must be constructed and developed with reflecting the overall strategy and strategic objectives of the firm. To develop IT infrastructure for KM, that supports the realization of a corporate strategy, an IS strategy that includes detailed planning and directions for the construction of the IT infrastructure has to be aligned with the corporate competitive strategy. If the IS strategy of a company is not aligned with its 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 the IT infrastructure, may occur among the members of an organization (Newkirk and Lederer, 2006; Byrd et al., 2006). Therefore, it seems that high levels of IS strategic alignment positively affect the adoption and construction of the IT infrastructure for KM.

The construction of an IT infrastructure that can promote the activation of KM into the direction demanded by the business strategy of a firm basically requires organization members to fully understand and recognize the firm's strategic missions or positions (Levy and Powell, 2000; Keams and Sabherwal, 2007). In the study of Keams and Sabherwal (2007), which employed the knowledge-based view of strategic alignment, it was empirically confirmed that knowledge integration or sharing in business strategic objectives between IT managers and business managers contributes to the development of an IT infrastructure that successfully supports the realization of the corporate strategy in a company. In their research, knowledge integration implies the shared and combined knowledge of individuals. They also asserted that knowledge integration in business strategic objectives across business and IT managers is enabled by the mechanisms of organizational learning, such as joint activities, interactions and communications, and brainstorming.

In the development processes of the IT infrastructure, cooperation and harmony between the managers of diverse departments are also needed and required (Kunnathur and Shi, 2001; Johnson and Lederer, 2010). Kunnathur and Shi (2001) empirically identified collaborations among departmental managers in the IS planning process as a key success factor for the development of strategic IS. They indicated that a certain degree of cooperation

between the managers of a company can be attained through general agreement or shared understanding about business strategy, strategic goals, and the strategic objectives of IS, which is a result of organizational learning. Johnson and Lederer (2010) argued that mutual understanding in the roles of IT between chief managers, which can be obtained through organizational learning, enhances the levels of team or organizational cooperation for the construction of an IT infrastructure that assists in the achievement of the diverse competitive benefits of a firm. Organization members' understanding on strategic objectives as well as collaborations for the development of the IT infrastructure can be obtained through organizational learning caused by the SPMS. With organizational learning, business strategic missions can be carved into the organization members' memory, and, consequently, all employees of a firm can maintain a consistent business strategic orientation that can also contribute to the enhancement of cooperation among the members of an organization. Hence, it is likely that organizational learning itself positively influences the adoption of an IT infrastructure. Based on the above reasoning, the following Hypotheses 5 and 6 can be proposed.

H5. The degrees of IS strategic alignment have a positive impact on the adoption degrees of IT infrastructure for KM.

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

D. IT Infrastructure for KM and Competitive Applications of Knowledge Resources

When various types of knowledge acquired, transferred and shared through the IT infrastructure for KM are utilized to realize and achieve business strategy and strategic targets, these utilizations are referred to as competitive applications of knowledge resources (Keams and Lederer, 2000; Greiner et al., 2007). The competitive applications of knowledge resources can directly lead to improvements of organizational capabilities, such as enhanced organizational creativity (Lee and Choi, 2003) and increased dynamic capabilities (Prieto and EasterbySmith, 2006). Organizational creativity implies the capability of producing valuable and useful products and services

by the employees of an organization. Dynamic capabilities refer to an organization's abilities or ways of responding in a rapidly changing environment. Lee and Choi (2003) empirically showed the positive relationships among IT infrastructure, knowledge creation process and organizational creativity. Sher and Lee (2004) empirically found moderating effects of IT infrastructure on the relationship between KM and enhancement of dynamic capabilities. However, to assure and maintain the competitive applications of knowledge resources with the IT infrastructure for KM, it has to be constructed and adopted in such a way that the firm can respond to the various demands of corporate strategy on KM activities. Hence, since the degrees of IS strategic alignment positively affects the development of IT infrastructure for KM, that is well matched with the knowledge requirements of business strategy, the effects of IT infrastructure for KM on the competitive applications of knowledge resources are likely to be greater under the high degrees of IS strategic alignment.

With the firm's enhanced organizational creativity or dynamic capabilities, which are the results of competitive applications of knowledge resources, a firm can respond and adapt in a timely manner to a fast-changing environment (Abou-zeid and Cheng, 2004; Prieto and EasterbySmith, 2006). A firm's speedy responses and adaptations to environmental uncertainties link to its increased competitiveness, which gives rise to improved organizational performance and increased business value. Thus, the competitive applications of knowledge resources, which bring about enhanced dynamic capabilities or creativity, contribute to the improvement of organizational performance. Lee and Choi (2003) empirically suggested the positive effects of organizational creativity on organizational performance. Liao et al. (2010) also asserted that the acquisition of new knowledge improves the performance of a firm through increased innovation capabilities. Based on the above reasoning and arguments, we can suggest the following Hypotheses 7 and 8.

H7. When the degrees of IS strategic alignment are high, the adoption degrees of IT infrastructure for KM have a greater positive impact on the competitive applications of knowledge resources than under the low degrees of IS strategic alignment.

H8. The competitive applications of knowledge

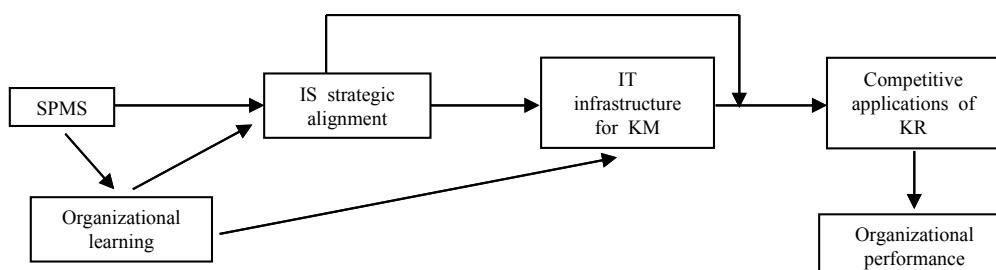


Figure 1. Research Model

resources have a positive impact on the organizational performance of a firm.

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

III. Research Method

A. 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 organizations 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 executives of the selected firms were contacted to ask for their participation in the research. At the beginning, 127 organizations 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 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 briefly explained. The survey was conducted during a three-month period between October 2013 and January 2014. Table 1 summarizes the sample characteristics according to the industrial type of the firms.

B. Measurements

1. SPMS

The adoption levels of SPMS were measured by

Table 1. Sample characteristics

Type of industry	Chemical industry	Machine industry	Auto-mobile	Electronic industry	Textile	Food	Paper & pulp	Non-metal	Metal industry	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 - 1,000		1,000 -		Total
No. of firms	11		31		29		16		30		117

considering the inclusion of strategic orientations in performance measures, links between business strategy and management activities, the reflection of strategic objectives in business processes, and relationships with customers and suppliers in performance evaluations (Chenhall, 2005; Li and Tang, 2009). Twelve question items, developed by Chenhall (2005), were utilized 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 twelve items include the documented form, links between operating performance and business strategies, linking business activities with strategic goals, the effects of one business unit on other units, provision of warning signals and past indicators, linking to suppliers and customers, and providing financial, customers, business processes and innovation measures.

2. Organizational Learning

The direct results or final phase of organizational learning are changes in shared mental models (Virany et al., 1992). Therefore, the degree of organizational 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 center 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'.

3. Degrees of IS Strategic Alignment

IS strategic alignment implies the degrees of the integration between business strategic planning and strategic IS development and application planning (King and Teo, 1994; Segars and 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 a 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.

4. IT Infrastructure for KM

The types of IT infrastructure are grouped into three kinds: transfer or cooperation, storage and search infrastructure. Based on previous studies (Gold et al., 2001; Chua, 2004), 14 question items were constructed to measure the adoption and usage levels of IT infrastructure. For transfer or cooperation IT, six items were used. They include usage of IT in collaboration with other people inside and outside the organization, 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 storage infrastructure, are clear rules for knowledge classification, use of a database or data warehouse, and systematic storage (Chua, 2004). The five items used for measuring search IT represent the 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 IT infrastructure were measured on a seven-point Likert-type scale, anchored by 'strongly disagree' and 'strongly agree'.

5. Competitive Applications of Knowledge Resources

The levels of competitive applications of knowledge resources refer to the degrees of utilization of knowledge assets in obtaining competitive benefits or positions (Kearns and Lederer, 2000; Greiner et al., 2007). This study used the five question items of Kearns and Lederer (2000) to measure the degree of 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.

6. Organizational Performance

Organizational performance was measured by asking whether the firm's average performance indicators for three years are higher than those of the industry to which the firm belongs (Duh et al., 2006). As in the study of Duh et al. (2006), it was assumed that the respondents (i.e., chief production executives) know the industry average. The eight question items, developed by Duh et al. (2006), were utilized. 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.

7. Control Variables

Since size and age may have significant effects on IS strategic alignment and competitive applications of knowledge resources, in this study, organization size and age were considered as control variables. Size is the number of employees of a firm in the year 2013, and the organizational age is measured by counting the years elapsed since the founding of the firm. The industry type is a surrogate measure of knowledge-intensity or advancement (Park et al., 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-intensive 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.

IV. Data Analysis and Results

A. 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 organizational learning, and the IT infrastructure, competitive applications of knowledge resources and organizational 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 IT infrastructure and item 7 (improvement) in 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 of any other 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.

Discriminant validity involves a lack of relationships among measures that should not theoretically be related. In terms of discriminant validity, it needs to show that the average variance extracted for each construct exceeds the squared correlation between that construct and any other construct. Table 3 describes that the average variances extracted (the diagonal elements) of each pair of constructs are greater than the squared correlations (the off diagonal elements). Both the alpha coefficients and the values of the mean and standard deviation for the research variables were calculated and are summarized in Table 4.

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		
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

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

Table 3. Average variances extracted (AVE)

Constructs	SPMS	IS strategic alignment	Learning	Storage & search IT	Transfer IT	Competitive applications of KR	Performance
SPMS	0.91	-	-	-	-	-	-
IS strategic alignment	0.41	0.86	-	-	-	-	-
Learning	0.39	0.35	0.79	-	-	-	-
Storage & search IT	0.29	0.39	0.22	0.72	-	-	-
Transfer IT	0.27	0.25	0.22	0.38	0.78	-	-
Competitive applications of KR	0.12	0.12	0.14	0.25	0.15	0.59	-
Performance	0.12	0.26	0.19	0.29	0.16	0.22	0.81

KR: knowledge resources.

Table 4. Summary statistics of research variables

Variables	Mean	Standard deviation	Minimum	Maximum	Alpha coefficient
SPMS	4.8	1.03	2.1	7.0	0.96
Organizational 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
Organizational 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	-

* Million \$

B. Effects on IS Strategic Alignment

To demonstrate the positive effects of SPMS and organizational learning on IS strategic alignment, regression models were employed. In regression models 1 and 2, only the impact of SPMS was analyzed. Table 5 shows the results of the analyses. In Table 5, the effects of SPMS on IS strategic alignment and organizational learning are significant and positive. From these results, it is confirmed that SPMS contributes to the enhancement of IS strategic alignment as well as the activation of organizational learning. Thus, Hypotheses 1 and 2, which suggest the

impact of SPMS, are fully accepted. In regression model 3, the effects of organizational learning on IS strategic alignment were analyzed. The results are presented in Table 6. It is found that organizational learning significantly and positively influences IS strategic alignment. Therefore, it is concluded that IS strategic alignment is facilitated and activated through organizational learning. This result also supports Hypothesis 3, which indicates the positive impact of organizational learning on IS strategic alignment.

Table 5. Multiple regression analyses (N=117)

Independent variables	SPMS	Size	Age	Level1	Level2	Level3	R ² (F)
Dependent variable	B coefficient (t-value)	B coefficient (t-value)	B coefficient (t-value)	B coefficient (t-value)	B coefficient (t-value)	B coefficient (t-value)	-
Organizational 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)

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

Table 6. Multiple regression analyses (N=117)

Independent variables	Organizational learning	Size	Age	Level1	Level2	Level3	R ² (F)
Dependent variable	B coefficient (t-value)	B coefficient (t-value)	B coefficient (t-value)	B coefficient (t-value)	B coefficient (t-value)	B 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)

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

C. Indirect Impact of SPMS

To verify the mediating effects of organizational 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: the regression coefficients, x: SPMS (predictor variable), z: organizational learning (mediator variable), size and age: the organization size and age, and level: levels of knowledge-intensity. As the decision criteria for the mediating impact of organizational learning, four basic rules were applied in the analysis as follows: (i) b_1 , the beta coefficient for the original independent variable is statistically significant in regression (1); (ii) in regression (2), b_2 , the coefficient of the mediator variable is statistically significant; (iii) the adjusted R^2 of regression (2) is greater than that in regression (1); and (iv) the significance of b_1 in regression (2) is weaker than that in regression (1) (Baron and Kenney, 1986). The results of the mediated regression analysis are presented in Table

7. In Table 7, it is observed that the beta coefficient of SPMS in regression (2) is smaller than that of regression (1), the beta of organizational learning is significant, and the adjusted R^2 of regression (2) is greater than that in regression (1). Thus, it seems evident that SPMS has an indirect impact on IS strategic alignment through organizational learning. From these results, Hypothesis 4 is supported.

D. Effect on IT Infrastructure for KM

The effects of IS strategic alignment and organizational learning on IT infrastructure for KM were examined with multiple regression analysis. The results of the regression analyses are presented in Table 8. In the case of storage and search IT, the effects of IS strategic alignment and organizational learning are significant and positive. In Table 8, 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, which propose the positive impact of IS strategic alignment and organizational learning. Thus, it seems that since the orientations or directions of the construction of the IT infrastructure can be clearly recognized and established through IS strategic alignment and organizational learning, the development of IT

Table 7. Results of mediated regression analysis

Regression model 1	Y = $b_0 + b_1 \cdot X + b_2 \cdot \text{Size} + b_3 \cdot \text{Age}$		Regression model 2	Y = $b_0 + b_1 \cdot X + b_2 \cdot Z + b_3 \cdot \text{Size} + b_4 \cdot \text{Age}$		
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	Organizational learning	0.31 ^a	0.50 ^a	0.58

a: $p < 0.01$.

Table 8. Multiple regression analyses (N=117)

Independent variables	Organizational learning	IS strategic alignment	Size	Age	Level1	Level2	Level3	R^2 (F)
Dependent variable	B coefficient (t-value)	B coefficient (t-value)	B coefficient (t-value)	B coefficient (t-value)	B coefficient (t-value)	B coefficient (t-value)	B 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)

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

infrastructure for KM can be activated.

E. Competitive Applications of Knowledge and Organizational Performance

To empirically test whether the effects of IT infrastructure for KM on the competitive applications of knowledge are greater under high levels of IS strategic alignment, the observations of IS strategic alignment were divided into two groups with the median value being employed as the dividing point. In each group, the impact of IT infrastructure on the competitive applications of knowledge was analyzed with a multiple regression analysis. By comparing the results of the regression analyses between the two groups, the different effects of the IT infrastructure according to the levels of the IS strategic alignment can be identified. In Tables 9 and 10, the results are presented. In Table 9, which is the results of relatively high degrees of IS strategic alignment (i.e., higher than the median value), it is observed that both the storage and search infrastructure and transfer IT infrastructure significantly and positively influence the competitive applications of knowledge resources. However, Table 10 that is the results of low levels of

IS strategic alignment (i.e., lower than the median value) shows that only storage and search infrastructure significantly affects the competitive applications of knowledge. By comparing the results of Tables 9 and 10, it is found that the impact of storage and search infrastructure is similar between groups, but the influence of transfer IT is greater under high degrees of IS strategic alignment. These results partially confirm that the effects of IT infrastructure on the competitive usage of knowledge assets are greater when the levels of IS strategic alignment are high.

We adopted a multiple regression analysis to investigate the impact of the competitive applications of knowledge resources on the performance of a firm. Table 11 shows that the competitive applications of knowledge significantly influence the organizational performance of a firm. It is found that the effects on organizational performance, ROS and ROA are significant and positive. These results also support the previous assertions that the benefits realized by the competitive usage of knowledge assets, such as dynamic capabilities and knowledge creativity, contribute to the improvement of organizational performance. Thus, Hypotheses 7 and 8 are partially and fully accepted, respectively.

Table 9. Multiple regression analyses (High levels of IS strategic alignment: N=57)

Independent variables	Storage & search IT	Transfer IT	Size	Age	Level1	Level2	Level3	R ² (F)
Dependent variable	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	-
Competitive applications of KR	0.26 (1.91 ^a)	0.28 (2.24 ^b)	0.13 (1.07)	0.17 (1.25)	0.06 (0.50)	0.00 (0.00)	0.21 (1.60)	0.29 (3.39 ^a)

a: $p < 0.01$, b: $p < 0.05$, c: $p < 0.1$. The scores of VIF were below 1.4. KR: knowledge resources. Size and age: the organization size and age. Level: levels of knowledge-intensity.

Table 10. Multiple regression analyses (Low levels of IS strategic alignment: N=56)

Independent variables	Storage & search IT	Transfer IT	Size	Age	Level1	Level2	Level3	R ² (F)
Dependent variable	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	-
Competitive applications of KR	0.27 (1.91 ^a)	-0.05 (-0.25)	-0.12 (-0.74)	-0.09 (-0.64)	0.09 (0.56)	0.00 (0.00)	-0.00 (-0.01)	0.19 (1.48)

c: $p < 0.1$. The scores of VIF were below 1.9. KR: knowledge resources. Size and age: the organization size and age. Level: levels of knowledge-intensity.

Table 11. Multiple regression analyses (N=117)

Independent variables	Competitive applications of KR	Size	Age	Level1	Level2	Level3	R ² (F)
Dependent variable	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	<i>B</i> coefficient (t-value)	-
Organizational 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 ^b)	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)

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 organization size and age. Level: levels of knowledge-intensity.

V. Conclusion and Discussion

A. Research Conclusion

SPMS promotes organizational learning through the functions of communications, dialogues, discussions and evaluations of the business strategic topics among the members of an organization. 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., Ittner et al., 2003; Chenhall, 2005; Li and Tang, 2009). 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 organizational learning. This research also empirically showed the indirect effects of SPMS on IS strategic alignment through organizational learning. 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. 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 Zack (1999) and Hansen et al. (1999), 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 organizational 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 organizational 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., Lee and Choi, 2003; Artail, 2006; Lopez-Nicolas and Soto-Acosta, 2010). However, according to our results, it was partially found that when the degrees of IS strategic alignment are high, the effects

of IT infrastructure on the competitive applications of knowledge are greater than under the low levels of IS strategic alignment. Since the competitive applications of knowledge refer to the utilization 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 greater positive impact on the competitive applications of knowledge. Previous studies have suggested the general phenomenon that IT can support knowledge usage. The results of this study showed that according to the types of knowledge application (i.e., competitive or non-competitive), the required forms of IT infrastructure might be different. This study also found that the competitive applications of knowledge positively influence the performance of a firm.

B. Practical Implications

Although the previous IS studies have proposed various influence factors on IS strategic alignment, the concrete total mechanism or tools to realize and implement these influence factors were not represented. From the results of this study, it is evident that manufacturing firms can utilize SPMS like the balanced score card as a total mechanism to realize the roles of the influence factors. If there is no agreed goal orientations among the members of an organization for the adoption of an IT infrastructure, conflicts or dissonance can occur during development processes. In this study, it was asserted that IS strategic alignment and organizational learning through SPMS can reduce the degrees of conflict and enhance cooperation among the managers of diverse departments. The fact that the forms of IT infrastructure are likely to be different according to the kinds of knowledge usage indicates some implications for the design of IT infrastructure. Most prior research suggested appropriate kinds of IT infrastructure to support specific types of KM activities, such as transfer, storage and search or application. However, among the specific types of KM activities, various kinds can be classified and identified (i.e., within transfer, tacit knowledge or explicit knowledge transfer can be categorized). Therefore, to design and construct IT infrastructure for KM with considering diverse kinds in each type of KM activities are more recommended.

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