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Capabilities, Processes, and Performance of Knowledge Management: A Structural Approach

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ABSTRACT

The purpose of this study is to examine structural relationships among the capabilities, processes, and performance of knowledge management, and suggest strategic directions for the successful implementation of knowledge management. To serve this purpose, the authors conducted an extensive survey of 68 knowledge management-adopting Korean firms in diverse industries and collected 215 questionnaires. Analyzing hypothesized structural relationships with the data collected, they found that there exists statistically significant relationships among knowledge management capabilities, processes, and performance. The empirical results of this study also support the well-known strategic hypothesis of the balanced scorecard (BSC). © 2007 Wiley Periodicals, Inc.

1. INTRODUCTION

The essence of knowledge management is to improve organizational performance by approaching to the processes such as acquiring knowledge, converting knowledge into useful form, applying or using knowledge, protecting knowledge by intentional and systematic method, and knowledge management can be understood by innovation process of organization with individual to search for creative problem solving method. The dynamic nature of the new marketplace today has created a competitive incentive among many companies to consolidate and reconcile their knowledge assets as a means of creating value that is sustainable over time. To achieve competitive sustainability, many companies are launching extensive knowledge management efforts (Gold, Malhotra, & Segars, 2001).

Prior research has explored which factors are essential for managing knowledge effectively. Most studies of them have examined the relationships of knowledge management capabilities, processes, and performance. Some research has focused on the relationship between capabilities and processes (Hansen, 1999; Szulanski, 1996; Zander & Kogut, 1995); the other studies have focused on the relationship between capabilities and organizational performance (Becerra-Fernandez & Sabherwal, 2001; Gold et al., 2001;

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Simonin, 1997). However, there are very few empirical studies proposing an integrative model framework, for example, the balanced scorecard (BSC) approach to knowledge management performance measurement. Lee and Choi (2003) insisted that an integrative perspective of the knowledge variables based on relevant theories is necessary, and they proposed an integrative research framework for studying knowledge management including knowledge enablers, processes, intermediate outcome, and organizational performance.

A key to understanding the success and failure of knowledge management within organizations is the identification and assessment of various factors that are necessary for the knowledge management performance measurement with a balanced view like the BSC (Arora, 2002; Gooijer, 2000).

In this study, we examine structural relationships among various factors of the knowledge management value chain, and suggest strategic directions of what to prepare for successfully implementing knowledge management. To serve this purpose, we figure out the core constructs of the knowledge management value chain through an extensive literature review about capabilities, processes, and performance of knowledge management, and propose the integrated knowledge management framework. In addition, we conduct an extensive survey on knowledge management adopting Korean firms in diverse industries and verify the causal relationships between core constructs of value chain through confirmatory factor analysis (CFA) and structural equation analysis (SEA).

2. LITERATURE REVIEW

Many researchers have emphasized three major factors for knowledge management: capabilities, processes, and organizational performance (Beckman, 1999; Demarest, 1997; O'Dell & Grayson, 1999). Knowledge management capabilities are organizational mechanisms for generating knowledge continuously (Ichijo, Krogh, & Nonaka, 1998); they can encourage acquiring knowledge, protecting knowledge, and facilitating knowledge sharing in an organization (Stonehouse & Pemberton, 1999). Knowledge management processes can be thought of as a structured coordination for managing knowledge effectively (Gold et al., 2001).

2.1. Capabilities

To compete effectively, companies must leverage their existing knowledge and create new knowledge that favorably positions them in their chosen markets. To accomplish this, companies must develop the ability to use prior knowledge to recognize the value of new information, assimilate it, and apply it to create new knowledge and capabilities (Cohen & Levinthal, 1990). Many researchers have proposed capabilities influencing knowledge management as preconditions or organizational resources for effective knowledge management (Gold et al., 2001; Gray, 2001; Holsapple & Joshi, 2000; Ichijo et al., 1998; Krogh, Nonakam, & Aben, 2001; Lee & Choi, 2003; Leonard-Barton, 1995; Malone, 2002; Quinn, Anderson, & Finkelstein, 1996; Wiig, 1997; Zack, 1999).

For example, Krogh et al. (2001) define knowledge management infrastructure as "organizational mechanism to create knowledge constantly and intentionally in organization," and presented five factors of knowledge management infrastructure such as (a) the will to generate knowledge, (b) conversation between employees, (c) organizational structure, (d) relationships between employees, and (e) human resources. Quinn et al. (1996) insisted

that activities such as appropriate employee's staffing, employee's ability and technology development, systematic organizational structure development, construction of compensation system about employee's performance should be promoted to use knowledge asset effectively.

Gray (2001) examined empirically that the mutual relationships between knowledge management practice ways proposed in organization to support creation, storage, and transfer of knowledge can raise organizational performance. Specifically, he presented five ways such as (a) formal training of employees, (b) construction of knowledge repository, (c) informal knowledge fairs of employees, (d) spur of communities of practices (CoP), and (e) talk rooms of R&D employees about their current projects for knowledge management practice ways to raise organizational performance.

Gold et al. (2001) examined an empirically effective knowledge management model from the perspective of organizational capabilities. This perspective suggests that a knowledge infrastructure consisting of technology, structure, and culture along with knowledge process architecture of acquisition, conversion, application, and protection are essential organizational capabilities or preconditions for effective knowledge management. Lee and Choi (2003) emphasized that knowledge management consists of processes to manage knowledge and enablers (or capabilities) to support these processes. They also argue that knowledge management enablers consist of organizational culture, structure, people, and information technology support.

2.2. Processes

A number of studies have addressed knowledge management processes; they divide knowledge management into several processes (Alavi & Leidner, 2001; Bhat, 2002; DeLong, 1997; Gold et al., 2001; Lee & Choi, 2003; Lee & Yang, 2000; Nonaka & Takeuchi, 1995; Ruggles, 1998; Shin et al., 2001; Skyrme & Amidon, 1998; Spender, 1996; Teece, 1998). They have identified many key aspects to this knowledge management process: capture, transfer, and use (DeLong, 1997); acquire, collaborate, integrate, and experiment (Leonard-Barton, 1995); create, transfer, assemble, integrate, and exploit (Teece, 1998); create, transfer, and use (Skyrme & Amidon, 1998; Spender, 1996).

For example, Alavi and Leidner (2001) considered four processes including creation, storage, transfer, and application. Gold et al. (2001) clustered various capabilities into four broad dimensions of process capability—acquiring knowledge, converting it into a useful form, applying or using it, and protecting it. Lee and Choi (2003) focused on the knowledge creation process, and they adopt the SECI (socialization, externalization, combination, internalization) process model by Nonaka and Takeuchi (1995) to explore knowledge creation. Ruggles (1998) divided company's knowledge management processes by four categories including generating and accessing, facilitating and representing, embedding and usage, and transferring and measuring. Knowledge management processes that he presents are the (a) generating new knowledge, accessing valuable knowledge from outside sources (a generating and accessing process); (b) facilitating knowledge growth through culture and incentive and representing knowledge in documents, databases, and software (a facilitating and representing process); (c) embedding knowledge in processes, products, and/or services and using accessible knowledge in decision making (an embedding and usage process); and (d) transferring existing knowledge into other parts of the organization and measuring the value of knowledge assets and/or impact of knowledge management (a transferring and measuring process).

2.3. Performance

Although a company's value is generated by intangible assets like knowledge or brand, financial measurement that is developed depending on industrial society taking a serious view, external growth is still much used to measure a company's performance in knowledge management and knowledge worker's performance. Performance measurement is one of most important management activities—"what you measure is what you get." Performance measurement becomes the basis of strategy establishment and achievement in the future because it can definitely bring a company's vision and strategic target to all organization members as well as CEOs, and performs a role that makes efficient internal business processes possible. Of course, it is true that conventional performance measurement based on financial reporting provides comparative objective performance outcome in companies. Nevertheless, short-term and past-oriented financial indicators cannot become unique indicators that can evaluate company's performance any more. Now intangible assets such as knowledge rather than tangible financial assets are a measure of a company's value. Therefore, various attempts to measure organizational performance in knowledge management have been conducted accordingly (Arora, 2002; Brooking, 1997; Drew, 1997; Edvinsson, 1997; Gooijer, 2000; Kaplan & Norton, 1996, 2000; Simonin, 1997; Sveiby, 1997; Ulrich, 1998).

For example, Sveiby (1997) developed an intangible asset monitor (IAM) to measure the performance of intangible assets such as human capital, structural capital, and market capital. The intangible asset monitor presents performance indicators as they relate to intangible assets as plain and simple; categorizes intellectual capital by employee capability, internal structure, external structure; and uses three performance indicators of growth/innovation (change), efficiency, and stability, respectively, in these categories.

Kaplan and Norton (1996, 2000) proposed the BSC as a strategic performance measurement framework including financial indicators as well as nonfinancial indicators. The BSC is a strategic learning system that can amend business theory and organizational strategy through monitoring a company's performance from its knowledge management activities.[1]

On the other hand, Arora (2002) found three knowledge management purposes: the improvement of organization knowledge, the creation of new knowledge or innovation, and improved employee job based on extended collaboration. Construction of a knowledge repository and activations of communities of practice (CoP) has been suggested to support overall knowledge management. Arora further notes that although knowledge management activities can achieve the objectives (or purposes) of knowledge management, knowledge management does not actually contribute greatly to the organizational performance. The BCA takes a serious view of a specific target set and provides feedback by organizational strategy to knowledge management; the BCA can practice knowledge management effectively in an organization by enabling the development and utilization

[1]Despite the usefulness of the BSC, there is a shortcoming. An entirely different topology of BSC has to be developed according to what intangible asset that individual company's is interested in. Comparison between companies is actually impossible because it is hard to measure performance in specific companies by universal outside indicators. Deshpande et al. (1993) and Drew (1997) develop comprehensive and relative indicators measuring performance of knowledge management to supplement this shortcoming. Specifically, they measured the performance of companies in relation to success, profitability, growth rate, innovativeness, business size, and market share through relative comparisons with key competitors from a subjective viewpoint for the development of performance indicators that considered both financial and operational issues.-

of a knowledge management index. Gooijer (2000) also suggested the BCA to measure knowledge management performance. Specifically, he defines knowledge management as practice activities that support employees' cooperation and integration, and proposes a knowledge management scorecard (KMSC) model to measure performance in knowledge management.

3. RESEARCH MODEL

In this study, we highlight a few major factors that can explain large parts of knowledge management based on the literature review so far.

3.1. Variables

3.1.1. Capabilities. A variety of knowledge management capabilities have been addressed in the literature. Among these capabilities, people, organizational structure, culture, and information technology (IT) are incorporated into our research model. People are at the heart of creating organizational knowledge (Ndlela & Toit, 2001).

People create and share knowledge; therefore, managing people who are willing to create and share knowledge is important. Knowledge and competence can be acquired by admitting new people with desirable skills. In particular, T-shaped skills embodied in employees are most often associated with core capability. T-shaped skills may enable individual specialists to have synergistic conversations with one another (Madhaven & Grover, 1998).

The organizational structure may encourage or inhibit knowledge management. This study includes a key structural factor like centralization. It is recognized as a key variable underlying the structural construct. Moreover, its effect on knowledge management within organizations is a widely recognized potential (Lubit, 2001).

Organizational culture is the most important factor for successful knowledge management. Organizations should establish an appropriate culture that encourages people to create and share knowledge within an organization. This study focuses on learning organization (Eppler & Sukowski, 2000).

Information technology and its capabilities contribute to knowledge management; IT is widely employed to connect people with reusable codified knowledge, and it facilitates conversations to create new knowledge, and allow an organization to create, share, store, and use knowledge (Raven & Prasser, 1996). Therefore, IT is essential for initiating and carrying out knowledge management. This study focuses on IT support.

3.1.2. Processes. The role of knowledge management processes is not consistent. Some studies recognized both knowledge capabilities and processes as antecedents of organizational performance (Becerra-Fernandez & Sabherwal, 2001). Other studies recognized knowledge capabilities as preconditions of knowledge processes (Hansen, 1999; Szulanski, 1996; Zander & Kogut, 1995). Therefore, the challenge is to clarify the role of knowledge management processes. To explore the role of knowledge management processes, this study adopts the eight knowledge processes proposed by Ruggles (1998): generating knowledge; accessing valuable knowledge from external sources; facilitating knowledge growth through culture and incentive; representing knowledge in documents, databases, and software; embedding knowledge in processes, products, and/or services; using accessible knowledge in decision making; transferring existing knowledge into other parts of

the organization; and measuring the value of knowledge assets and/or impact of knowledge management. Knowledge management is largely based on a management theory that has focused on a process-based view, especially when considering what it is that actually gets managed in organizations. Our study takes this process perspective and applies it to what can be managed about knowledge. In this study, we categorized Ruggles' (1998) eight processes into four processes: acquisition, conversion, application, and diffusion.

3.1.3. Performance. Measuring organizational performance strongly affects the behavior of managers and employees. Methods for measuring organizational performance in knowledge management can be categorized into four groups: financial measures, intellectual capital, tangible and intangible benefits, and balanced scorecard. This study adopts a modified balanced scorecard method. The balanced scorecard is more useful than intellectual capital or a tangible and intangible approach because it shows cause and effect links between knowledge components and organization strategies (Kaplan & Norton, 1996, 2000).

In summary, we constructed a research model as shown in Figure 1 based on the literature review so far, and this empirical research model illustrates the relationship among variables. As shown in Figure 1, the research model consists of knowledge management capabilities, knowledge management processes, and knowledge management performance. We considered organization member's T-shaped skills, centralization of organizational structure, learning organization culture, and IT support level for capabilities in knowledge management, and considered knowledge management process of generating, accessing, facilitating, representing, embedding, usage, transferring, and measuring for knowledge management processes. In addition, we considered customer performance and financial performance for knowledge management performance. The causality of components by structural equation model (SEM) based on the research model of Figure 1 is as follows.

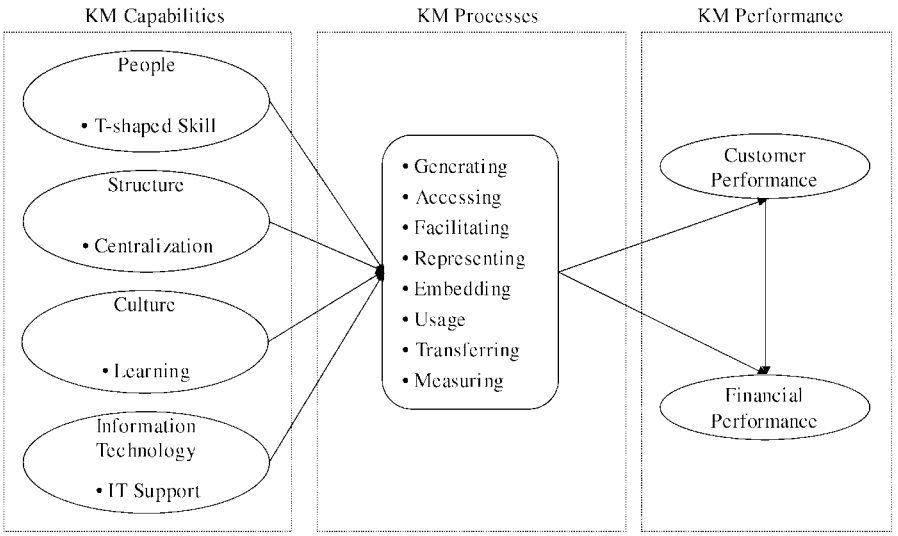

Figure 1 Research model.

$$\eta_1 = \gamma_{11} \cdot \xi_1 + \gamma_{12} \cdot \xi_2 + \gamma_{13} \cdot \xi_3 + \gamma_4 \cdot \xi_4 + \zeta_1$$

$$\eta_2 = \beta_{21} \cdot \eta_1 + \zeta_2$$

$$\eta_3 = \beta_{31} \cdot \eta_1 + \beta_{32} \cdot \eta_2 + \zeta_3$$

where ξ_1 is people; ξ_2 is structure; ξ_3 is culture; ξ_4 is information technology; η_1 is knowledge management processes, η_2 is customer performance; η_3 is financial performance. γ, β represent estimated parameters, ζ represents the error term.

3.2. Hypotheses

In this study, we derived hypotheses from theoretical statements made in the literature review on knowledge management. We present hypotheses through the following variables.

3.2.1. T-Shaped skills. T-shaped skills are both deep (the vertical part of the "T") and broad (the horizontal part of the "T"); that is, their possessors can explore particular knowledge domains and their various applications in particular products. People with T-shaped skills are extremely valuable for creating knowledge because they can integrate diverse knowledge assets (Leonard-Barton, 1995).

They have the ability both to combine theoretical and practical knowledge and to see how their branch of knowledge interacts with other branches. Therefore, they can expand their competence across several functional branch areas, and thus create new knowledge (Madhavan & Grover, 1998). Hence, we hypothesize:

Hypothesis 1: There is a positive relationship between the presence of the organizational members with T-shaped skills and the knowledge management process.

3.2.2. Centralization. Centralized structure hinders interdepartmental communication and frequent sharing of ideas due to time-consuming communication channels; it also causes distortion and discontinuousness of ideas (Stonehouse & Pemberton, 1999). A decentralized organizational structure has been found to facilitate an environment where employees participate in the knowledge building process more spontaneously. Knowledge processes require flexibility and less emphasis on work rules (Ichijo et al., 1998). Therefore, the increased flexibility in an organizational structure can result in activated knowledge management activities. Hence, we hypothesize:

Hypothesis 2: There is a negative relationship between centralization and the knowledge management process.

3.2.3. Learning. Learning can be defined as the degree to which it is encouraged in organizations. Learning is the acquisition of new knowledge by people who are able and willing to apply that knowledge in making decisions or influencing others. For efficient knowledge processes, organizations should develop a learning culture and provide various learning means such as education, training, and mentoring (Swap, Leonard, Shields, & Abrams, 2001; Swieringa & Wierdsma, 1992). Hence, we hypothesize:

Hypothesis 3: There is a positive relationship between learning and the knowledge management process.

3.2.4. Information technology support. Information technology support refers to the degree to which knowledge management is supported by the use of IT. Many researchers have found that IT is a crucial element for efficient knowledge processes (Davenport & Prusak, 1998; Gold et al., 2001; Raven & Prasser, 1996) for the following reasons. First, IT facilitates rapid collection, storage, and exchange of knowledge on a scale not practicable in the past. Second, a well-developed technology integrates fragmented flows of knowledge. This integration can eliminate barriers to communication among departments in an organization. Third, IT supports all sorts of knowledge processes such as generating, facilitating, usage, and transferring. Hence, we hypothesize:

Hypothesis 4: There is a positive relationship between IT support and the knowledge management process.

3.2.5. Organizational performance. In this study, organizational performance is measured with the use of customer and financial perspective indicators of balanced scorecard in comparison with key competitors (Arora, 2002; Deshpande, Jarley, & Webster, 1993; Drew, 1997; Gooijer, 2000). Typically, the goals of organizational change include the various aspects of organizational performance such as organizational effectiveness, survival, improvement, or innovation. Organizational performance can be thought of as the output of knowledge processes that encourages these aspects. Thus, improvements of knowledge processes could lead to better organizational performance (Davenport, 1999; Quinn et al., 1996). Hence, we hypothesize:

Hypothesis 5: There is a positive relationship between the knowledge management process and customer performance.

Hypothesis 6: There is a positive relationship between the knowledge management process and financial performance.

On the other hand, many studies that propose the BSC for performance measurement of knowledge management occasionally suggest a strategy map and business theory that have a linear connection with innovation and learning → internal business process → customer performance → financial performance (Kaplan & Norton, 1996). In this study, we accommodate these viewpoints and establish an additional hypothesis of causality between customer performance and financial performance.

Hypothesis 7: There is a positive relationship between customer performance and financial performance.

4. RESEARCH METHODOLOGY

4.1. Data Collection

Samples were restricted to the companies that adopted knowledge management or held similar process innovation campaigns. In this study, we conducted a questionnaire-based survey. Questionnaires were sent to the task force team in charge of knowledge management (or process innovation campaigns) of 74 companies in Korea that had been introduced to knowledge management practices. In addition, we sent multiple questionnaires to each company to promote response. After conducting an extensive survey to 74 companies, 215 questionnaires returned from 68 companies. All were used in our statistical analysis.

4.2. Survey Measures

We developed multiple-item measures of all constructs (variables). Multiple-item measures are generally thought to enhance confidence that the constructs of interest are being accurately assessed and the measurement of the variable will be more consistent (Churchill, 1979). Multiple-item measures are used for most variables to improve the reliability and validity of the measures. In addition, variables are measured with 6-point Likert-type scales that provide the advantage of standardizing and quantifying relative effects (Lee & Choi, 2003). In the next section we discuss the measures for each variable of interest. Research constructs were used based on related studies and pilot tests. Most of the research constructs have already been validated and used for other studies on knowledge management, organizational design, learning, or IT management.

4.3. Survey Items

The questionnaires consisted of 35 items about capabilities, processes, and performance of knowledge management. Items about knowledge management capabilities consisted of organization members' T-shaped skills (five items), centralization of organizational structure (five items), learning organization (five items), and IT support (five items) as shown in Table 1.

Knowledge management processes consisted of generating knowledge, accessing knowledge, facilitating knowledge, representing knowledge, embedding knowledge, using knowledge, transferring knowledge, and measuring knowledge assets (eight items) as shown in Table 2.

We measured customer and financial performance of companies using KMSC (Arora, 2002; Gooijer, 2000) and relative performance indicators modified so that BSC can be applied universally to all organizations (Deshpande et al., 1993; Drew, 1997). Specifically, we developed three items to measure customer performance based on KMSC. Although financial performance is more realistic when using metric financial data such as return on investment (ROI), in the case of Korean companies, it is hard to connect the effect of the knowledge management initiative with metric financial performance. The knowledge management adoption period is short, and it is hard to standardize performance indicators in all business categories. Therefore, we used cognitive measures such as relative financial performance as compared to key competitors instead of metric financial data, and selected four items for this (see Table 3).

5. EMPIRICAL ANALYSIS

5.1. Sample Characteristics

Of the responses analyzed, 35.4% were manufacturing firms, and 19.1% were information–communication, and consulting–business service firms, respectively. Banking and insurance firms had 14.4% response rate. Most of respondents were middle managers (95.8%) from varied departments such as marketing, R&D, planning, etc. Table 4 summarizes the respondent characteristics in terms of industry type and department.

5.2. Assessment of Reliability

Before reliability analysis, we tested normality, linearity, and homoscedasticity about individual items to measure constructs, that is, T-shaped skills, centralization, learning

TABLE 1. Item Measures of Knowledge Management Capabilities

Constructs		Items	Variable names
People	T-shaped skills	Our company members . . .	T1
		can know their own know-how accurately.	T2
		can explain their own tasks to others.	T3
		think that their own tasks are the region employing knowledge.	T4
		think that they are expert in their own tasks.	T5
		can know core knowledge needed in their own tasks.	
Structure	Centralization	Our company members . . .	C1
		can take action without a supervisor (R).	C2
		are encouraged to make their own decisions (R).	C3
		do not need to refer to someone else (R).	C4
		do not need to ask their supervisor before action (R).	C5
		can make decisions without approval (R).	
Culture	Learning	Our company . . .	L1
		provides various formal training programs for performance of duties.	L2
		provides opportunities for informal individual development other than formal training	L3
		such as work assignment and job rotation.	L4
		encourages people to attend seminars, symposia, and so on.	L5
		provides various programs such as clubs and community gatherings.	
		members are satisfied by the contents of job training or self-development programs.	
IT	Support	Our company . . .	S1
		provides IT support (e.g., intranet) for information sharing.	S2
		provides IT support (e.g., groupware) for information acquisition.	S3
		provides IT support (e.g., DW or knowledge repository) for knowledge acquisition.	S4
		provides IT support (e.g., knowledge map) for knowledge source finding and accessing.	S5
		provides IT support (e.g., CRM) for customer information gathering	

Note. (R) = reverse measure.

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TABLE 2. Item Measures of Knowledge Management Processes

Constructs	Items	Variable name
Knowledge management processes	Our company stresses . . .	P1
	generating new knowledge.	P2
	accessing valuable knowledge from external sources.	P3
	facilitating knowledge growth through culture and incentive.	P4
	representing knowledge in documents, databases, and software.	P5
	embedding knowledge in processes, products, and/or services.	P6
	using accessible knowledge in decision making.	P7
	transferring existing knowledge into other parts of the organization.	P8
	measuring the value of knowledge assets and/or impact of knowledge management.	

organization, IT support, knowledge processes, customer performance, and financial performance actually (Hair, Anderson, Tatham, & Black, 1995). First, all observed items have normality with a significance level of .05 according to the Kolmogorov–Smirnov (K–S) test for normality. Second, individual items that correspond to specific construct have a high correlation with a significance level of .05 according to the correlation analysis for linearity test. Third, according to the result of the Levene-test to test homoscedasticity and heteroscedasticity between individual items that correspond to a specific construct, a significance level of .05 was not found.

On the other hand, we conducted an exploratory factor analysis about seven constructs (T-shaped skills, centralization, learning organization, IT support, knowledge management processes, customer performance, and financial performance) using an oblique rotation method that did not assume independence between factors (Hair et al., 1995). We used the principal component as an initial factor extraction method, and an eigenvalue of 1 as extraction criteria. The result of the exploratory factor analysis using oblique rotation is summarized in Table 5.

TABLE 3. Item Measures of Knowledge Management Performance

Constructs	Items	Variable name
Customer performance	Compared with key competitors, our company . . .	CP1
	has greater improvement of customer satisfaction.	CP2
	has more creation of new customers.	CP3
	has more retention of current customers.	
Financial performance	Compared with key competitors, our company . . .	FP1
	has a greater return on investment.	FP2
	has a greater market share.	FP3
	has a greater net profit.	FP4
	has a greater economic value added.	

TABLE 4. Respondents Characteristics

	Frequency	%
Industry:		
Manufacturing	76	35.3
Banking and Insurance	31	14.4
Information and Communication	41	19.1
Consulting and Business Service	41	19.1
Construction and Engineering	3	1.4
Wholesale and Retail	8	3.7
Service Industry except Upside	11	5.1
Etc.	4	1.9
Department:		
Accounting & Finance	20	9.3
Production	6	2.8
Marketing	44	20.5
Personnel Management/Training	3	1.4
Research & Development	24	11.2
General Affairs	5	2.3
Planning	45	20.9
Management Information System	29	13.5
Others	39	18.1

As shown in Table 5, eight items of knowledge management processes were grouped together for one factor by exploratory factor analysis using oblique rotation, and items of other constructs were grouped together properly according to all operational definitions. A reliability analysis using Cronbach's alpha on the extracted factors is summarized in Table 6.

As shown in Table 6, internal consistency is high because the reliability of nine factors (constructs) is more than 0.8.

5.3. Assessment of Validity

This study used content validity, construct validity, and a criteria-related validity method to test validity about items developed by researchers (Cronbach, 1971).

5.3.1. Content validity. Content validity is based on the extent to which a measurement reflects the specific intended domain of content (Carmines & Zeller, 1991). For example, it is the assessment on the degrees of correspondence between conceptual definitions (T-shaped skills, centralization, learning, IT support, knowledge process, customer performance, and financial performance) and the items to be observed. In this study, we recognize content validity through our previous extensive knowledge management practice analyses and case studies about Korean companies.

5.3.2. Construct validity. Construct validity seeks agreement between a theoretical concept and a specific measuring device or procedure; in the conduct of theoretical research,

TABLE 5. Structural Matrix of Exploratory Factor Analysis Using Oblique Rotation

Items	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7
P4	**.802**	−.171	−.345	.184	−.469	−.514	−.212
P3	**.756**	−.157	−.428	.115	−.358	−.577	−.143
P6	**.736**	−.421	−.578	.231	−.294	−.408	−.523
P2	**.726**	−.485	−.417	.333	−.293	−.356	−.256
P5	**.724**	−.451	−.527	.232	−.407	−.346	−.503
P1	**.647**	−.520	−.469	.227	−.359	−.379	−.476
P7	**.645**	−.307	−.469	.269	−.581	−.516	−.315
P8	**.603**	−.422	−.542	.153	−.470	−.400	−.537
C2	−.320	**.919**	.412	−.261	.217	.317	.164
C3	−.176	**.854**	.406	−.294	.232	.294	.144
C5	−.343	**.847**	.320	−.139	.264	.342	.137
C4	−.314	**.829**	.340	−.369	.264	.327	.231
C1	−.230	**.815**	.290	−.382	.282	.209	.091
FP3	.409	−.399	**−.939**	.241	−.228	−.287	−.408
FP2	.348	−.278	**−.912**	.183	−.264	−.321	−.364
FP1	.377	−.418	**−.910**	.222	−.262	−.294	−.351
FP4	.411	−.322	**−.902**	.181	−.229	−.294	−.415
T5	.094	−.215	−.181	**.792**	−.252	−.131	−.165
T4	.254	−.434	−.204	**.783**	−.186	−.118	−.051
T2	.148	−.151	−.149	**.759**	−.091	−.093	−.141
T3	.039	−.282	−.118	**.734**	−.232	−.199	.072
T1	.357	−.304	−.363	**.715**	−.103	−.183	−.430
S3	.423	−.170	−.316	.189	**−.843**	−.406	−.142
S2	.281	−.209	−.211	.180	**−.783**	−.350	−.282
S4	.350	−.182	−.348	.010	**−.772**	−.366	−.095
S1	.159	−.376	−.129	.392	**−.734**	−.291	−.214
S5	.509	−.440	−.385	.229	**−.568**	−.251	−.513
L2	.469	−.229	−.406	.117	−.391	**−.853**	−.397
L4	.329	−.326	−.401	.225	−.344	**−.844**	−.261
L3	.358	−.389	−.251	.226	−.343	**−.821**	−.135
L1	.362	−.199	−.281	.073	−.323	**−.769**	−.361
L5	.414	−.392	−.268	.132	−.468	**−.684**	−.190
CP3	.416	−.100	−.528	.170	−.325	−.439	**−.826**
CP2	.334	−.237	−.603	.214	−.266	−.428	**−.774**
CP1	.303	−.208	−.491	.144	−.307	−.503	**−.770**

it is the most important validity. To understand whether a piece of research has construct validity, three steps should be followed. First, the theoretical relationships must be specified. Second, the empirical relationships between the measures of the concepts must be examined. Third, the empirical evidence must be interpreted in terms of how it clarifies the construct validity of the particular measure being tested. In this study, we test construct validity by using confirmatory factor analysis (Carmines & Zeller, 1991).

As developed in the previous sections, each of the item clusters in Tables 1 through 3 represents an a priori measurement model of theoretical construct space. Given this theory-driven approach to construct development, confirmatory factor analysis provides an

TABLE 6. Oblique Rotation and Reliability Analysis Result

Constructs		Number of items			Cronbach's alpha
		Initial	Oblique	Reliability	
Knowledge management capabilities	T-shaped skills	5	5	5	0.8199
	Centralization	5	5	5	0.9195
	Learning	5	5	5	0.8762
	IT Support	5	5	5	0.8221
Knowledge management processes	Generating & accessing Facilitating & representing Embedding & using Transferring & measuring	8	8	8	0.9050
Knowledge management performance	Customer performance	3	3	3	0.8723
	Financial performance	4	4	4	0.9424

appropriate means of assessing the efficacy of measurement among scale items and the consistency of a prespecified structural equation model with its associated network of theoretical concepts (Hair et al., 1995; Jöreskog & Wold, 1982). In essence, the expectation is that each of the developed scales will uniquely measure its associated factor and that this system of factors will represent the system of relationships illustrated in Figure 1. Complex variables such as these should be modeled with their theoretical networks and then as a collective system (Jöreskog & Wold, 1982). Proceeding in this manner provides the fullest evidence of measurement efficacy and also reduces the likelihood of confounds in full structural equation modeling, which may arise due to excessive error in measurement. Working within this context, LISREL 8.3 for Windows NT is utilized as the analytical tool for testing statistical assumptions and estimation of the measurement and structural equation.

To assess the strength of measurement between the items and associated constructs, three kinds of measurement models are estimated. The first measurement models examine the system of relationships among measures of knowledge management capabilities (T-shaped skills, centralization, learning, and IT support). As shown in Figure 2, parameter estimates, fit indices, and observed residuals imply that the hypothesized dimensions of knowledge management capabilities provide a good fit for the observed covariance among the collection of item measures.

The observed χ^2 value of the self-efficacy model is 15.175 (p-value = 0.010), the centralization model χ^2 is 20.863 (p-value = 0.001), the learning model χ^2 is 31.692 (0.000), and the IT support model χ^2 is 9.730 (p-value = 0.083). Although χ^2 is not significant except in the IT support model with its significance level of .05, the goodness of fit indices (GFI), the adjusted goodness of fit indices (AGFI), the normed fit indices (NFI), and the nonnormed fit indices (NNFI) are very high, suggesting good model fit. All indicator reliabilities are sufficiently high and statistically different from zero. The residual matrix for the models contains no values significantly different from zero and the composite reliabilities of each construct are all above 0.80. In short, the fit statistics seem to suggest that each scale is capturing a significant amount of variation in these latent dimensions of knowledge management capabilities.

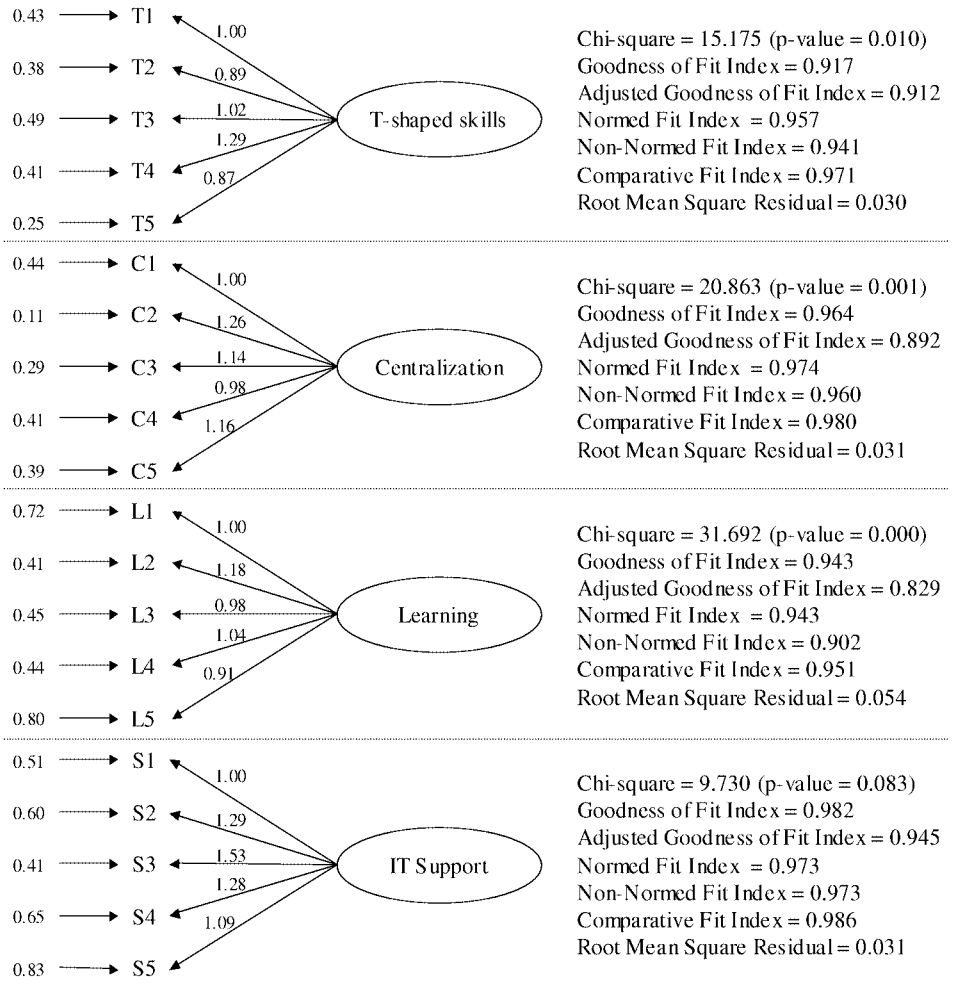

Figure 2 Measurement models of knowledge management capability.

The second measurement models examine the system of relationships among measures of knowledge management process. As shown in Figure 3, parameter estimates, fit indices, and observed residuals imply that the knowledge process is a reasonable representation of the covariance among their respective item measures. The model χ^2 value is 106.155 (p-value = 0.000), and χ^2 is not significant and rather large. Similar to the previous models, the GFI, AGFI, NFI, and the NNFI are high and suggest good model fit.

The third measurement models examine the system of relationships among measures of knowledge management performance (customer and financial perspectives). As shown in Figure 4, fit measures as well as parameter estimates suggest that this model of organizational performance is a good fit for the observed covariance in the sample. The observed χ^2 value of the customer model is 4.434 (p-value = 0.035) and the financial model χ^2 is 7.830 (p-value = 0.020). The GFI, the AGFI, the NFI, and the NNFI are high and suggest good model fit.

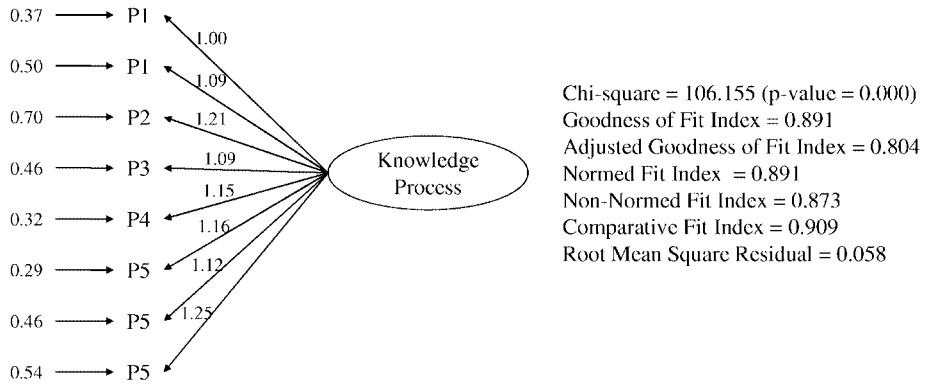

Figure 3 A measurement of the knowledge management process.

Through the confirmatory factor analyses, construct validity such as unidimensionality, concentration validity, and discriminant validity is verified.

5.3.3. Criteria-related validity. Criteria-related validity is the degree to which performance on one assessment predicts future performance on another assessment or in another task (predictive). For example, it is the degree to which the assessment of knowledge management processes accurately estimates a knowledge management performance. Therefore, criteria-related validity can be satisfied if the result of correlation analysis between constructs is significant (Gronlund, 1998).

In this study, we conducted a correlation analysis using the arithmetic mean value (summated scale) of the remaining items reflecting each construct through confirmatory factor analysis. The purpose of using a summated scale is to reduce measurement error and to raise representative of constructs into unidimensionality (Hair et al., 1995). Therefore, the higher mean value, the more agreement on the definition of constructs. Table 7 illustrates the result of conducting correlation analysis between constructs using a summated scale.

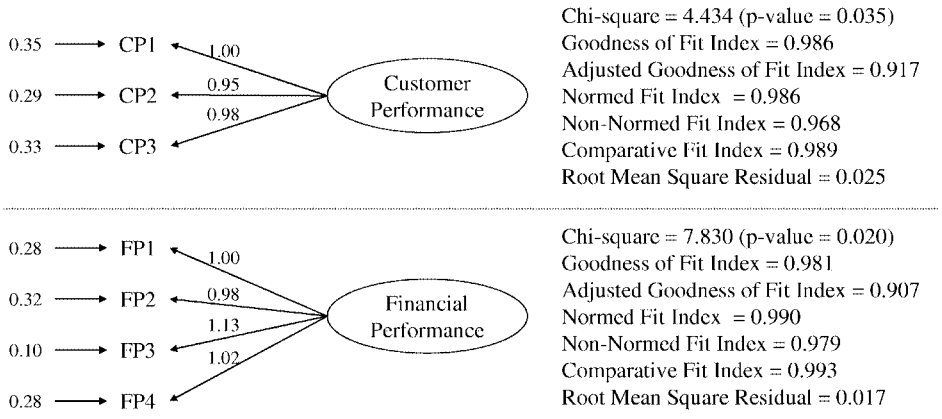

Figure 4 Measurement models of knowledge management performance.

TABLE 7. Correlation Coefficients Matrix of Constructs

Constructs	*M*	*SD*	T-shaped skills	Centralization	Learning	IT Support	Process	Customer	Financial
Self-efficacy	4.57	0.6693	1						
Centralization	3.07	0.9149	−0.404*	1					
Learning	3.83	0.9653	0.257*	−0.436*	1				
IT Support	4.22	0.8343	0.313*	−0.398*	0.545*	1			
Process	3.92	0.7784	0.375*	−0.528*	0.668*	0.651*	1		
Customer	3.81	0.9556	0.263*	−0.287*	0.554*	0.456*	0.631*	1	
Financial	3.65	1.0369	0.305*	−0.451*	0.411*	0.399*	0.623*	0.598*	1

*$p < .01$.

5.4. Assessment of the Structural Equation Model

In this study, we assumed that knowledge management capabilities may have effect on knowledge management processes, and then successful knowledge management processes may have an effect on knowledge management performance. As theorized, distinct causal paths from people, structure, culture, and IT capabilities predict alternative outcomes with respect to knowledge processes, and distinct causal paths from knowledge processes predict knowledge management performance (customer and financial perspectives).

As shown in Figure 5, the hypothesized model seems to provide a reasonable fit for the observed covariance. The observed χ^2 for this model is 955.292 ($df = 544$; $p = 0$). Associated fit indices (GFI, AGFI, NFI, NNFI, and CFI) meet recommended levels.

As also illustrated in Figure 5, the path coefficients of the estimated model support the theorized relationships of Figure 1 in direction and magnitude except the relationship between self-efficacy and process. Again, this implies that capabilities (decentralization of organizational structure, learning organization culture, and IT support) contribute to the successful knowledge management activities, and successful knowledge management activities contribute to performance in knowledge management.

It is important to note that the mathematical manifestation of these relationships is consistent with developed theoretical perspectives outlined in the introductory sections of this article. The contribution of these results is a more precise definitional aspect of these dimensions and some insight into the magnitude of their association. Although the reported model fits (particularly the χ^2 value) may be considered somewhat moderate in strength, it is important to balance the fit measures with the complexity of the model (measured by the high degrees of freedom). The strength of item loadings, consistency in directional path, and match to theory seem to imply strongly that the model illustrated in Figure 1 provides valid insight into the relationship between organizational performance, knowledge management capabilities, and processes. Table 8 summarizes the hypothesis test results in terms of path coefficients (standardized) and t-value in significance level 0.01.

6. CONCLUSIONS

Our results can help managers establish distinctive strategic positions. Knowledge management strategies can be described along two dimensions to reflect knowledge

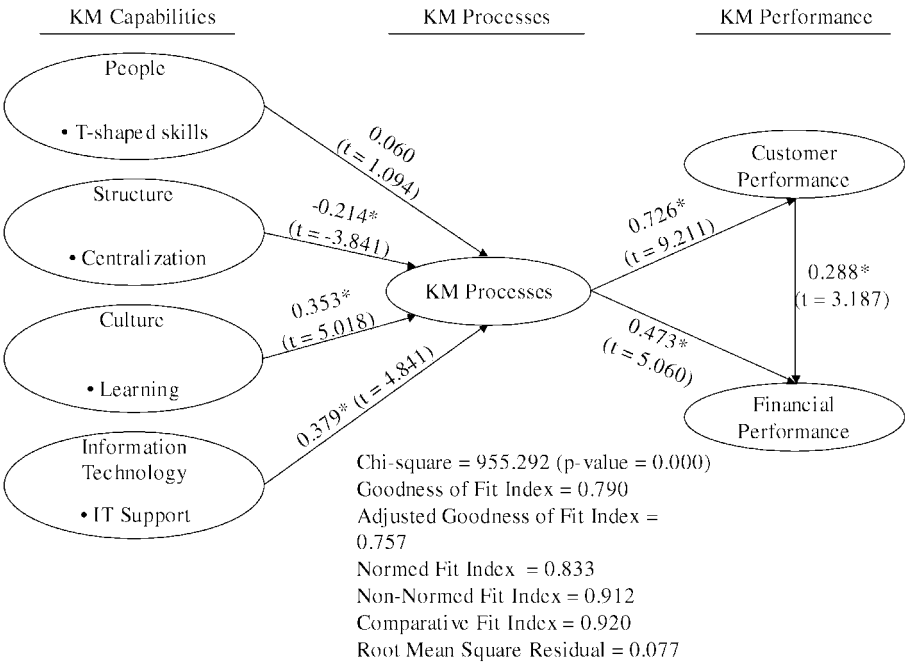

Figure 5 A structural model of capabilities, process, and performance. *Path coefficients are standardized regression weights.

management focus. One dimension refers to knowledge processes such as acquiring, converting, using, and transferring knowledge. The other dimension refers to the organizational capabilities to help the knowledge processes. Knowledge management strategists can sharpen weak knowledge management processes based on capabilities mentioned in our study.

In this study, we have focused on the discussion and analysis of knowledge management to core capabilities that are needed to facilitate knowledge process, and then to

TABLE 8. The Results of the Hypothesis Test

No	Hypotheses	Path coefficients	*t*-value	Results
H1	Self-efficacy → Knowledge process	0.060	1.094	Reject
H2	Centralization → Knowledge process	−0.214	−3.841*	Accept
H3	Learning → Knowledge process	0.353	5.018*	Accept
H4	IT Support → Knowledge process	0.379	4.841*	Accept
H5	Knowledge process → Customer performance	0.726	9.211*	Accept
H6	Knowledge process → Financial performance	0.473	5.060*	Accept
H7	Customer performance → Financial performance	0.288	3.187*	Accept

*$p < .01$.

derive an organization's competitiveness. We believe this to be a very important distinction because many organizations tend to launch programs of knowledge management without due consideration of the company's capabilities and processes to guarantee any measure of success. Through analysis of theory and empirical testing, this study strongly supports the notion that companies may possess a predisposition for successful knowledge management through the improvement of key capabilities and processes. Our results imply that organizational structure (decentralization), learning organizational culture, and IT support from a definitional basis for the theoretical framework positively impacts key aspects of knowledge processes (or knowledge management activities) Our results also imply that process activation of generating, accessing, facilitating, representing, embedding, usage, transferring knowledge, and measuring knowledge assets form an operational perspective for the framework of knowledge combination and exchange that underlies the theory of knowledge integration is positively related to organizational performance (customer and financial perspectives). Together, these results suggest that theories of knowledge capabilities provide a rich resource for developing empirically based studies and that capabilities can provide a useful benchmark for managing knowledge management within the company.

Although this research presents strong evidence regarding the relationships among capabilities, processes, and performance of knowledge management, the results should be considered in light of its inherent limitations. First, this study presents a cross-sectional research that does not consider time-lag effects. A longitudinal study to investigate the dynamic features of knowledge management would provide further robust results. Second, it focuses on relatively large and profitable firms. The results may differ in small or venture firms. Finally, the results are limited to Korean firms. The generalization from a Korean setting to other countries may be questionable.

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