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EFFECTIVE WORK UNIT KNOWLEDGE MANAGEMENT (KM): AN EXPLORATORY INVESTIGATION OF THE ROLES OF NETWORK, TASK ENVIRONMENT, AND KM STRATEGIES

Knowledge Management

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Abstract

Many organizations have initiated knowledge management practices to improve the effectiveness of knowledge creation, transfer, and utilization. However, few studies have been attempted to address what makes some work units within the organization more effective in their use of knowledge than others. In this study we explore the potential contribution of inter-unit network structure as well as intra-unit task environment to the overall KM effectiveness within an organization. The results indicated that both a unit's boundary-spanning role and its extensive interaction with other units help promote the overall effectiveness of the unit's KM activities. In addition, we found that a unit's KM strategy played a mediating role between intra-unit task characteristics and KM effectiveness.

Keywords: Network structure, Knowledge management, knowledge management effectiveness, Task Characteristics

Introduction

In recent years, knowledge has been acknowledged as a sustainable basis for competitive advantage in organizations (Teece, 2000; Zack, 1999). Many organizations have initiated knowledge management (KM) practices to improve the effectiveness of knowledge creation, transfer, and utilization. Much attention has been given to knowledge management practices (Alavi and Leidner, 2001; Brown and Duguid, 2001; Hansen et al., 1999; Zack, 1999), as well as how knowledge is employed to create value within organizations (Gold et al., 2001; Lee and Choi, 2003; Sabherwal and Bercerra-Fernandez, 2003). However, a typical employee spends most of his/her work days interacting with other members within the same work unit, and much of these are KM activities, such as knowledge creation, sharing, transfer, and utilization. While many studies contribute to understanding the success of knowledge management (KM) at the organizational level (Hansen et al., 1999; Lee and Choi, 2003; Wasko and Faraj, 2005), few studies have attempted to examine why some work units within the organization are more effective in their use of knowledge than others (Sabherwal and Bercerra-Fernandez, 2003; Cummings, 2004).

To achieve effective KM at the organizational level, there is a vital need to integrate knowledge from various work units. Thus, the process of knowledge exchange between work units is critical to organizational KM effectiveness. In the social networks literature (e.g. Burt, 1992; Coleman, 1988), network structures facilitate exchange relationships that afford opportunities and assets that would otherwise not be available. Previous studies have uncovered the influence of network characteristics, i.e., the manner in which a work unit exchanges information with other units, such as centrality, tie strength, and structural holes, on factors such as knowledge transfer across organizational subunits (Hansen, 1999, 2002), group effectiveness (Oh et al., 2004), organizational performance (Ahuja and Carley, 1999; Tsai, 2001), and innovation (Ahuja, 2000). Therefore, to the extent that an organization takes these network characteristics into consideration, it may be able to improve KM effectiveness at the work unit

level and ultimately enhance its overall KM effectiveness. *This motivates our first research question for the study: How do a work unit's network positions in its relationships with other units affect the unit's KM effectiveness?*

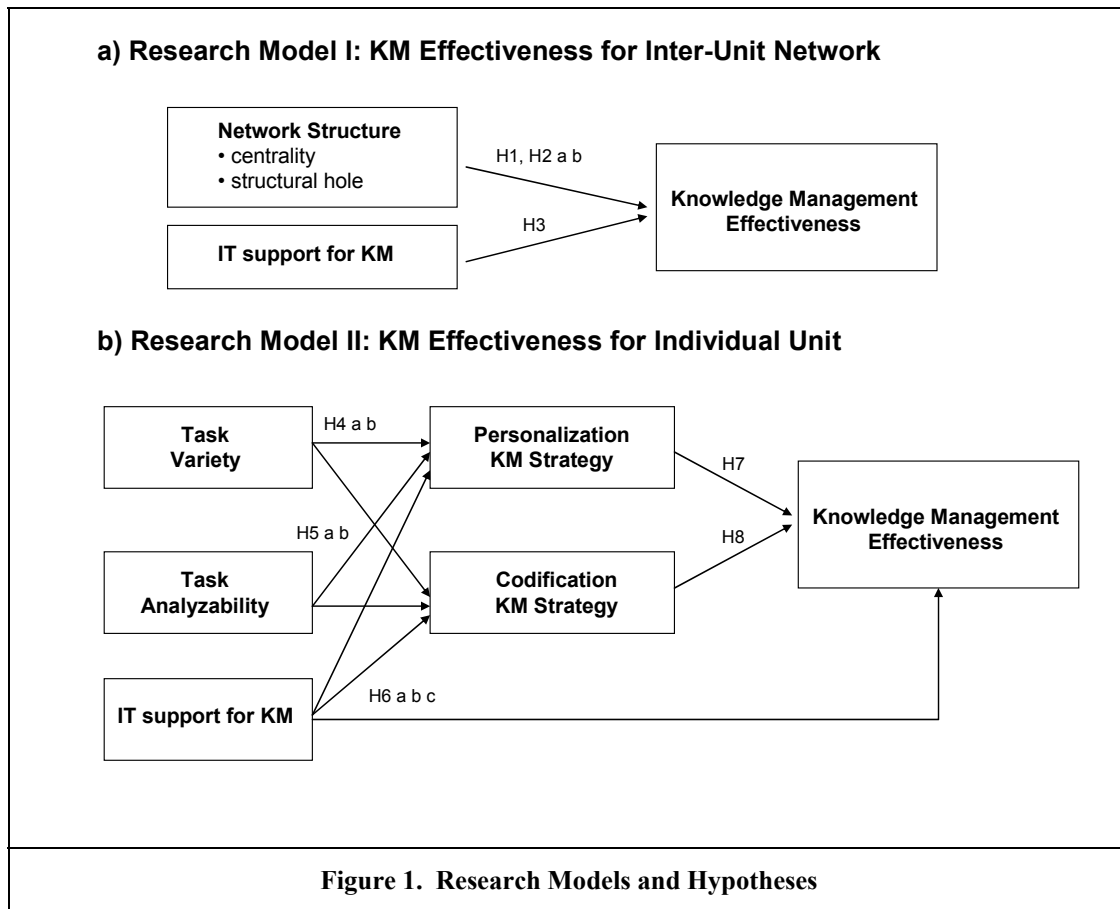
According to the information processing theory (Galbraith, 1973), organizations need quality information to reduce environmental uncertainty. The various units within an organization differ in their information processing needs. The information processing requirements of each unit are characterized by the extent to which the task contains variety and is analyzable (Perrow, 1967; Daft and Lengel, 1986). Further, the form and nature of the knowledge that is being processed may vary. Some organizations prefer to deal with codified and explicitly represented forms of knowledge, whereas others may rely on the tacit knowledge of personnel to solve problems. Thus, researchers have identified two different KM strategies: codification and personalization (Hansen et al., 1999). While a firm needs an overall KM strategy at the organizational level, much of KM activities occur daily within work units, and these activities may not be managed effectively in a uniform manner throughout an organization due to differences in task characteristics in various work units. However, little attention has been directed at examining the relationship between task characteristics and KM strategies, and its ultimate impact on KM effectiveness. *Thus, the second research question we will address in the study is: Given the task environment within a work unit, how will different KM strategies affect its KM effectiveness?*

The paper is organized as follows. First, we will present two research models, corresponding to the two research questions identified above. This is followed by a list of hypotheses based upon the research model. Next, we describe our research methodology and the research variables. Subsequently, we present the study results and a discussion of research findings. We conclude the paper with a discussion of the limitations and the implications of the study.

Research Models

We have developed two research models to address the two research questions. As shown in Figure 1, the first model attempts to study the influence of inter-unit network structure and IT support on KM effectiveness. The overarching theoretical basis for this model is the socio-technical perspective advocated by Mumford (1983). Since the inception of the IS field, this perspective has been the anchor for IS development and adoption in the context of organizations (Bostrom and Heinen, 1977). In the case of KM, the network structure constitutes a vital social capital (Burt, 1992; Coleman, 1988). When the presence of this social component is joined by information technology, i.e., IT support for KM, we can then expect to achieve more KM effectiveness.

For the second model in Figure 1, we seek to examine the extent that factors within individual units may influence KM effectiveness. The relevant theoretical base is the information processing perspective developed by Galbraith (1973). According to this theory, to cope with uncertainty, an organization may either attempt to reduce uncertainty or enhance its ability for dealing with uncertainty by increasing its information processing capacity. One way to increase information processing capacity, according to Galbraith (1973), is to use computer and IT. Further, the information processing requirements of each unit are influenced by two underlying task characteristics: task variety and task analyzability (Perrow, 1967; Daft and Lengel, 1986). Accordingly, we have included three independent variables in the second model: task variety, task analyzability, and IT support for KM.



KM Effectiveness as an Outcome Variable

For the study of knowledge management, like other IS management phenomena, researchers need to identify a suitable success measure (DeLone and Mclean, 1992). Previous KM studies have used organization performance and creativity (Lee and Choi, 2003), organizational effectiveness (Gold et al., 2001), and KM effectiveness (Sabherwal and Becerra-Fernandez, 2003) as success measures. KM effectiveness for any entity involves an assessment of “whether the entity receives and understands the knowledge needed to perform its tasks” (Sabherwal and Becerra-Fernandez, 2003; p. 227). To access perceived KM effectiveness, Sabherwal and Becerra-Fernandez (2003) measured general KM satisfaction. However, they suggested that more comprehensive measure might be required in order to capture the richness of this construct. According to Alavi and Leidner (2001), KM effectiveness may be conceptualized by focusing on the extent of success in the KM cycle: the creation, storage/retrieval, transfer, and application of knowledge for task performance in the organization. In this study, we attempt to conceptualize KM effectiveness as KM satisfaction with the process of knowledge creation, acquisition, transfer, and application.

Inter-Unit Network Structure and KM Effectiveness

The impact of social networks on social capital and KM activities has been widely discussed in the literature (Borgatti and Foster, 2003; Brass et al., 2004; Burt, 2000). We focus on investigating the effect that the network position of intra-organizational units has on their KM effectiveness. A unit may enjoy informational benefits by forming a network relationship with other units that have complementary resources. Previous studies have shown that these resource exchange networks lead to benefits such as enhancing innovation (Tsai, 2001; Tsai and Ghoshal, 1998), facilitating knowledge transfer (Hansen, 1999; Tsai, 2002), and improving performance (Ahuja and Carley,

1999; Oh et al., 2004; Reagans and Zuckerman, 2001). We consider two network characteristics that may influence KM effectiveness of intra-organizational units: *indegree* centrality and structural holes (Burt, 1997; Hansen, 2002; Nerkar and Paruchuri, 2005).

The degree of centrality in a work unit's network positions reflects the extent to which the unit is involved in resource exchange. Thus, centrality exemplifies a work unit's power relative to other units (Freeman, 1979; Ibarra, 1993). Units that are more central in a resource exchange network are likely to engage in forging new intra-organizational linkages that can lead to benefits such as knowledge and resource sharing, mutual learning, and access to complementary skills (Tsai, 2000). In addition, a central unit is capable of applying other units' knowledge or practices to deal with complex challenges (Tsai, 2001). Further, the degree of centrality may be associated with Uzzi's notion of *embeddedness* (1997), which implies that the focal unit shares resources, exchanges knowledge and collaborates with other units to solve problems. The units with higher degree of centrality are able to improve access to the quality of information, which in turn enhances its performance (Hansen, 2002; Kilduff and Krackhardt, 1994; Tsai, 2001). Therefore,

H1: *The centrality of a work unit's network position is positively associated with the work unit's KM effectiveness.*

Another prominent characteristic of a unit's network position is the structural hole. Structural holes refer to the extent to which an actor in a network has access to unconnected non-redundant contacts (Burt, 1992). In the context of intra-organizational units, a structural hole would be a buffer between units that are themselves not connected. Structural holes provide an opportunity for a work unit to access diverse information and knowledge, leading to richer content (Hargadon and Sutton, 1997; Nerkar and Paruchuri, 2005). The more structural holes a unit spans, the fewer its redundant contacts (Ahuja, 2000; Burt, 1992). Burt (2000) argues that units that span more structural holes are likely to accumulate more social capital and enjoy better performance than those with fewer structural holes. Thus, such units afford benefits such as the creation of new knowledge and enhancing the potential for innovative behavior (Obstfeld, 2005; Reagan, Zuckerman, and McEvily, 2004).

From the social network perspective, there are two different views on how network positions create social capital. The traditional "closure" view emphasizes the positive effects of dense and cohesive ties on a normative environment that facilitate trust and cooperation between actors (Coleman, 1988, 1990), which in turn affords benefits such as exchange of information and knowledge. Structural hole theory (Burt, 1992, 1997), on the other hand, claims that benefits from social capital result from the brokerage opportunities, since actors who span structural holes are able to access diverse information. These two perspectives lead to opposite predictions on how the inter-unit network structures may affect a unit's performance in task environment (Gargiulo and Benassi, 2000; Reagans and Zuckerman, 2001).

In the closed network, social closure (i.e., lack of structural holes) fosters the development of trust and shared norms of behaviors, which in turn facilitates knowledge exchange and collaboration between units (Ahuja, 2000; Coleman, 1988). Further, dense ties between units are likely to restrain opportunism (Ahuja, 2000; Coleman, 1988; Rowley, Behrens, and Krackhardt, 2000). Thus, highly interconnected network enables the units to enjoy informational benefits, such as fine-grained information transfer and joint problem solving (Ahuja, 2000; Reagans and Zuckerman, 2001; Uzzi, 1997).

This study uses the network variable *constraint*, which refers to the extent to which a work unit's network is concentrated in redundant contacts (Burt, 1992). The *constraint* is a function of direct communication between units. Units that span more structural holes are less constrained. Greater benefits, such as access to diverse information, accrue to units that have lower *constraints* or more non-redundant contacts. On the contrary, network with fewer structural holes (i.e., more redundant contacts) may promote collective behaviors and reduce opportunism, which in turn may also enhance the unit's effectiveness in their use of knowledge. Thus, both of the following two hypotheses are supported by previous studies and theories:

H2a: *The extent of the redundant contacts (lack of structural holes) that a work unit maintains is positively associated with the work unit's KM effectiveness.*

H2b: *The extent of the redundant contacts (lack of structural holes) that a work unit maintains is negatively associated with the work unit's KM effectiveness.*

As discussed earlier, the socio-technical perspective (Mumford, 1983) compels us to pay attention to the social network structure as well as IT support in examining the contributors to KM effectiveness. Indeed, IT plays a major

role in facilitating the flow of knowledge in organizations. IT can improve the efficiency and effectiveness of an organization by promoting knowledge codification (Leidner and Elam, 1995), or by reducing the cost of communication (Pickering and King, 1995). IT enables people not only to access prior knowledge, but to search for and absorb new knowledge and easily reach experts in specialized areas (Dewett and Jones, 2001; Hansen, 1999). Further, IT increases information and knowledge exchange even when people are not physically proximate (Sarbaugh-Thompson and Feldman, 1998), which in turn influences organizational performance (Lind and Zmud, 1995). Thus, we hypothesize,

H3: *Extent of organizational IT support for KM is positively associated with the degree of KM effectiveness in the work unit.*

KM Effectiveness for Individual Units

Much of knowledge management activities, such as knowledge creation, sharing, and storage, occur in work units, as an employee typically spends most of his or her working hours in the work unit interacting with his or her colleagues or team members. In this section, we examine the relationships between task environment, KM strategies, and KM effectiveness in the context of a work unit (see Part (b) of Figure 1).

For KM strategies, a work unit can generally follow a codification strategy or a personalization strategy (Hansen et al., 1999) in its KM activities: creating, transferring, and utilizing knowledge. While the codification strategy involves mostly formal documentation, the personalization strategy relies mainly on face-to-face interactions between workers (Gammelgaard and Ritter, 2005). For example, procedures for handling accounts payable can be readily documented (i.e., codified). In these situations, knowledge may be codified by means of manuals, formal documents, and databases, etc. Personalization, on the other hand, refers to how people interact and share their knowledge with others. For example, peculiar ways to handle certain types of customers would be difficult to describe and codify, and the sharing and transfer of such knowledge would benefit greatly from personal interactions between employees.

Task environment can be characterized by task variety and analyzability (Perrow, 1967). Task variety refers to the number and frequency of exceptional, unexpected, and/or novel events in the task over time (Daft and Macintosh, 1981). According to the information processing theory, organizations process information to reduce uncertainty and equivocality (Daft and Lengel, 1986; Galbraith, 1977). Task variety represents uncertainty about the occurrence of problems and exceptions in performing a task (Daft and Macintosh, 1981). Thus, when task variety is high, people have greater difficulty in predicting problems or activities in advance (Daft and Macintosh, 1981), and they would normally devote more efforts in seeking information/knowledge from formally recorded documents or computer files (the codification strategy) or by consulting colleagues through face-to-face contacts (the personalization strategy):

H4a: *In an organizational work unit, the level of task variety is positively associated with its reliance on the personalization KM strategy.*

H4b: *In an organizational work unit, the level of task variety is positively associated with its reliance on the codification KM strategy.*

Task analyzability refers to the extent to which a task can be broken into small, well-defined components (Perrow, 1967; Ahuja and Carley, 1999). Analyzable tasks involve more rules and procedures. Thus, when the environment for a work unit is permeated mostly by analyzable tasks, there are more information cues available and more procedures established (Rice, 1992), and people are expected to process more formalized and written form of information. On the other hand, in a work unit with unanalyzable tasks, information processing is “more personal, less linear, more ad hoc and improvisational” (Daft and Weick, 1984: p. 287) than for units with more analyzable tasks. For unanalyzable tasks, people are required to seek satisfactory solutions to problems outside of their domains of rules and procedures (Rice, 1992). Further, people are more likely to use rich media, such as face-to-face communication, for accomplishing the task (Rice, 1992; Van de Ven et al., 1976). Thus,

H5a: *In an organization work unit, the level of task analyzability is negatively associated with its reliance on the personalization KM strategy.*

H5b: *In an organization work unit, the level of task analyzability is positively associated with its reliance on the codification KM strategy.*

Previous studies have shown that IT is a major component of KM infrastructure (Gold et. al., 2001; Kankanhalli et al., 2003) and contributes significantly to the knowledge creation process (Lee and Choi, 2003). Majchrzak, Malhotra, and John (2005) observed that IT enables an individual to develop knowledge through communicating one's own ideas and integrating it with others' ideas. An organization with the codification approach makes high investment in information technology to facilitate the creation, storage, retrieval, sharing, and transfer of knowledge assets that are deemed to be reusable (Hansen et al., 1999). On the other hand, firms engaged in the personalization approach invest heavily in human capital, relying on the deep tacit knowledge of their employees. IT may facilitate conversations and the exchange of tacit knowledge (Hansen et al., 1999). The sharing of the wealth of tacit knowledge possessed by employees in these firms is crucial to their success. Researchers (e.g. Stein and Zwass, 1995) argued that IT support is crucial to deal with the core knowledge of organizations.

H6a: The extent of organizational IT support for KM is positively associated with the reliance on the personalization KM strategy in a work unit.

H6b: The extent of organizational IT support for KM is positively associated with the reliance on the codification KM strategy in a work unit.

H6c: The extent of organizational IT support for KM is positively associated with the degree of KM effectiveness in the work unit.

Through the internalization process (Nonaka, 1994), explicit knowledge may be embodied in action and practice, and thus individuals are able to absorb it and turn it into tacit knowledge. Face-to-face communication (i.e., personalization) and learning by doing are examples of internalization processes by which individuals acquire knowledge. Sabherwal and Becerra-Fernandez (2003) found that internalization facilitates individual level KM effectiveness. In addition, we may expect individuals to enhance effectiveness by exchanging tacit knowledge through joint activities. Thus, a work unit would have high KM effectiveness if the unit relies heavily on personalization in its KM activities.

H7: In an organization work unit, the extent of its reliance on the personalization KM strategy is positively associated with the degree of KM effectiveness.

To make tacit knowledge agreeable and understandable to others, it should be "objectivated" (von Krogh and Roos, 1995). Among the four types of the knowledge creation process (Nonaka, 1994), externalization refers to the process of transforming tacit knowledge into documented forms that others can understand, which is central to the codification KM strategy (Hansen et al., 1999). Sabherwal and Becerra-Fernandez (2003) found that externalization facilitates individual level KM effectiveness. Thus, a work unit is more likely to have higher KM effectiveness if members of the unit more actively engage in the codification activities in managing knowledge.

H8: In an organization work unit, the extent of its reliance on the codification KM strategy is positively associated with the degree of KM effectiveness.

Research Methodology

The survey method was used to empirically test the hypotheses. We developed the items in the questionnaire by adapting previously validated instruments. We administered two survey forms: a member-survey form that obtained responses from members of each work unit, and a leader-survey form issued only to the leader of each unit to obtain his/her perception on inter-unit communications. The sample frame consists of experienced knowledge workers which typically includes managers and professionals. Drucker (1994) defined knowledge workers as high-level employees who apply theoretical and analytical knowledge, acquired through formal education, and who have a habit of continuous learning. Managers and professionals hold the typical characteristics of knowledge workers and were found to play key roles in knowledge management (Choi and Lee, 2003; Janz et al., 1997). A pilot test was undertaken with 12 experienced knowledge workers, which resulted in some refinement to the questionnaire.

The refined instrument was used to collect data from 27 business units of a large multi-unit advanced aerospace technology company located in a large southern city. The member-survey form was administered to a total of 500 managers and professionals in the company. 156 responses were returned (31 percent response rate). Additional questionnaires (i.e. the leader-survey) to measure inter-unit network structure were distributed to the team leaders of 27 work units, and 20 responses were returned (74 percent response rate). Out of the 156 responses, 27 have

incomplete data and were eliminated from further analysis. Among the remaining 129 responses, 84 were from these 20 work units. As a result, 20 leader responses as well as 84 member responses were used in the data analysis.

Sample Characteristics

At the beginning of the questionnaire, we provide a definition of knowledge. Next, we explain what a “work unit” is with this description:

Everyday you work with a number of colleagues in a “work unit” which is headed by your immediate supervisor (or by yourself). Examples of such work units include various functional departments (e.g. marketing, finance, purchasing, R&D, HR, etc.) and units within a large department (e.g. quality control in the production function, accounts receivable in the accounting function, etc.).

The respondent is also asked to indicate the name of the unit he/she belongs to and also briefly describe its activities. In addition, the questionnaire also asks for basic demographic information from the respondents.

The age of respondents ranged from 25 to 65 with an average of 48.04 (S.D. = 8.86). Consequently, knowledge workers of virtually all ages were represented in our sample. The presence of both genders in our sample also appears to be consistent with what one might expect in a population of knowledge workers: 68% male and 32% female. The mean number of years a respondent had spent with his/her present unit was 8.26 (S.D. = 7.54). Thus, we can be reasonably sure that they assessed the conditions in their units with a relatively high degree of accuracy. The average size of work units was 27.1 people (S.D. = 27.12; 32 for 75 percentile). About one third (35.2 %) of the respondents classified themselves as managers, and the remainder consisted of engineers, analysts, specialists, and a variety of other knowledge workers. These sample characteristics provide strong indications that the respondents are reasonably representative of the population of experienced knowledge workers.

Measurement of Research Variables

Dependent Variable

Knowledge Management Effectiveness. The items for KM effectiveness were developed based on our conceptualization of KM effectiveness discussed earlier (see Appendix 1). This encompasses satisfaction with the stages of the KM cycle, i.e., the process of knowledge creation, acquisition, storage, transfer, and application. The 7-point Likert scale was used, anchored by “strongly disagree” (1) and “strongly agree” (7).

Independent Variables

Network structure. On the leader-survey form, the names of all the work units involved in the study were listed. We assessed work unit relations by asking team leaders a question: “In the past year, how much information did you obtain on work-related matters from this team?” (Burt, 1992; Ibarra, 1993; Sparrowe et al., 2001). The 5-point Likert scale was used, anchored by “none” (1), “some” (3), and “very much” (5). This scale is the basis of the two network structural measures described below.

We considered *indegree* centrality as well as *network constraints* (lack of structural holes). *Indegree* centrality refers to a work unit’s power or status in a network (Wasserman and Faust, 1994). In addition, *indegree* indicates the extent to which a work unit serves as a knowledge source or advisor to other units (Hansen, 2002). *Indegree* is the most suitable centrality measure for capturing an actor’s information or knowledge access (Freeman, 1979; Tsai, 2001). *Indegree* centrality of a work unit n_i was computed as,

$$C(n_i) = \frac{x_{+i}}{g-1}$$

where x_{+i} represents the number of ties received by work unit i , and $g-1$ is the maximum possible number of ties linking i to the other units (Wasserman and Faust, 1994). We used a constraint-based approach to measuring structural holes (Gargiulo and Benassi, 2000; Nerkar and Paruchuri, 2005). *Network constraint* refers to the extent to

which a work unit’s network is concentrated in redundant contacts (Burt, 1992). The sum of network constraints is considered as lack of structural holes (Gargiulo and Benassi, 2000). They were computed following Freeman’s (1979) definition in UCINET 6 software package (Borgatti, Everett, Freeman, 2002). *Network constraint* was measured as,

$$C_{ij} = (p_{ij} + \sum_q p_{iq} * p_{qj})^2 \text{ for } q \neq i, j$$

where p_{ij} is the proportion of work unit i ’s relations invested in contact j , and $\sum_q p_{iq} * p_{qj}$ is the portion of work unit i ’s relations invested in contacts q who are in turn invested in contact j (Burt, 1997).

KM Strategies: Personalization and Codification. We developed the questionnaire items based upon Choi and Lee (2003). The measures reflected the extent of relying on formal documentation or spontaneous face-to-face interaction throughout the knowledge management cycle – creation, acquisition, sharing and transfer, and utilization (see Appendix 1). We used the 7 point Likert scale, anchored by “to a very little extent” (1) and “to a very great extent” (7).

Task Characteristics: Task Analyzability and Task Variety. Both scales were developed and validated by Daft and Macintosh (1981), who reported a Cronbach’s coefficient alpha = 0.77 for task variety and 0.86 for task analyzability. We used the 7-point Likert scale, anchored by “to a very little extent” (1) and “to a very great extent” (7).

IT support for Knowledge Management. The items measuring IT support for KM (see Appendix 1) were developed based upon the measures used by Lee and Choi (2003). The 7-point Likert scale was used, anchored by “strongly disagree” (1) and “strongly agree” (7). Table 1 and 2 reports the descriptive statistics and correlations for independent and dependent variables.

Table 1. Descriptive and Correlations of Research Variables					
Inter-Units (N = 20)					
	Means	S.D.	Correlation		
			1	2	3
1. KM Effectiveness ^a	4.18	0.96			
2. Indegree Centrality	0.29	0.10	0.39		
3. Network Constraint ^b	0.23	0.02	-0.51	-0.18	
4. IT support for KM ^a	4.12	0.85	0.46	-0.18	0.02
Note: a) The measure was aggregated by work unit. b) Structural holes were measured by using a network constraint-based approach.					

Table 2. Descriptive, ICRs, Correlations, and AVE Values of Research Variables									
Intra-Unit (N = 84)									
	Means	S.D.	ICR	Correlation					
				1	2	3	4	5	6
1. KM Effectiveness	4.31	1.17	0.95	0.88					
2. Codification	4.39	1.21	0.92	0.58	0.87				
3. Personalization	5.39	0.85	0.91	0.28	0.07	0.84			
4. Task Variety	4.80	0.92	0.85	0.19	0.27	0.39	0.76		
5. Task Analyzability	4.86	1.15	0.91	0.43	0.48	-0.06	-0.02	0.84	
6. IT support for KM	4.17	1.39	0.97	0.48	0.46	0.18	0.10	0.40	0.93
ICR: Internal Composite Reliability; AVE: Average Variance Extracted									
Note: Boldface numbers on the diagonal are the square roots of the AVE values.									

Reliability and Validity

For the intra-unit analysis, given the size of the sample (N = 84), we tested the research model using the partial least square (PLS) method with PLS Graph 3.0 (Chin, 2001). Before testing the various hypotheses, we first examined the reliability and validity of the scales. The internal composite reliability (ICR) values are reported in Table 2. If ICR values are less than 0.70, the items may be unrelated, or measuring more than one construct. As seen in the table, all ICR values are above 0.70 (range from 0.85 to 0.97), and thus deemed acceptable (Fornell and Larcker, 1981). To ascertain the discriminant and convergent validity, we require the average variance extracted (AVE) to exceed 0.50, or the square root of AVE to be greater than the correlation between a construct and any other construct (Chin, 1998). As can be seen in Table 2, the square root of the AVEs (on the diagonal) is indeed greater than the corresponding correlations. We have also carried out an exploratory factor analysis with varimax rotation. The results, as indicated in Table 3, reveal that all the constructs are clearly delineated.

Table 3. Exploratory Factor Loading for Research Variables (Intra-Unit, N = 84)

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
KSAT1	0.875	0.086	-0.032	0.083	0.123	0.069
KSAT2	0.883	0.157	0.118	0.082	0.121	0.186
KSAT3	0.631	0.317	0.269	0.045	0.117	0.389
KSAT4	0.744	0.371	0.254	-0.019	0.143	0.120
KSAT5	0.786	0.284	0.117	0.052	0.253	0.329
EO1	0.178	0.704	-0.085	0.250	0.365	0.175
EO2	0.220	0.832	0.012	0.037	0.054	0.232
EO3	0.225	0.835	0.078	0.115	0.253	0.121
EO4	0.343	0.743	-0.038	0.180	0.176	0.294
TO1	0.035	0.097	0.860	0.094	-0.094	-0.001
TO2	0.146	-0.102	0.848	0.086	-0.005	0.203
TO3	0.077	0.001	0.795	0.151	-0.033	0.147
TO4	0.112	0.019	0.749	0.293	-0.011	-0.047
TV1	0.038	0.173	0.116	0.784	-0.052	0.142
TV2	-0.006	0.214	0.011	0.862	-0.174	0.046
TV3	0.160	-0.156	0.313	0.643	0.059	-0.119
TV4	0.027	0.103	0.278	0.613	0.049	-0.003
TA1	0.093	0.252	0.031	-0.145	0.782	0.039
TA2	0.024	0.077	0.046	-0.064	0.822	0.238
TA3	0.311	0.086	-0.134	0.211	0.782	0.184
TA4	0.246	0.225	-0.154	-0.099	0.748	0.194
IT1	0.084	0.189	0.055	-0.060	0.143	0.876
IT2	0.270	0.173	0.022	0.025	0.132	0.895
IT3	0.250	0.101	0.071	0.102	0.068	0.901
IT4	0.054	0.117	0.140	0.040	0.089	0.888
IT5	0.157	0.180	0.034	0.019	0.338	0.842

Levels of Analysis

The unit of analysis is individual for intra-unit analysis (Hypotheses 4 through 8). All task-related and KM-related measures were measured at the individual level. For inter-unit analysis (Hypotheses 1 through 3), the unit of analysis is at the work unit level. Network structure, as described earlier, was measured at the work unit level by collecting responses from unit leaders. Individual perceptions on IT support and KM effectiveness were aggregated by taking the average of unit members' responses and expressing them as the work unit value (Janz et al., 1997). And, the long tenure of most of the work unit members indicated that our perceived measures reflected a view of the collective (Hackman, 1992; Janz et al., 1997).

To justify using the average value of work unit members as an indicator, it was critical to demonstrate high within-work unit agreement. The inter-rater agreement represents interchangeability among raters (James et al., 1984). Agreement was assessed using the $r_{wg(j)}$ index. The median values of $r_{wg(j)}$ for KM effectiveness and IT support for KM were 0.93 and 0.91, respectively. George (1990) indicated that aggregation is justified by a median $r_{wg(j)}$ value of 0.70 or greater. The value of $r_{wg(j)}$ were also consistent with the findings of other studies (Choi and Lee, 2003; Janz et al., 1997).

Hypotheses Testing

We used regression analysis to examine the relationship between inter-unit network structure and KM effectiveness. Results of the regression analysis are summarized in Table 4.

	R²	β	t-value
Dependent: KM Effectiveness			
<i>Indegree Centrality</i>	0.15	0.54	1.76*
<i>Network Constraint</i>	0.26	-3.39	2.46*
IT support for KM	0.22	0.54	2.17*
Note: * indicates $p < 0.05$ and ** indicates $p < 0.01$			

The results showed that a work unit occupying a more central position is likely to have higher KM effectiveness, confirming H1 ($b = 0.54$, $t = 1.76$, $p < 0.05$). As hypothesized in Hypothesis 2b, there was a significant negative relationship between the redundant contacts that a work unit maintains and its KM effectiveness ($b = -3.39$, $t = 2.46$, $p < 0.05$), and we found support for this hypothesis. Also, there was significant relationship between and IT support for KM, supporting H3 ($b = 0.54$, $t = 2.17$, $p < 0.05$).

Results of the PLS analysis for intra-unit, including all R^2 and path coefficients values, are reported in Table 5 and also indicated in Figure 2. R^2 values indicate the amount of variance explained by the model (Chin, 1998). The model explained 39% of the variance in the use of codification KM strategy, 21% of variance in the use of personalization strategy, and 47% of variance in KM effectiveness.

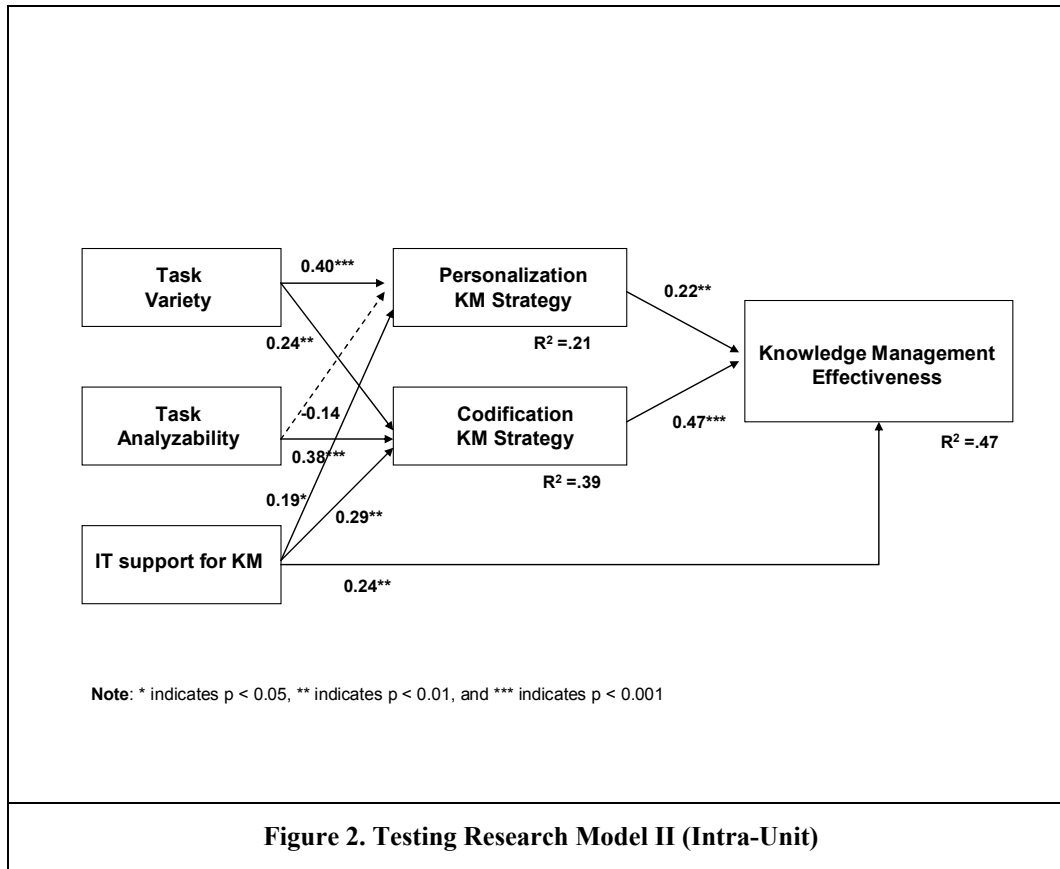
Table 5: Results of PLS Analysis (Intra-Unit, N = 84)

		<i>Personalization</i>	<i>Codification</i>	<i>KM Effectiveness</i>
	R^2	0.21	0.39	0.47
H4 a b	Task Variety			
	<i>Path Coefficient</i>	0.40***	0.24**	
	<i>t value</i>	4.90	2.90	
H5 a b	Task Analyzability			
	<i>Path Coefficient</i>	-0.14	0.38***	
	<i>t value</i>	1.24	3.62	
H6 a b c	IT support for KM			
	<i>Path Coefficient</i>	0.19*	0.29**	0.24**
	<i>t value</i>	1.83	3.14	2.73
H7	Personalization			
	<i>Path Coefficient</i>			0.22**
	<i>t value</i>			2.38
H8	Codification			
	<i>Path Coefficient</i>			0.47***
	<i>t value</i>			5.56
Note: * indicates $p < 0.05$, ** indicates $p < 0.01$, and *** indicates $p < 0.001$				

The results show that task variety is positively associated with personalization KM strategy usage, providing support for H4a ($b = 0.40$, $t = 4.90$, $p < 0.001$). Also, there was significant relationship with the work unit's codification strategy usage (H4b: $b = 0.24$, $t = 2.90$, $p < 0.01$). As expected, task analyzability is significantly related to the use of codification strategy and we found support for H5b ($b = 0.38$, $t = 3.62$, $p < 0.001$). However, there was no relationship between task analyzability and the personalization strategy, thus no support for H5a ($b = -0.14$, $t = 1.24$).

As hypothesized, IT support for KM is positively associated with the personalization strategy, confirming H6a ($b = 0.19$, $t = 1.83$, $p < 0.05$). IT support for KM is also found to be significantly related to the codification strategy (H6b: $b = 0.29$, $t = 3.14$, $p < 0.01$), supporting H6b. Further, we found a significant relationship between IT support for KM and KM effectiveness, rendering support for H6c ($b = 0.24$, $t = 2.73$, $p < 0.01$).

As hypothesized, use of the personalization strategy is significantly related to KM effectiveness and we found support for H7 ($b = 0.22$, $t = 2.38$, $p < 0.01$). Finally, our research also find support for the positive association between the codification strategy usage and KM effectiveness, supporting H8 ($b = 0.47$, $t = 5.56$, $p < 0.001$).



Discussions and Limitations

We have proposed a set of three hypotheses to examine the relationship between inter-unit network structures and KM effectiveness, as well as a set of five hypotheses to investigate the effects of intra-unit task environment on KM effectiveness, through different KM strategies.

As hypothesized, units that have a more central position are likely to have higher KM effectiveness (H1 supported). High degree of centrality in a network that is characterized by high communication and knowledge exchange activities enables units to access useful knowledge from other units (Tsai, 2001). Thus, these units are expected to enjoy informational benefits, which in turn enhance their effective use of knowledge. Also, redundant contacts that a unit maintains have a negative impact on KM effectiveness (H2b supported), which indicates that structural holes spanned by a unit provide opportunities for the unit to broker and control the flow of information between units. Further, structural holes enable the unit to construct an efficient, information-rich network with other units, in which the unit can afford the resource sharing benefits (Burt, 1992; Ahuja, 2000). Our results are consistent with previous studies in social networks. In this research, we found that these social networks are important contributors to KM effectiveness.

For hypothesis 3, we found evidence for the benefits of IT support in facilitating KM. This is a strong indication that IT, which may not be sufficient by itself to make KM effective, is a necessary and vital tool for knowledge management, and this is the case not just at the organizational level (Lee and Choi, 2003; Gold et al., 2001), but also at the work unit level. Our results for the first research question, therefore, further illustrate the validity of the social technical perspective put forth by Mumford (1983).

From the intra-unit analysis, our results showed that task variety is significantly related to the use of both personalization and codification KM strategies in the unit (H4a and H4b supported). Interestingly, the link to

personalization (i.e., path coefficient = 0.40) appears to be much stronger than that for codification (i.e., path coefficient = 0.24). This seems to indicate that variety in the task environment would make it more unstructured, and thus engender more need for personalization than codification. Future studies may further explore the theoretical and practical dimensions of this comparison.

As seen in Figure 2, task analyzability has a significant influence on the codification strategy usage (H5b supported), but not on the personalization strategy (H5a not supported). This result means that, in a work unit with analyzable tasks, people are most likely to process information or knowledge in a formalized and written form (Rice, 1992). Interestingly, we found partial support for our argument that task analyzability is negatively related to the use of personalization strategy. This finding indicates that information processing with rich media such as face-to-face communication may be required for unanalyzable tasks. In addition, both types of KM strategies have positive impacts on KM effectiveness (H7 and H8 supported). These findings suggest that KM at the work unit level need to maintain a balance between the personalization and codification strategies. However, we also see evidence that this strategy is contingent upon the unit's task environment and there is potentially no universally appropriate KM strategy for a unit.

As indicated earlier, previous studies have suggested that IT support is crucial to facilitate KM process (Alavi and Leidner, 2001; Gold et al., 2001; Hansen et al., 1999; Lee and Choi, 2003). These are consistent with our results which showed that organizational IT support for KM is significantly related to both types of KM strategies as well as KM effectiveness (H6a, H6b, and H6c supported). This means that, in today's environment, information technology is a necessary and vital tool in processing information and knowledge, and IT support will directly enhance KM effectiveness, as well as indirectly enhance it through the influence on KM strategies.

Limitations

We have uncovered a pattern of influence on KM effectiveness that has not been previously examined. These results, however, should be interpreted with caution. For the inter-unit analysis, we draw a sample of 20 work units from one organization. While our preliminary findings hold great promise, generalization of the results to work units universally requires further inquiries. For the intra-unit analysis, the results are based on individual responses. As in many other published IS studies, collecting all measures from a single respondent raises the concern of common method bias. In the case of this study, we have examined the common method variance, referring to variance resulting from the use of a common method rather than from the construct itself (Podsakoff et al., and Podsakoff, 2003). We conducted Harman's single-factor test (Podsakoff et al., 2003). In this study, all 26 items were analyzed by using a principal components factor analysis. We found six factors, in which the first factor accounted for 34.4% of the variance. Further, no general factor was apparent in the unrotated factor solution. The results indicated that common method variance was not a major problem in this study (Sabherwal and Becerra-Fernandez, 2003; Scott and Bruce, 1994). In addition, for independent variables such as task characteristics and KM strategies, the questions are targeted specifically at actual activities within a unit, with little or no filtering through individual perception. Thus, we conclude that common method bias has minimum impact on the validity of our results.

Conclusion and Implications

The current study attempted to provide an understanding of 1) the influence of inter-unit network structure and IT support on KM effectiveness, and 2) the influence of intra-unit task environment and IT support on KM strategies and KM effectiveness. Our results have significant implications for KM research. First, previous KM studies on the impact of network characteristics of intra-organizational units have been limited in scope, focusing primarily on knowledge sharing (Hansen, 2002; Hansen, Mors, and Løvås, 2005). Ours is the first to examine the impacts of network structures on overall KM effectiveness, which encompasses the entire cycle of KM activities, including knowledge creation, sharing, and utilization. Second, the results reveal the relative strength of a unit's network position in its effective use of knowledge. This finding resonates with the findings of Reagans and Zuckerman (2001) who demonstrated that team productivity are positively influenced by demographic diversity as well as by the strength of the relationship between actors. Thus, future studies may look at the antecedents and facilitators to explicate the relationship between two network perspectives (i.e., closure and structural hole views) and KM effectiveness. Finally, IS researchers are beginning to examine the underlying factors that can potentially explain the complex phenomena in organizational communications, and according to Te'eni's research (2001), task variety is one of the most significant factors. Our results have shed more lights into this emerging line of inquiry. In

addition, we found that a unit's KM strategy played a mediating role between intra-unit task characteristics and KM effectiveness. Future research may explore the appropriate mixture of personalization and codification strategies under different task environments in order to achieve higher KM effectiveness.

The study has interesting and potentially substantive implications for KM practice. First, our findings suggest that inter-unit knowledge exchange and a unit's brokering role can be a vital component of a work unit's KM strategy. The unit manager may enhance KM effectiveness by paying attention to its boundary-spanning communications via structural holes, as well as generally encouraging interaction and communications with other units. Second, the work unit manager may improve the scope and effectiveness of the unit's KM practices by striking a balance between the personalization and the codification strategies for KM. In sum, for successful KM in a work unit, its manager should not only establish appropriate inter-unit relationship, but also develop the unit's own knowledge management strategies.

We found interesting influence patterns of the relationships between inter-unit network structure and KM effectiveness. Further, our study has revealed the significant role of task environments in the intra-unit KM activities. Our study is one of the first to focus attention on work unit KM and specifically consider the influence of task characteristics in the unit. Our results have provided a basis for future inquiries, which may, for example, examine the relationships between KM strategies at the unit levels and the organizational level. Although *indegree* is considered as the most suitable centrality measure (Freeman, 1979; Tsai, 2001), future studies need to consider other network measures, such as tie strength and network heterogeneity, to explore the relationship between network structure and KM effectiveness. In addition, future studies may include other facilitators and antecedents, such as culture, trust, and absorptive capacity, to provide richer understanding of the intra-organizational KM activities.

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Appendix 1. Instruments

All items were measured on a 7-point Likert scale. We provide a definition of knowledge and make a distinction between information and knowledge in the survey:

Knowledge Management Effectiveness (based upon Sabherwal and Becerra-Fernandez, 2003)

1: Strongly Disagree, 7: Strongly Agree

Note: Knowledge management includes how knowledge is created, acquired, stored, shared, and applied.

KSAT1 I am satisfied with how new knowledge is created in my work unit.

KSAT2 I am satisfied with how knowledge is acquired in my work unit.

KSAT3 I am satisfied with how knowledge is shared and transferred in my work unit.

KSAT4 I am satisfied with how knowledge is applied and utilized in my work unit.

KSAT5 Overall, I am satisfied with knowledge management in my work unit.

Knowledge Management Strategy (based upon Choi and Lee, 2003)

1: To a very little extent, 7: To a very great extent

Note: Formal Documents include traditional papers, manuals, computer files, databases, repositories, and Webs (Internets and Intranets), etc. for explicitly recording knowledge.

Codification Strategy

EO1 Using formal documents to capture and describe knowledge.

EO2 Formally recording knowledge whenever it is created (e.g. from projects and meetings).

EO3 Using formal documents to share and transfer knowledge.

EO4 Using knowledge and procedures from formal documents to solve problems.

Personalization Strategy

TO1 Making face-to-face social interactions to exchange knowledge.

TO2 Engaging in informal dialogues and formal meetings to share and transfer knowledge.

TO3 Using meetings and discussion via brainstorming and debate, etc. to generate new knowledge.

TO4 Using knowledge from accumulated experience to solve problems.

Task Variety (adopted from Daft and Macintosh, 1981)

1: To a Very Little Extent, 7: To a Very Great Extent

TV1 Work decisions are dissimilar from one day to the next.

TV2 The work could be described as routine. (reverse-coded)

- TV3 When a problem arises, it takes a lot of experience and training to know what to do.
- TV4 There is variety in the events that cause the work.

Task Analyzability (adopted from Daft and Macintosh, 1981)

1: To a Very Little Extent, 7: To a Very Great Extent

- TA1 Normal work activities in our jobs are guided by standard directives, rules and procedures.
- TA2 In carrying out our work, there is an understandable sequence of steps that can be followed.
- TA3 Established materials (professional books, directives, manuals, statutes) cover our work.
- TA4 In our type of work, people actually rely on established practices and procedures.

IT Support for KM (based upon Lee and Choi, 2003)

1: Strongly Disagree, 7: Strongly Agree

- IT1 Our organization has IT support for learning and knowledge creation.
- IT2 Our organization has IT support for capturing knowledge when it is created.
- IT3 Our organization has IT support for storing and retrieving knowledge.
- IT4 Our organization has IT support for sharing and transferring knowledge among colleagues.
- IT5 Our organization has IT support for using and applying knowledge in our work.

