An Investigation of Knowledge Management within a University IT Group

HOPE KOCH, Texas A&M University, USA
DAVID PARADICE, Florida State University, USA
BONSUG CHAE, Texas A&M University, USA
YI GUO, Texas A&M University, USA

In today's competitive global economy characterized by shorter product life cycles, increased employee turnover, and ubiquitous information technologies, an organization's ability to manage knowledge may be the only remaining source of competitive advantage (Drucker, 1995; 1999). Even though a number of researchers have outlined the importance of adopting knowledge management (KM) practices (Argyris & Schon, 1996; Davenport, 1994; Davenport, DeLong, et al., 1998; Davenport, Jarvenpaa, et al., 1996; Malhotra, 2000a; 2000b; 2000c; Nonaka & Takeuchi, 1995; Senge, 1990) and many organizations have given lip service to the term, there is still some ambiguity concerning what KM actually is (Malhotra, 2000b) and little attention has been paid to factors that enable effective KM to occur (Nonaka, et al., 1995). This research uses technical and human-centric approaches combined with Holsapple and Joshi's (1998) Kentucky Initiative to investigate KM within a small information technology group. Based on the findings of our case study, we propose some factors that seem to enable effective KM and a modification to Holsapple and Joshi's architecture of a KM episode.

INTRODUCTION

In today's competitive global economy characterized by shorter product life cycles, increased employee turnover, and ubiquitous information technologies, an organization's ability to manage knowledge may be the only remaining source of competitive advantage (Drucker, 1995; 1999). Even though a number of researchers have outlined the importance of adopting knowledge management (KM) (Argyris, et al., 1996; Davenport, 1994; Davenport, et al., 1998; Davenport, et al., 1996; Malhotra, 2000a; 2000b; 2000c; Nonaka, et al., 1995; Senge, 1990) and many organizations have given lip service to the term, there is still some ambiguity concerning what KM actually is (Malhotra, 2000b) and little attention has been paid to factors that enable effective KM to occur (Nonaka, et al., 1995). Some researchers and practitioners hold an information processing view of KM, seeing KM as a computer system that helps an organization manage knowledge; others take more of a human-centric view seeing KM as primarily a social process. The purpose of this research project is to explore how KM actually occurs within a small IT group (Figure 1) and to identify some factors that appear to enable effective KM within the IT group.

This project stemmed from discussions between industry representatives on Texas A&M University's Center for the Management of Information Systems (CMIS) advisory board and researchers. Centering on the KM "buzz", discussion soon turned to debate as information processing views and human-centric views of KM clashed. The information processing view, which has been popular in the trade press and widely implemented in practice (Davenport, et al., 1998; Hansen, Nohria, et al., 1999; Malhotra, 2000a), sees KM as archiving explicit knowledge of individuals in technology based repositories (Applegate, Cash, et al., 1988). The human-centric approach (Churchman, 1971; Davenport, 1994; Malhotra, 2000a; 2000c; Mitroff & Linstone, 1993) incorporates organizational, social, and individual dimensions into KM purporting that "current technology cannot replace the imagination and creativity in human minds, tap the tacit dimensions of knowledge creation, and translate information into meaning" (Malhotra, 2000c, p.10).

Because of this debate, the practitioners and researchers at the CMIS meeting decided that exploring KM concepts in a real setting would help everyone better understand what KM is and how KM occurs. We chose the IT group at Texas

A&M University's Mays College of Business as the subject for this case study.

The remaining three sections of this paper consist of a discussion of the research method and Holsapple and Joshi's KM framework. Next, we explain how KM occurs within the IT group and pose some enablers of KM within the group. Finally, the conclusion discusses limitations, avenues for future exploration, and managerial/theoretical implications.

THEORETICAL BACKGROUND

Before explaining how KM occurs within the IT group, we must clarify the meaning of KM and our framework for organizing the discussion of KM. This research project adopts and is organized according to Holsapple and Joshi's explanation of an organizational KM episode (Figure 1) as "the application of knowledge manipulation skills in performing knowledge manipulation activities that operate on the organization's knowledge resources to achieve organizational learning and projection; this process is both facilitated and constrained by KM influences and is triggered by a knowledge need" (Holsapple & Joshi, 1998, pp. 3-4).

KM influences, (box A in Figure 1), "govern how the conduct of KM unfolds in an organization" (Holsapple, et al., 1998, p. 4). The Holsapple and Joshi framework identifies managerial, resource, and environmental influences. "Governed by KM influences, organizational participants execute knowledge manipulation activities, (box C in Figure 1), as an expression of their knowledge manipulation skills" (Holsapple, et al., 1998, p. 10). Knowledge selection, knowledge acquisition, knowledge generation, internalization, and externalization are all knowledge manipulation activities, which operate on knowledge resources, (box F in Figure 1), to create organizational value. Knowledge resources include schema and content resources; schema resources consist of purpose, strategy, culture, and infrastructure; content resources consist of participant knowledge and artifacts. Organizational value is the result of achievement of organizational learning and projection. "Organizational learning is a process that results in enhancement of internal competencies whereas projection results in enhancement within an organization's environment" (Holsapple, et al., 1998, p.4).

INVESTIGATION METHODOLOGY

Our case study (Emerson, 1983; Emerson, Fretz, et al., 1995; Gubrium & Holstein, 1997; Strauss & Corbin, 1998; Yin, 1994) consisted of focused interviews with each of the five full-time members of the IT group at the Mays College of Business. A case study method was most appropriate for this research because it provides a deeper understanding of the KM process within a real-world context; allowing us to see if this group's KM episodes follow Holsapple & Joshi's model and allowing us to see what enables KM within the IT group. In addition, we chose the IT group within the Mays College because the small group size would allow us to investigate the entire KM process.

Each interview was approximately ninety minutes long. Holsapple & Joshi's Kentucky Initiative was used to help us formulate interview questions, which sought to uncover how KM occurs within the group. We considered both human-centric and technical components. A combination of the OSI model and the general top down business model for information systems provided a supplemental framework for analyzing KM from the technical perspective (Goldman, 1998). To achieve validity, each interviewer prepared and shared interview notes and perceptions with the other interviewers (Kilmann, 1999). We corroborated interview data with internal written documentation. Follow-up interviews, electronic communication, and review by members of the IT group helped clarify issues and validate observations (Lawler, Mohrman, et al., 1999; Leonard & Anslem, 1973).

Formed in early 1996, the IT group is primarily responsible for maintaining the computing infrastructure within the Mays College of Business. The group is organized in a flat organizational hierarchy with three full-time employees who report directly to the associate dean and one full-time employee who reports indirectly to the associate dean. Although the associate dean is responsible for a number of other programs within the Mays College of Business, in his role as the administrative head of the IT group his responsibilities include determining and enabling the overall direction. In analyzing the duties of each role in the operational IT group, there is a strong interrelationship between the four operational roles. For instance, the systems analyst II and the network administrator equally share responsibilities for five of the ten major responsibility areas and all but three major responsibility areas have explicit interrelationships or joint responsibilities among the four operational group members.

Figure 1: Architecture of a KM Episode During the Conduct of KM Adapted from (Holsapple, et al., 1998)

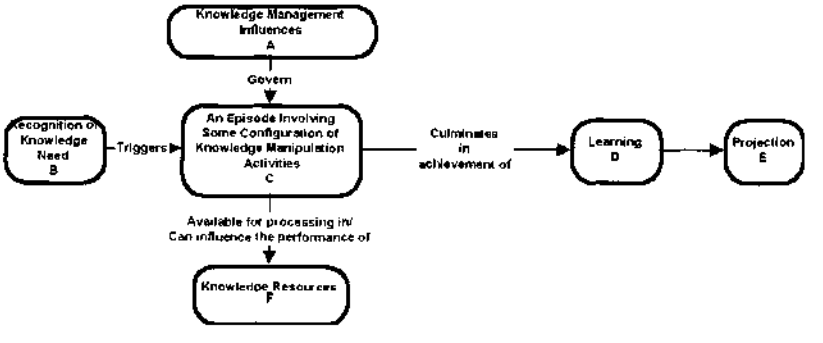

Table 1. KM Enablers

Knowledge Influences	Knowledge Manipulation Activities	Knowledge Resources
Coordination: managing dependencies so that in a KM episode knowledge selection occurs first; knowledge acquisition occurs when knowledge selection fails and when the time and cost of knowledge generation exceeds the time and cost of knowledge acquisition; **Control:** hiring employees that "fit in" and physical security protects existing knowledge; evaluating the quality of existing knowledge and generating new knowledge through personal feedback, surveys, and experiments; **Leadership:** supporting learning, encouraging teamwork and open communication; and tolerating failure;	**KNOWLEDGE SELECTION:** facilitating socialization through weekly meetings; overlapping job responsibilities; open, shared work space and a team-work culture;	**PURPOSE:** striving to always deliver the best; emphasizing achievement of a "moving target";
	KNOWLEDGE ACQUISITION: having financial resources; having information and communication services available; linking performance appraisal to knowledge acquisition; encouraging the development of relationships with potential external information sources;	**STRATEGY:** embedding a continuous learning processes; financially supporting KM
		CULTURE: being team-oriented, warm, supportive, friendly, non-competitive, and emphasizing trust;
	KNOWLEDGE GENERATION: facilitating group processes; empowering employees to initiate knowledge generation; hiring employees with an appetite for learning; communicating openly; having well-developed participant knowledge; encouraging experimentation; desiring to improve processes; allowing socialization and reflection time;	**INFRASTRUCTURE:** having job descriptions that emphasize responsibility sharing, interrelationships between roles and dual roles; sharing work space, meeting weekly, and having electronic communication systems; not promoting competition between employees with salary apportionments or hierarchical positions; linking performance appraisal to knowledge acquisition;
RESOURCE: fund accounting allocates financial resources for KM activities in direct support of the Mays College of Business's mission; for knowledge resource enablers see knowledge resources;	**INTERNALIZATION:** having an open work area and weekly meetings; retaining employees; allocating time to develop artifacts;	
ENVIRONMENTAL: monitoring a changing environment through benchmarking, environmental scanning, and socialization	**EXTERNALIZATION:** Understanding of purpose; making recipients aware of available services through training sessions, meetings, electronic communication, and the grapevine; allowing down-time and socialization;	

KM ENABLERS

In order to see what enabled the IT group to effectively manage knowledge, we asked questions that would uncover whether effective KM was occurring but that did not pressure the interviewees to respond in a certain way. In measuring whether effective KM was occurring we asked the IT group members if they felt that their knowledge base had increased, was accessible, and could be made available to external recipients. While, the research project investigated KM from both organizational and technical dimensions, we found that the enablers of KM are overwhelmingly organizational. While the IT group is heavily involved with technology, they did not see KM as a technical process and very rarely cited technology as an enabler of KM. Factors appearing to enable KM were present in every part of a KM episode: knowledge influences, knowledge manipulation activities, and knowledge resources. The sections that follow further explain how KM occurs within the IT group and the enabling factors.

KM Influences

"KM influences (box A in Figure 1), are concerned with what impacts an organization's conduct of KM and what governs its' performance of knowledge manipulation activities" (Holsapple, et al., 1998, p. 4). Holsapple & Joshi identify three KM influences: managerial, resource, and environmental. The paragraphs that follow explore each influence and its related aspects within the IT group.

Managerial Influences

In the IT group, the associate dean role is primarily responsible for managerial influences, which can include coordinating, controlling, measuring, and leading the conduct of KM. Coordination deals with the order in which knowledge manipulation activities are deployed. Management's choices in coordinating dependencies within and between knowledge resources, other resources, and knowledge manipulation activities influence the way KM unfolds within an organization. These choices are manifest in the order in which the IT group chooses knowledge manipulation activities. In a KM episode, members of the IT group first utilize knowledge selection to see if required knowledge is available within the group's previously internalized knowledge. Executing knowledge selection first promotes effective KM because the ability to acquire knowledge previously

internalized is more efficient than seeking knowledge from outside sources (knowledge acquisition) or regenerating the knowledge.

"Control is concerned with ensuring that needed knowledge resources are available in sufficient quantity and quality, subject to required security" (Holsapple, et al., 1998, p.6). A dimension of control is protection, in terms of how the IT group protects existing knowledge resources. Management influences the methods the IT group uses to protect its knowledge resources which include protecting artifacts with physical security and protecting culture and infrastructure with hiring practices that recruit employees that "fit in" with the existing group. Management also influences mechanisms for controlling the quality of knowledge within the IT group. Personal feedback, surveys, and experimentation are the primary mechanisms for evaluating the quality of internalized knowledge within the IT group. These evaluating mechanisms resemble the "convincing" practices that knowledge workers use in Schultze's work (2000).

The managerial influence activity of leadership is defined as "creating conditions that allow participants to readily exercise their knowledge manipulation skills, to contribute their own individual knowledge resources to the organization's pool of participant knowledge, and to have easy access to relevant knowledge resources" (Holsapple, et al., 1998, p. 8). The leadership values that seem to promote KM within the IT group include: desire for teamwork, encouragement of open communication, support of learning, and a tolerance for failure. These resemble some of the recommendations Nelson and Cooprider made in their 1996 article.

Resource Influences

Knowledge, financial, human, and other resources also have bearing on how KM episodes unfold (Davenport, et al., 1998; Holsapple, et al., 1998). Resource influences can both support and constrain the execution of knowledge manipulation activities and thus affect the development of knowledge resources. In the IT group, financial resources, which include: funding, endowment, enrollment, and tuition; affect the ability to acquire and retain human and material resources. In turn, human resources may engage material resources in the development of schematic knowledge resources, which then influence the deployment of financial resources.

For example, human resources help develop the schematic knowledge resources which interact to support the IT group's mission of being a leader in the application of IT to educational processes. The financial resources of a $1 million dollar endowment and a $3 per student credit hour computer access fee are restricted and can only be used in direct support of the Mays College of Business's IT mission (Strategic Planning Committee, 1998). Because of the financial resource restriction, knowledge manipulation activities not in direct support of the mission are not allocated financial resources and thus not supported within the IT group.

Environmental Influences

In contrast to managerial and resource influences, organizations have little control over environmental influences. Competition, fashion/technology, markets, time, and GEPSE (governmental, economic, political, social, and educational) can all influence the conduct of KM. By evaluating each of these environmental influences through benchmarking studies, environmental scanning, and socialization, the IT group is constantly launching KM episodes to acquire external information. This new information spawns future KM episodes regarding adoption and deployment of technology and other initiatives.

KNOWLEDGE MANIPULATION ACTIVITIES

The purpose of the preceding section was to identify KM influences and to explain how they enable KM within the IT group. This section explores forces that enable the IT group to execute knowledge manipulation activities (box C in Figure 1). Knowledge manipulation activities include: knowledge selection, knowledge acquisition, knowledge generation, internalization, and externalization.

Knowledge selection "refers to the activity of identifying needed knowledge within an organization's existing knowledge resources and providing it in an appropriate representation to an activity that needs it" (Holsapple, et al., 1998, p.12). Within the IT group, knowledge selection is usually executed before other knowledge manipulation activities because socialization and the teamwork culture make internal knowledge easily accessible. Executing knowledge selection first allows participants' to easily draw upon existing organizational resources rather than acquire this same knowledge from external resources or 'reinvent the wheel' through knowledge generation. Hollingshead (1998) found that being able to execute knowledge selection first can directly impact the quality of member's work and decisions.

In order to perform knowledge selection, members of the IT group must identify appropriate knowledge from internal resources. This process may differ between the operational and strategic layers of the IT group. Identifying relevant knowledge within the operational IT group consists of informal inquiries with an immediate turnaround time and/or an informal socialization process whereby members become aware of the location of varying types of knowledge. The informal socialization process is facilitated by the groups' open, shared working area. Identifying the location of knowledge between the operational and strategic group and between members of the operational group in different offices consists of both formal and informal inquiries; has a longer turnaround time; and consists of a socialization process dependent on weekly staff meetings. Hollingshead's (1998) work, which posits that "self disclosure, conversations, and shared experiences" enable group members to learn who has what expertise, supports this finding.

Knowledge selection also involves capturing knowledge from within the IT group. How knowledge is captured depends upon whether the knowledge is tacit or explicit. Tacit knowledge is captured in socialization (Nonaka, et al., 1995), which enables the IT group to develop a system of shared meanings, facilitating effective communication (Cummings, Mohrman, et al., 1999). The open work area, overlapping job descriptions, and teamwork-oriented culture enable the capture of tacit knowledge in the IT group. Explicit knowledge is easier to capture than tacit knowledge because it "can be expressed in words and numbers, and is easily communicated and shared in the form of hard data" (Nonaka, et al., 1995, p.8). Explicit knowledge may be captured verbally, electronically, or through written documentation. Weekly meetings, socialization, and a communication infrastructure enable the capture of explicit knowledge in the IT group.

Knowledge acquisition will usually occur in the IT group after knowledge selection fails to address a knowledge need. "Knowledge acquisition refers to the activity of identifying knowledge in the organization's external environment and transforming it into a representation that can be internalized and/or used within the organization" (Holsapple, et al., 1998, p. 12). In the IT group, knowledge acquisition is enabled by an environment that financially supports acquiring external knowledge and an infrastructure that makes external information and communication resources easily accessible. For example, financial resources enable the IT group to acquire training and technology manuals, as well as attend seminars; achievement of these activities are also linked to an individual's performance evaluation. In addition, the group has access to a comprehensive library system, University classes, information services, the Internet, email, and a telephone system. The group is also encouraged to build relationships with potential sources of information such as vendors, students, recruiters, and other IT personnel within other colleges and universities.

"Knowledge generation is a knowledge manipulation activity that produces knowledge by processing existing knowledge where the latter has been acquired by selection, acquisition, and/or prior generation" (Holsapple, et al., 1998, p.14). The IT group will choose knowledge generation to meet a knowledge need when knowledge selection fails and when external knowledge is unavailable or too time consuming and/or expensive to acquire. Sub-activities involved in knowledge generation include: monitoring the organization's knowledge resources; evaluating selected or acquired knowledge; producing knowledge from a base of existing knowledge; and transferring the produced knowledge (Holsapple, et al., 1998).

In knowledge generation, managerial influences and existing knowledge resources are enablers. The associate dean facilitates weekly meetings, which helps members of the IT group assess what has been done effectively, what needs improvement, and what measures to take in addressing challenges. Other managerial influences that enable knowledge generation within the IT group include: empowering employees to initiate knowledge generation activities and hiring employees with an appetite for learning . Well developed participant knowledge including an understanding of processes within the group and their impact; a culture where group members want to improve processes; an environment that encourages experimentation; and an infrastructure that allows socialization and reflection time are some of the knowledge resources that enable knowledge generation in the IT group. Our findings are corroborated in Davenport, et al., 1998; Garvin, 2000; McDermott, 1999; and Nelson, et al., 1996. Once knowledge is produced, it can become part of the organization's existing knowledge resources, can be used in future internal activities, and can be transferred to external recipients.

Knowledge selection, knowledge acquisition, and knowledge generation provide knowledge flows into the IT group's knowledge base. These alter an organization's existing knowledge resources through internalization (Holsapple, et al., 1998), which Webster's dictionary defines as "incorporating into oneself such things as values, patterns, cultures, motives, and restraints as conscious or subconscious guiding principles through learning and socialization" (1993). Within the IT group, the open work area, weekly meetings, and periodic lunches enable internalization as these engagements build trust and create a common language. These findings are corroborated in Davenport, et al., 1998; and McDermott, 1999.

Once knowledge is internalized, it can be delivered to recipients outside of the organization through externalization. Targeting output is the first stage of externalizing knowledge; this process is governed by a group's purpose, which lays out the intended services, products, and recipients. To become aware of recipients' needs, the IT group must first make the intended recipients aware of the group's purpose, services, and knowledge. For example, in the Mays College of Business, the IT group periodically holds training sessions for faculty, staff, and students; and electronically posts updates regarding new members and their roles. Once some of the intended recipients are aware of the IT group as a source of knowledge, a socialization process makes others aware of conditions where the IT group's knowledge may be helpful. When the IT group becomes aware of an external knowledge need the group tries to fill the need, this may include transferring tacit knowledge as when equipment malfunctions and software idiosyncrasies are fixed or transferring explicit knowledge in conversations, meetings, web pages, etc.

Externalization is enabled by mechanisms like meetings, training sessions, electronic communication, and the grapevine, all of which make external recipients aware of the IT group's services and facilitate the projection of knowledge. In addition, the efficient execution of the other knowl-

edge manipulation activities and their related enablers, socialization, and downtime also enable externalization. Downtime enables the IT group to ponder external recipient needs and to develop social relationships so that the group can understand issues and their context.

This section explained how knowledge manipulation activities are used by the IT group in the conduct of KM. Because knowledge influences and knowledge resources affect the execution of knowledge manipulation activities, very few enablers of KM within the IT group are the result of knowledge manipulation activities alone.

Knowledge Resources

Knowledge resources are the final component of an organization's KM system (box F in Figure 1). Webster's dictionary defines a resource as "a source of revenue or wealth to a firm" (1993). "In the conduct of KM, human resources perform knowledge manipulation activities on knowledge resources to create value for an organization" (Holsapple, et al., 1998, p.17). An organization's knowledge resources consist of schema resources and content resources. "Schema resources depend on the organization for their existence and consist of culture, infrastructure, purpose, and strategy; schema resources are the basis for attracting, organizing, and deploying content resources" (Holsapple, et al., 1998, p.17). "Content resources exist independent of the organization to which they belong and include participant knowledge and artifacts" (Holsapple, et al., 1998, p.17).

"Schema knowledge resources are interrelated and are represented or conveyed in the workings of an organization" (Holsapple, et al., 1998, p.21). One of the four schema resources is purpose. Purpose influences the execution of knowledge manipulation activities discussed in the previous section and the development of knowledge resources. "Purpose defines an organization's reason for existence" (Holsapple, et al., 1998, p.22). The purpose of the IT group within the Mays College of Business at Texas A&M University is to support the college's ambition of being a world leader in the application of IT to educational processes. Purpose impacts the execution of KM because it governs the type of knowledge needs that will initiate KM episodes and it determines what external recipients can request and receive the group's knowledge. The IT group's purpose enables continuous execution of KM episodes since being a world leader is a "moving target".

"Purpose drives strategy formulation; which defines the activities undertaken to effectively achieve purpose" (Holsapple, et al., 1998, p.23). Strategy is comprised of plans for using infrastructure, culture, artifacts, participant knowledge, and other organizational resources in wealth creation (Holsapple, et al., 1998). The sections that follow discuss the IT group's strategy and how this strategy enables KM within the group.

The Mays College of Business' Vision 2020 defines the IT group's strategy as:

> maintaining state-of-the-art information technologies (teaching, research, administrative service, and other) with upgrades as needed and anticipated replacement cycles of every 3 to 4 years; ensuring the Mays College of Business's IT facilities are competitive with other business schools by benchmarking the state of the college's information technologies with at least 3 other highly ranked business schools at preeminent comprehensive public universities; providing the college with trained support staff to implement/maintain information technologies; working with the library to develop holdings of business-related information resources (Strategic Planning Committee, 1998, p. 23-24).

This strategy governs the type of knowledge needs that will launch KM episodes. The IT group's current strategy is embedded in a continuous learning cycle, recognizing the need for incessant deployment of KM episodes to keep pace with other universities' uses of IT and an ever-changing IT environment. The strategy addresses resource influences to support KM episodes by financially providing for training, equipment, product acquisition, and maintenance.

Enhancements to the IT group's strategy that may further enable KM might include explicitly recognizing the importance of managing knowledge (Pan & Scarbrough, 1999), creating artifacts (Bukowitz & Williams, 1999), and encouraging more reflection (Auer & Reponen, 1997). Recognition of the importance of managing knowledge would make the IT group more aware of preserving what the organization has learned; and thus make the group less dependent on socialization and culture as means of disseminating knowledge. One way of preserving the IT group's knowledge for the future is a strategy that encourages development of artifacts such as a computerized knowledge management system or more documentation. If the strategy encouraged more reflection time, the IT group could devote time to analyzing KM episodes and their impact on achieving the group's mission.

Culture is also a schematic knowledge resource. An organization's culture affects participant behavior in terms of how they perform knowledge manipulation activities. Members of the IT group described their culture as team-oriented, warm, supportive, friendly, non-competitive and emphasizing learning and trust. This culture seems to enable KM and supports Anderson and Weitz's (1992) work, which found that groups work better together in an atmosphere of trust based on mutual commitment and stable long-term relationships.

"The formal counterpart to an organization's cultural knowledge resources is infrastructure" (Holsapple, et al., 1998, p.22). Infrastructure consists of the knowledge that structures an organization's participants in terms of the roles that have been defined for participants to fill, the relationships among those roles, and the regulations that govern the use of roles and relationships (Holsapple & Luo, 1996). In studying the IT group, several components of their infrastructure seem to enable KM.

The IT group's infrastructure enables knowledge selection by promoting teamwork and socialization. Examples of the IT group's infrastructure KM enablers include: responsibility sharing written into job descriptions, the network administrator's job description explicitly outlines seven of eight areas where responsibilities are shared with the systems analyst; group members sharing the same office; weekly meetings; flat organizational hierarchy; and financial rewards that are not based on a set amount allocated between members. The IT groups' infrastructure also enables knowledge acquisition as performance evaluation criteria outlines areas where knowledge acquisition needs to occur and specifies a plan for obtaining that knowledge; the budgeting/ procurement process allocates financial resources for these activities.

Content knowledge resources are both enabled and constrained by the schematic knowledge resources discussed above (Holsapple, et al., 1998). Unlike schema knowledge resources "content knowledge resources exist independent of the organization to which they belong" (Holsapple, et al., 1998, p.17); are embodied in usable representations (Newell, 1982); and allow knowledge from the past to be brought to bear on present activities (Pan, et al., 1999). "Participant knowledge and artifacts make up the two types of content knowledge; the primary difference between the two is that participant knowledge has knowledge processing abilities and artifacts do not" (Holsapple, et al., 1998, p.18). While these resources can be used in KM episodes, we did not discover any KM enablers that were unique to content knowledge resources.

The extent that participant knowledge is made available in KM episodes is the result of managerial influences on schematic resources. For example because management has helped design an infrastructure that creates a culture emphasizing teamwork and socialization, participants willingly bring their knowledge to bear in KM episodes, thus increasing organizational knowledge. Unfortunately, because knowledge is easily selected from other members, knowledge artifacts and computerized participant knowledge are not well developed. This lack of explicit knowledge artifacts seems to corroborate Schultze's (2000) findings, the systems administrators in her study kept extensive artifacts documenting their thoughts and actions because the culture was unfriendly. Without a mechanism for preserving knowledge in artifacts, knowledge resources will decrease, particularly when core and ancillary participants leave the organization (Senge, 1990).

CONCLUSION

Our study explored how KM occurs within a specific IT group. While we set out to study both organizational and technical dimensions of KM, this study showed the importance of people and thus the human-centric approach in the execution of KM. We found that the IT group did engage in technical aspects KM; however, the information processing view of KM played a minor role in the group's KM process. The organizational dimension was more critical to the actual execution of KM. From a practical viewpoint, the study underscores the necessity of understanding and supporting the human element of KM over the technical element that is so often more heavily touted in vendor solutions and the trade press.

Social aspects of KM manifest in many ways. Adequate employee retention policies are required to prevent the loss of intellectual capital embedded in employees' knowledge. Quality of knowledge work is often enhanced by personal feedback from users. Encouragement in areas of experimentation is often beneficial in creating an environment conducive to the creation of knowledge. Knowledge selection activities often involve approaching other knowledge workers first. This occurs because when co-workers have solutions to knowledge problems, accessing that knowledge on a person-to-person basis is often faster and the knowledge is communicated in a much richer manner than when one must resort to non-personal knowledge-containing artifacts. Knowledge sharing activities include conversations, meetings, and formal and informal communications (which may include email). Users of the outputs of knowledge workers use social activities such as meetings and email to communicate their needs; these social activities also facilitate externalization of knowledge to users. In short, attention to social factors in the knowledge workplace impacts all phases of KM. Moreover, the most essential of these social aspects, leadership, may be much more critical to creating an effective KM environment than the technology used to support that environment.

Our study has two theoretical implications. First, this study validates and improves Holsapple & Joshi's 1998 KM framework by showing that the conduct of KM within a particular IT group follows their model up to a point. That point occurs where KM culminates in the achievement of learning and projection (Figure 1). Whereas the Holsapple & Joshi model showed learning and projection occurring in parallel, our study indicates that learning occurs before projection. Therefore, the two steps occur in sequence. We also outlined some enablers of KM within the IT group. This model suggests that cooperative learning theory (Janz, 1999, p.173) can be leveraged in explaining some enablers of KM. Even though, the IT group studied does not intentionally pursue KM with a KM strategy, the group did engage in KM

episodes and enablers of KM were present in knowledge influences, knowledge manipulation activities, and schema resources. In the spirit of Newell and Simon's (1976) exposition regarding computer science as empirical inquiry, this study adds a data point to the accumulating knowledge of KM.

In Hollingshead's 1998 exposition, she wrote "knowing what other group members know can increase each member's access to information and can have a direct impact on the quality of member's work and group decisions". Our study exposed the integral nature of teamwork and social interactions in all areas of KM. From a practical standpoint, organizations should consider incorporating some of our proposed KM enablers into the design of IT work structures as a means of improving KM processes to create an organizational environment more supportive of KM. Most importantly, organizations must recognize and support the social aspect of KM. Organizations that focus solely on technical support for KM will find that their efforts fall far short of their expectations.

Finally, since our study dealt with a single IT group, future research studying KM within other IT groups would help validate our findings. Of particular concern is the difficulty of measuring knowledge and effective KM. Research that better operationalizes these constructs would be valuable (Baum, Ittner, et al., 2000; Holtshouse, 1998; Teece, 1998).

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Hope Koch (B.B.A. in Accounting, the University of Mary-Hardin Baylor; M.B.A. in Information Systems, Baylor University) is pursuing her Ph.D. in Information & Operations Management at Texas A&M University. Hope is a Certified Public Accountant in the State of Texas, has industry experience with a Fortune 500 company, and has taught Accounting and Information Systems courses at Baylor University. (hope-koch@tamu.edu).

David Paradice (B.S. in Information and Computer Science, M.S. in Industrial Management, Georgia Institute of Technology; Ph.D. in Management Information Systems, Texas Tech University) is currently on the faculty at Florida State University. Dr. Paradice has published numerous articles focusing on the use of computer-based systems in support of managerial problem formulation and on the influence of computer-based systems on ethical decision-making processes. He has co-authored *Database Systems for Management* and *Application Development in Microsoft Access* and co-edited *Ethical Issues in Information*. (dparadic@cob.fsu.edu).

Bongsug Chae (M.B.A., St. John's University) is pursuing his Ph.D. in Information and Operations Management at Texas A&M University. Bonsug's current research interests include: large scale information systems development, the use of IT for sustainable development, knowledge management, social theories for IT, and philosophical foundations of information systems. (Bchae@CGSB.TAMU.EDU)

Yi Guo (B. E. in Information Engineering, Northern Jiaotong University, Beijing, China; M.S. in MIS, University of Nebraska at Omaha) is pursuing her Ph.D. Student in Information & Operation Management at Texas A&M University. Yi's research interests include agent-based systems, knowledge management, and e-commerce. (Mguo@CGSB.TAMU.EDU)