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Organizational Knowledge Sharing Culture and KMS Effectiveness

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ORGANIZATIONAL KNOWLEDGE SHARING CULTURE AND KMS EFFECTIVENESS

Culture Organisationnelle de Partage des Connaissances et Efficacité des Systèmes de Gestion de Connaissances

Completed Research Paper

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Abstract

Organizations are increasingly adopting Knowledge Management Systems (KMS) to realize firm and operational level benefits. Many KMS fail to yield desired outcomes due to the lack of understanding of the antecedents of successful KMS. Prior studies have established organizational culture as a key antecedent of successful KM. This study investigates the relationship between KMS effectiveness, in terms of its impact on performance, and organizations' knowledge culture. We develop a model of organizational knowledge processes and employ simulations to examine how the cultural values that govern the employees' knowledge seeking and sharing propensities influence the impact of KMS on decision making performance. We find that knowledge seeking propensities have a greater influence on KMS effectiveness than knowledge sharing propensities. We also find organizational cultures that foster such knowledge sharing behaviors can expect greater and sustainable performance gains if proactive knowledge seeking is incorporated into work processes.

Keywords: Knowledge management, knowledge sharing, organizational culture

Résumé

Cette étude examine la relation entre la culture organisationnelle liée au partage des connaissances et l'efficacité des systèmes de gestion de connaissances (KMS). Nous construisons un modèle des processus de partage de connaissances organisationnelles et nous utilisons des simulations pour examiner comment les valeurs culturelles peuvent influencer l'impact des systèmes de gestion de connaissances sur la performance des décisions.

초록 (Abstract in Korean)

본 연구는 조직의 지식문화가 지식경영시스템(KMS)의 효과성에 미치는 영향을 살펴보고 있다. 이를 위해 본 연구는 조직학습모형을 기초로한 지식근로 시뮬레이션 모델을 구축하여, KMS 가 구축되어 있는 환경과 그렇지 못한 환경에서의 조직학습 성과를 비교하여 조직의 지식문화가 조직성과에 어떠한 영향을 미치는지 분석하였다. 시뮬레이션 결과, 조직원들의 지식공유의도보다 그들의 지식탐색의도가 성과에 더 중요한 영향을 미치는 것으로 나타났다.

Introduction

As organizations realize that the knowledge residing among their employees is their most valuable resource and that their competitiveness hinges on effective management of these intellectual resources (Ashworth et al. 2004), Knowledge Management (**KM**) has rapidly become an integral business function (Alavi and Leidner 2001). Organizations are increasingly adopting Knowledge Management Systems (**KMS**) to effectively manage organizational knowledge (Davenport and Prusak 1998). The basic idea of managing knowledge is quite simple and intuitive. Simply put, KM is a systemic and organizationally specified process for acquiring, organizing and communicating knowledge of employees so that other employees may make use of it to be more effective and productive in their work (Alavi and Leidner 2001). However, like many innovative management practices, KM has proven to be more difficult to implement in practice and it is the harsh reality that many KM initiatives result in less than desirable outcomes (Fahey and Prusak 1998). Organizations are still struggling to understand how best to implement effective KMS as there is little theory available to explain when such efforts will lead to success or failures (Repenning 2002).

In an effort to better understand when and why KM initiatives fail (or succeed), this study investigates the relationship between organizational culture and the effectiveness of IT-enabled KM initiatives. In recent years, there has been a growing consensus that organizational culture is one of the key enablers (or barrier) to effective KM (Balthazard and Cooke 2004). For example, Davenport and Prusak (1998) recognized the need to develop a knowledge-intensive culture that encourages knowledge sharing (both proactive seeking and sharing of knowledge), while Alavi and Leidner (2001) and Nonaka (1994) emphasize the relationship between corporate culture and knowledge creation capabilities. Janz and Prasarnphanich (2003) even assert that "… organizational culture is believed to be the most significant input to effective KM and organizational learning in that corporate culture determines values, beliefs, and work systems that could encourage or impede knowledge creation and sharing" (p. 353). Even from a technological perspective of KMS, organizational culture has been found to influence KM infrastructure capabilities (Gold et al. 2001) and KM technology usage (Alavi et al. 2005).

Organizational culture is a complex phenomenon that has been studied by a variety of disciplines including organizational theory, organizational behavior and psychology. Despite conflicting definitions and multiple interpretations of organizational culture, researchers agree that organizational culture constitutes a "set of social norms that define the rules or context for social interaction through which people act and communicate" (Nadler and Tushman, 1988). In the context of KMS, these social norms and values effect how individuals within the organization share knowledge. DeLong and Fahey (2000) postulate that culture shapes the organization's perception of knowledge, defines the relationships between individuals and organizational knowledge, creates the context for social interactions for knowledge use and sharing. This stream of research has investigated the motivations and behaviors of the individuals who share knowledge, and the impacts of these behaviors on the potential benefits of KM initiatives (Ba et al. 2001). For example, Osterloh and Frey (2000) identified the extrinsic and intrinsic motivations of individuals to share their knowledge with others in the organization. Wasko and Faraj (2005) extended this line of investigation in the context of electronic networks of practice. The current literature seems to focus primarily on explicating the motivations of knowledge workers to share with others the knowledge they posses. Surprisingly, the literature is rather silent about the other party involved in knowledge sharing – i.e., the knowledge recipient (or seeker). Such a one-sided focus may be limiting as the "knowledge market" perspective (Davenport 1999) highlights the importance of examining the behaviors of both the knowledge seeker (i.e., the buyer) as well as the knowledge sharer (i.e., the seller). The propensity to buy knowledge determines if and how frequently organizational members seek knowledge from one another, while the propensity to sell knowledge determine if and when an individual will share her own knowledge when someone approaches her. In the context of assessing the impact of KMS, it is important to consider both the knowledge seeking and sharing propensities since the propensity to sell or share knowledge influences how organization members contribute knowledge to the KMS, whereas the propensity to buy or seek knowledge determines if and how this knowledge is utilized. Put differently, a KMS implementation may efficiently codify and store knowledge across the organization; however unless this knowledge is accessed and utilized, it will fail to create any value for the organization.

The goal of this study is to investigate how the organization's knowledge culture (in terms of both the knowledge seeking and sharing propensities of the organization's knowledge workers) influences the success of KMS implementations. For our purposes, we consider the impact of KMS in terms of its impact on organizational performance. The success of the KMS is determined by its ability to increase organizational performance in terms of the increased efficiencies and accuracy of knowledge work such as decision making and problem solving. Through

this study, we seek to answer two main research questions: (1) How is an IT-enabled KM initiative's effectiveness, in its ability to have a positive impact on organizational performance, influenced by the knowledge sharing and seeking propensities of the organizational members? and (2) How can these propensities be leveraged to extract the most value from a KM initiative? This research differs from prior studies on KM and organizational culture in two ways. *First*, we distinguish between *both* the knowledge seeking and sharing propensities and behaviors of the organization's members and *second*, we explicitly conceptualize KMS effectiveness in terms of its *actual* impact on organizational performance rather than rely indirectly on proxies such as members' willingness to share or volume of knowledge artifacts contributed to knowledge repositories as these can only represent *potential* benefits of KMS.

Unfortunately, the study of KM is not without major methodological challenges due to the dynamic nature of the phenomenon. KM is a dynamic and continuous set of processes and practices embedded in individuals, as well as in groups and physical structures where at any point in time in a given organization, individuals and groups may be involved in different aspects of the KM process (Alavi and Leidner 2001 p. 123). Since the phenomena that we are interested in studying are essentially non-linear emergent processes, they are challenging to isolate, observe and quantify in empirical settings. Consequently, instead of relying on conventional approaches to theory development and testing, we employ simulation modeling as the primary research methodology in an effort to develop *new* insights from *established* variables (Davis et al. 2007; Harrison et al. 2007). In situations where it is challenging to collect time variant data at the individual and organizational levels for empirical analysis, simulations have been found to be an effectual substitute (Davis et al. 2007). Simulation modeling also offers numerous benefits. First, the formal modeling required for developing simulation models affords theoretical rigor and consistency in *precisely* connecting structure to behavior (Harrison et al. 2007). Secondly, simulations allow systematic experimentation in a controlled environment (e.g., unpacking constructs, relaxing assumptions, varying construct values, adding new features etc.) to produce new theoretical insights (Davis et al. 2007). Such experimentation allows us to address "what if?" questions, and is more efficient than other research methods, especially when explaining longitudinal, non-linear and emergent phenomena such as organizational learning and KM processes. Finally, as we are interested in the impacts of individual behaviors (at the micro-level) on organizational level performance (at the macro-level), simulations have been found to be particularly useful tools for studying such impacts, as they allow us to isolate, model and systematically experiment with micro-level behaviors and objectively monitor macro-level dynamics and emergent outcomes (Lomi and Larsen 1996). Simulations have been used widely in the field of organizational sciences (e.g., Repenning 2002) to study complex emergent phenomena such as organizational learning (e.g., Carley 1992; March 1991) and the dissemination of culture (e.g., Axelrod 1997).

The precision and versatility of simulation modeling does however come with a cost. Imposing precision on the linkage between structures, assumptions and behaviors can threaten external validity of the theoretical analysis (Mezias and Glynn 1993). Our simulation model does in no way attempt to capture all variables and relationships identified in the literature. Rather, we focus on developing a simple model that can aid in developing new theoretical insights. We acknowledge the limitations of simulation methods (including restrictive assumptions of the models and the lack of external validity) and stress that the purpose of this study is to generate novel theoretical insights that can (and should) later be examined empirically.

With this in mind, we develop a simulation model that captures the KM processes and connects organizational performance as an emergent outcome of these KM processes. Knowledge work is modeled as decision making, wherein the solutions to the organization's problems are formulate based on prior experience and knowledge. Organizational performance can be conceptualized and measured as the accuracy of the organization's decisions. While individuals create knowledge by learning from their past experiences, while learning at the organizational level occurs through KM processes. The organization's knowledge culture is modeled as the knowledge seeking and sharing propensities. These propensities determine whether organizational members seek knowledge from the KMS or their colleagues and/or contribute their knowledge to the KMS or share their knowledge with inquiring colleagues. Using this model we experiment with different types of organizational cultures and examine the effectiveness of the KMS under different configurations of knowledge sharing propensities.

A Model of Organizational Knowledge Processes

In the following discussion, we first formalize the basic model that is derived from Carley (1992) and describe our extensions vis-à-vis the context for KM processes. Carley's model of organizational learning is a useful starting point for modeling KM processes as this model effectively captures organizational performance as an outcome of knowledge utilization at the individual level. We then formalize the decision making activities that the organization

engages in, and describe the individual decision making process. Next, we describe how the KMS is incorporated into our model to facilitate knowledge storage, transfer and application and how it affects the individuals' decision making. Finally, we discuss the role of organizational knowledge culture in the individual decision making process.

Organization, Groups and Knowledge Specialization

The organization is modeled as an information processor that operates in an environment that supplies it with problems (or tasks) for which the organization must formulate a response (i.e., make decisions) (Tushman and Nadler 1978). The performance of the organization in such an environment can be measured by its ability to make correct decisions across a sequence of decision making periods (Carley 1992).

Carley (1992) modeled the organization as single decision making entity, albeit with different organizational structures. We forego the analysis of organizational structures and simplify the model of the organization as a collection of groups (or teams), who comprise of individuals possessing a common domain specialization unique to the group, and are responsible for solving problems that are related to this specialization. This is consistent with how organizations are structured into specialized functional departments (e.g., procurement, production, marketing, sales etc.) – although organizations operate in a holistic environment, each functional department develops its own specialized strategic responses. The conceptualization of individual and group specialization is consistent with the knowledge based view of the firm, which recognizes the organization's role as an integrator of specialized knowledge (Grant 1996). While knowledge specialization leads to efficiencies in knowledge creation, acquisition and retention (Grant 1996), it also creates a disconnect between the specialists (Postrel 2002) and problems with knowledge division and coordination (Kogut and Zander 1996). Therefore, the introduction of groups with knowledge specializations into the model creates an environment that is conducive to the efficient creation of knowledge within specializations, and creates opportunities and needs for knowledge transfer within and across specializations (i.e., the purpose of KM efforts).

The organization is modeled as a collection of G groups, each with m individual members. In each decision making period, each group faces a new problem that is similar, but not necessarily identical, to previous problems it has already encountered. The organization's problem is partitioned into group-level problems which are consequently assigned to the individual groups. Each of the m group members autonomously evaluates the information on her portion of the new problem, and a final decision is made by the group by considering the inputs from all the group members. We assume that problem faced by the group has sufficient complexity to ensure that individuals do not have the necessary information, skills or resources to independently make a decision for the overall problem. The group's decision making process follows from Carley's (1992) *team* organizational structure, wherein the group members receive information (or a subproblem) and make a recommendation independent of others. The final group decision is the majority vote of the group members' recommendations. At the end of the decision making period, the group receives feedback from the environment, which is the correct (or "true") response for that problem and is determined exogenously. The feedback received is for the entire group-level problem and is the decision that would be made by a clairvoyant decision maker given the entire problem and having perfect knowledge of the pattern matching scheme. In other words, the group has a whole gets to know whether the group-level decision was correct but the individual members do not know whether or not their portion of the recommendation was correct.

The structure of the problem is borrowed from Carley's (1992) model as it provides a very general problem structure involving stochastic pattern matching. More specifically, a problem is modeled as an N bit string where each bit may take a binary value of 0 or 1 representing the existence (1) or absence (0) of a particular dimension of the environment. With this model formulation, N represents problem complexity with 2^N possible distinct problem types that a group may face. The likelihood of seeing an identical problem in consecutive decision periods decreases exponentially as problem complexity (N) increases. The objective of the group is to determine which pattern of 1's and 0's corresponds to a *yes* or *no* answer. Initially, the organization's members do not know if the correct pattern-response is majority classification, even/odd classification, parity etc. Each group receives a problem of complexity N and has m members, therefore, a group member is assigned a subproblem of length $n=N/m$. Individuals make a *yes* or *no* recommendation for their assigned subproblem (which a contiguous string of n bits), that they submit as their contribution to the group's final *yes* or *no* decision. The final decision for the group is determined by the majority vote of the individual recommendations (see Figure 1).

A problem is framed by drawing m subproblems of n bits each. The m member-level subproblems are concatenated to form the group-level problem of size N. Each group $g \in G$ specializes in a unique and non-overlapping set of

subproblems S_g (or specialization sets of size $2^n/g$). The non-specialization set ($S_{\sim g}$) comprises of all the subproblems that are not in S_g. Problems are drawn from the set S_g with higher probability than from the set $S_{\sim g}$. This ensures that each group receives problems in its specialization set more frequently than problems in its non-specialization set. Thus groups face problems that are generally pertinent but not necessarily limited to their knowledge specializations.

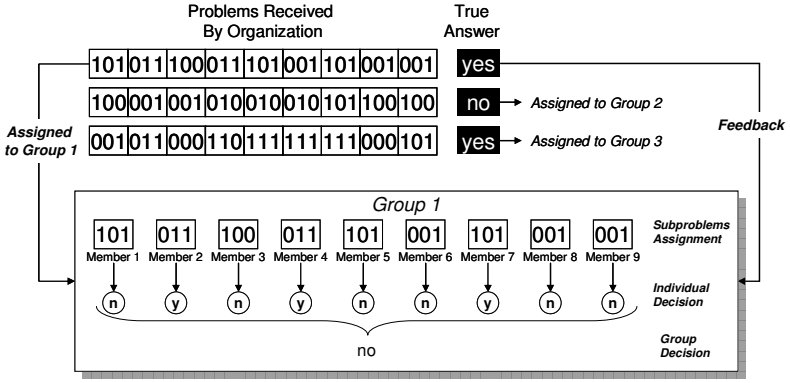


Figure 1: Organizational Decision Making & Feedback (*N = 27, n*=3, *G*=3, *m*=9)

Individual Decision Process

Individuals are modeled as imperfect statisticians who adjust their expectations for decision outcomes based on experience (Carley 1992). Individuals retain past experiences as knowledge stored in their memory (Walsh and Ungson 1991). In addition to their own past experiences, individuals can also utilize knowledge residing elsewhere in the organization (e.g., experiences of colleagues, knowledge artifacts stored in knowledge repositories etc.) to aid the selection of decision outcomes. The search for knowledge begins locally and proceeds to more distant sources of knowledge if the initial search fails to generate a *satisficing* outcome (Cyert and March 1963). Therefore, the following decision process is based on the assumption that individuals are biased towards knowledge sources that are closest to them (Miller et al. 2006), and will resort to other sources of knowledge only if they are unable to make a principled decision based on their past experiences. The knowledge source closest to each individual is her own memory. Therefore, individuals will first try to make the decision based on their own knowledge and experience. We term this process as *Internal Search*. If the individual does not possess the required knowledge to make an informed decision for the current problem, he or she will proceed to more distant sources of knowledge, such as his colleagues (*Local Search*) and/or the KMS (*Lookup*). These processes are described in greater detail below.

Theories in cognitive psychology state that individuals' memories are not perfect and knowledge is susceptible to decay over time. According to "trace decay theory" of human memory, forgetting occurs due to the automatic fading of "memory traces" (Baddeley 1986). Therefore, consistent with the Search of Associative Memory (SAM) model[1], we model an individual's memory as a cumulative record of past experiences within a fixed time frame. In other words, an individual retains information regarding the subproblems encountered for the past τ time periods only. This information includes the subproblem and the feedback (or correct group-level decision) received from the environment, and is recorded as follows. For each distinct subproblem that an individual has encountered in the past τ time periods, separate counts for the *yes* and *no* feedbacks are maintained. If the feedback received is *yes* (*no*), the *yes* (*no*) counter for the current subproblem is incremented. By incorporating forgetting into our model we are able to capture the recency effect in human memory[2].

[1] According to the SAM model, memories consist of a set of associations between items (e.g., subproblems and feedback) (Raaijmakers and Shiffrin 1981). The strength of these associations is determined by the frequency with which they co-occur. Therefore, if an individual has encountered a subproblem X 10 times, and the feedback associated with this subproblem has been *yes* 7 times and *no* 3 times, the individual will associate the correct response to problem X as *yes* in future time periods. The SAM model is applicable in the context of both episodic and semantic memory. Our model of individual memory is also consistent with the reinforcement learning (Sutton and Barto 1998).

[2] The serial position effect in cognitive psychology posits that things most recently learned are best remembered (Talmi and Goshen-Gottstein 2006).

As stated above, an individual first performs an *Internal Search* and tries to make an informed decision based on her own knowledge. More formally, *Internal Search* entails the following procedure: (1) Identify the *yes* and *no* counts for the subproblem; if the *yes* count is greater than *no* count, return *yes* as the decision; otherwise, return *no*; (2) If the *yes* and *no* counts are equal (or both are zero), seek an alternative knowledge source (i.e., perform *Local Search* or *Lookup*); (3) If this search does not yield a recommendation, return either a *yes* or *no* decision with equal likelihood (i.e., *Improvise* or guess the decision).

If the *Internal Search* fails to yield a decision (i.e., step (2) above), the individual can employ knowledge possessed by others in the organization to aid the decision making. This process is termed *Local Search* and entails the following: (i) Identify an organizational member who possesses the required knowledge; (ii) If a knowledgeable colleague is identified, employ her knowledge to make the decision (i.e., rely on the colleague's *yes*/*no* counter to make the decision); (iii) If no knowledgeable colleague is identified, improvise the decision (i.e., step (3) above).

The social relationships between individuals are an important aspect of interpersonal knowledge exchange (Levinthal and March 1993). During the process of identifying a colleague who may have the required knowledge, there exists an inherent bias towards searching locally and interacting with proximate neighbors rather than searching in a broader/extended network (Cyert and March 1963), as individuals tend to share knowledge within close knit networks (Robertson et al. 1996). Therefore, the scope of *Local Search* is limited to other members in the individual's group.

Prior studies on small groups recognize that the creation of transactive knowledge systems necessitate knowing one's own expertise as well as the expertise and knowledge of others in the group (Wegner 1986). These transactive knowledge systems enable the retrieval of the knowledge from others in the group in an efficient and effective manner (Moreland et al. 1998) as well as enable the group to implement knowledge as needed (Stasser 1998). We assume that such transactive knowledge systems exist within all the groups of the organization and enable the following: (a) the identification of group members who possess the required knowledge; (b) efficient and accurate transfer of knowledge between the sender and the recipient; (c) efficient utilization of the knowledge in decision making by the recipient. These assumptions reflect the efficient transfer of knowledge between the knowledge seeker and sharer, through face-to-face interactions (Orlikowski 2002).

The knowledge seeking and sharing propensities of the organizational members influences the amount of *Local Search* that occurs within the organization. The *Local Search* entails knowledge exchange between two individuals, and occurs only if an individual chooses to seek knowledge from a colleague and the colleague agrees to share her knowledge. More formally, an individual seeks knowledge within her group with probability b_i. If she seeks knowledge and is able to identify a group member who has the required knowledge, the group member shares this knowledge with the probability s_i. The probabilities b_i and s_i represent the individuals' propensity to seek (or *b*uy) and share (or *s*ell) knowledge through *i*nterpersonal interactions. If the group member is willing to share his knowledge, this knowledge in employed to make the decision. The decision process described above describes an individual's decision making process in the absence of a KMS and is termed as the Base Case Model.

The Knowledge Management System (KMS)

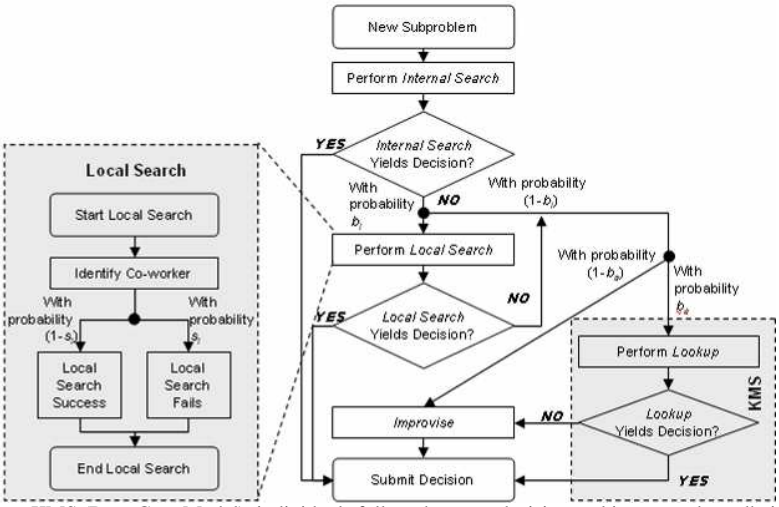
The goal of KM is "… for an organization to become aware of its knowledge, individually or collectively, and to shape itself so that it makes the most effective and efficient use of the knowledge it has or can obtain …" (Bennet and Bennet 2003). KMS are information systems (IS) employed to support and enhance an organization's knowledge process, which include knowledge creation, storage/retrieval, transfer and application (Alavi and Leidner 2001). In other words, the purpose of a KMS is to enhance the visibility and availability of knowledge within the organization, and positively impact the performance of knowledge-based tasks.

KMS differ with respect to the types of processes emphasized by the KM strategy, the approaches taken and the information technology (IT) used to facilitate KM efforts (Hansen, et al. 1999). Despite the variety of flavors in KMS implementations, we simplify our analyses by incorporating a generic KMS as a centralized knowledge repository that stores codified knowledge of organizational members, and can be used as an additional source of knowledge in the decision making process. The KMS is modeled as a knowledge repository that retains a cumulative record of subproblems and corresponding feedback that organizational members contribute to it. Unlike the individuals' memories, the KMS is not constrained by the limitations of human memory and is not subject to forgetting, recency effects and salience. Therefore, all knowledge contributed to the KMS is retained permanently in the form of knowledge artifacts. In addition to the list of possible subproblems, the KMS also maintains two

counters: one for the *yes* and one for the *no* decision outcomes. The KMS acquires and stores new knowledge, when members contribute by codifying and adding newly acquired experiences. At the end of each decision making periods, individuals contribute their newly acquired knowledge with the probability s_a. When an individual chooses to contribute to the KMS, the *yes* or *no* counter corresponding to the current subproblem he encountered is incremented based on the feedback that was received.

The KMS is the third knowledge source available to the organization's members in addition to their own memories and group members' expertise. The KMS is incorporated into the individuals' decision making process as follows. The querying, retrieving and utilization of knowledge from the KMS to make a decision for a subproblem is termed *Lookup.* When individuals perform a *Lookup*, the knowledge exchange is one sided as the propensities and actions of the knowledge sellers do not directly affect the current knowledge exchange. If the required knowledge exists in the KMS, the recipient can extract it without the consent of the contributor(s) of that knowledge. The decision making process in the KMS Model is depicted in Figure 2. The individual first performs an *Internal Search*, which is followed by a *Local Search* with probability b_i when the *Internal Search* does not yield a recommendation. In the Base Case Model, if the *Local Search* is not performed or fails to yield a recommendation, the individual resorts to *Improvisation.* On the other hand, in the KMS Model, if the *Local Search* fails, the individual looks for the required knowledge in the KMS with the probability b_a and uses this knowledge (if it exists) to make the decision. The individual is forced to *Improvise* the decision, only if all three knowledge sources fail to yield a decision.

The KMS representation is based on the following assumptions that ensure that the KMS is technologically efficient, consistent and reliable: (a) All knowledge contributed to the knowledge repository is codified accurately and completely, and (b) The knowledge extracted from the knowledge repository is precise, complete and accurately reflects the search criteria. These assumptions allow us to view the KMS from the most favorable light and to examine the influence of culture in the best case scenario regarding the technological aspects of KMS. Therefore, the performance benefits (or the lack thereof) that we see are the upper bounds and the implications of our results are optimal in nature.



Note: In organizations without KMS (Base Case Model), individuals follow the same decision making procedure albeit without the option to perform a *Lookup*. Therefore, if *Local Search* is not performed or does not yield a decision, individuals will directly proceed to *Improvisation*.

Figure 2: Individual Decision Making Procedure

Organizational Culture

Organizational culture constitutes shared beliefs, ideologies and the norms that influence the actions of the organization's members (Beyer 1981). Therefore, cultural values of the organization govern its members' predisposition or willingness to seek (or buy) and share (or sell) knowledge within the organization. We adopt the integration perspective of organizational culture that recognizes organizational culture as a homogenous collection of values that act as an integrative mechanism or social/normative glue that holds a potentially diverse group of

individuals together (Meyerson and Martin 1987).[3] Based on this perspective, we assume that all organizational members exhibit the same knowledge sharing propensities as they share the same cultural values.

In the model described above, individuals share knowledge through *interpersonal* interactions (with their group members) and indirectly (or *anonymously*) using knowledge artifacts in the KMS. The probability b_i represents an individual's willingness or propensity to seek or buy knowledge from a group member through interpersonal interactions (i.e., interpersonal knowledge buying propensity), while the probability b_a represents his willingness to seek or buy knowledge from KMS (i.e., anonymous knowledge buying propensity). High knowledge buying propensities reflect the willingness to proactively seek knowledge from external sources and their receptiveness to new ideas. On the other hand, the "Not Invented Here" syndrome is representative of low knowledge buying propensities, and reflects reluctance to reuse external knowledge (Katz and Allen 1992). Likewise, the probability s_i represents an individual's willingness to share his/her knowledge with a colleague through interpersonal interactions (i.e., interpersonal knowledge selling propensity), while s_a represents an individual's willingness to contribute to the KMS (i.e., anonymous knowledge selling propensity). For example, low knowledge selling propensities are representative of "knowledge hoarding" practices (Davenport and Prusak 1998). There are various factors that influence individuals' motivations to share their knowledge, including knowledge ownership (Wasko and Faraj 2005), expectation of personal benefits (Nahapiet and Ghoshal 1998) and social rewards such as reputation and status (Jones et al. 1997). These motivations (and it turn the propensities to sell knowledge) are determined by the organization's cultural values. For example, open and caring environments have been found to be important for learning and KM because they encourage interactions among individuals (Davenport and Prusak 1998; Gold et al. 2001). In contrast, competitive organizational cultures result in knowledge hoarding by individuals.

The organization's knowledge culture, therefore, can be characterized by the knowledge buying and selling propensities of the individuals and represented by the vector $[b_i, s_i, b_a, s_a]$. The four parameters $[b_i, s_i, b_a, s_a]$ are modeled as probabilities and are random variables drawn from the interval [0, 1]. To represent the wide variety of knowledge cultures, we assume that the *anonymous* and *interpersonal* knowledge *buying* and *selling* propensities are independent, as individuals' propensities for anonymous and interpersonal knowledge exchange are mutually exclusive. For example, an organizational culture represented by the vector [0.9, 0.6, 0.1, 0.4] identifies a culture with a high propensity for interpersonal knowledge exchange and low propensity for anonymous knowledge exchange. Moreover, the interpersonal knowledge buying propensity is greater than the interpersonal knowledge selling propensity, while the anonymous knowledge buying propensity is less than the anonymous knowledge selling propensity.

Methodology

The model presented above is implemented as a computational simulation model so that we may explore the effectiveness of KMS in different cultural settings of organizational knowledge sharing (i.e., for different values of b_i, s_i, b_a, and s_a). To generate insights into the effectiveness of KMS, we compare an organization's performance with and without the KMS (i.e., KMS Model vs. Base Case Model) under different conditions of buying and selling propensities. In the following section we describe the model calibrations that were implemented in the simulations and the different measures that were recorded. We also verify that the outcomes of the Base Case Model are consistent with our modeling assumptions and existing empirical evidence.

Model Calibration and Measures

In our simulation models, an organization is characterized by its structure (number of groups G, and number of organizational members m) and its knowledge culture (represented by the organizational members' knowledge buying and selling propensity). While keeping the structure constant (at G=3, m=9), we vary problem complexity

[3] The conflicting perspective is the differentiation perspective (Dougherty 1992), which acknowledges the existence of various local cultures within a global culture of the organization. While the differentiation perspective may be a more realistic depiction of large organizations, we adopt the integration perspective for the following reasons. First, we are interested in the knowledge sharing propensities of organization members, and the cultural characteristics that influence these propensities (such as risk taking, openness, reward systems etc.,) can be thought to be uniform throughout the organization. Second, subcultures within the organization are formed along the shared functional lines, job ranks etc., (e.g., Dougherty 1992; Schein 1985 etc.) In the context of KM, these subcultures can be interpreted to include individuals with similar knowledge requirements.

(N) and the organization's knowledge sharing culture (i.e., the knowledge buying and selling propensities [b_i, s_i, b_a, s_a]). We examine three levels of problem complexity: Low (N = 27 or n = 3), Medium (N = 45 or n = 5) and High (N = 63 or n = 7).[4] Of the possible 2^n subproblems, each group is randomly assigned approximately 1/3rd of the subproblems as the specialization set and each specialization set is independent (i.e., no subproblem can belong to the specialization set of more than one group). We also examine three levels of each of the knowledge buying and selling propensities: Low (*probability* = 0.2); Medium (0.5); and High (0.8). We limit the size of the individual memory (τ) to a 100 time periods, i.e., individuals retain the feedback for the last 100 subproblems they encountered. When complexity is low (N = 27), individuals have the capacity to retain their past experiences for all 2^n possible subproblem. However, when complexity is higher (N = 45 or 63), their memory is unable to retain past experiences for all the possible subproblems. We conduct the simulations using a full factorial design of $3(b_i)\times3(s_i)\times3(N) = 27$ for the Base Case Model and $3(b_i)\times3(s_i)\times3(b_a)\times3(s_a)\times3(N) = 243$ for the KMS Model for a total of 270 organizational configurations.

For each combination of the knowledge sharing propensities (b_i, b_a, s_i, and s_a), and problem complexity (N) we measure the performance and the actions taken by the members of the organization across 2500 time periods. The performance of the organization at time t was computed as the average percentage of correct decisions made over the time period [t-20, t].[5] We use three measures (p_i, p_m, p_e) to reflect the organization's performance at three different points in time (i.e., *i*nitial with t_i = 500, *m*id-term with t_m = 1000, and *e*nd with t_e = 2500)[6]. These measures are employed to isolate the impacts of the KMS implementation in the short, mid and long terms, since short term performance increases do not necessarily extend to similar increases in the long term, and vice versa (March 1991).

We also monitor and capture the individuals' actions in each decision making period (i.e., *Internal Search*, *Local Search*, *Lookup* and *Improvisation*). These actions reflect the knowledge source that was used by the individual to make the decision. By analyzing these actions, we may further investigate why the KMS implementation was effective (or ineffective). All results are based on 400 runs for each combination of knowledge sharing culture and environmental complexity.

Verification of Computational Model

A critical step in developing theory using simulation methods is to verify the computational representation (Davis et al. 2007). This step is similar to manipulation checks in experimental studies and examination of correlation matrices in multivariate analyses. Verification of the computational representation ensures internal validity by ascertaining that the simulation model accurately embodies the theoretical logic of the phenomenon modeled.

Our model showed several properties that characterize knowledge usage and transfer within an organization that we would expect. First, the problem complexity (N) adversely affects the organization' performance (both short and long term) and organizational learning ability. Low problem complexity (N = 27) allows for more frequent occurrences of similar subproblem classes and high feedback retention by individuals. On the other hand, high problem complexity (N = 63) leads to less frequent occurrences of similar subproblem classes, high levels of forgetting and consequently slower learning. When knowledge complexity is high, individuals take a longer time (when compared to lower knowledge complexity) to accumulate sufficient information to make accurate decisions. These findings are consistent with prior studies that examine knowledge complexity (e.g., Carley 1992; Miller et al. 2006).

Second, the knowledge sharing propensity of organizations' members influences its performance, which is consistent with existing findings (e.g., Davenport and Prusak 1998; Gold et al. 2001). To verify the impacts of organizational knowledge sharing culture, we regressed the three measures of performance (p_i, p_m and p_e) and the amount of *Local Search* at different points of time on the problem complexity (N) and the interpersonal knowledge buying and selling propensities (b_i and s_i).[7] The regression results show that knowledge buying propensity (b_i)

[4] The complexities (N and n) employed in the model are odd to ensure an unambiguous decision.
[5] The qualitative nature of our results are not sensitive to the window size (of 20), and the robustness of the results were verified to window sizes of 10, 50 and 100.
[6] By time t_i = 500, the individuals' behaviors are stabilized, while the organizations' performance can potentially improve. The mid term performance is measured by performance (p_m) at time t_m = 1000, and end performance (p_e) at time t_e = 2500. By time t_m = 1000, the individuals' behaviors are stabilized, and at t_e = 2500 the performance of most organizations has also stabilized.
[7] Due to space limitations, we present the regression results inline with the text. Unless otherwise noted, all parameter estimates are standardized coefficients and are statistically significant at $p < 0.05$.

exerts a more significant influence ($\beta_{bi} > 0.03$, $p < 0.001$ for all time periods) on performance than the knowledge selling propensity (s_i) ($\beta_{si} > 0.009$ for all time periods). While both the knowledge buying and selling propensities (b_i and s_i) significantly impact the number of decisions that are based on successful interpersonal knowledge exchanges (or *Local Search*), the buying propensity has a greater and consistent impact ($\beta_{bi} \sim 0.4$ at all time periods), though the impact of the selling propensity is lower and decreases with time ($\beta_{si} = 0.15$, 0.09 and 0.06 at t_i, t_m, and t_e respectively). In the initial time periods, due to their inexperience, individuals base a greater proportion of their decisions on *Local Search* than they do as they gain more experience and knowledge over time (see Figure 3). This amount of *Local Search* seems to depend more on the knowledge buying propensity (b_i) than on the knowledge selling propensity (s_i). These results imply that the organization members' willingness to seek knowledge from sources other than their own past experiences influences the utilization of knowledge (and consequently performance) within the organization to a greater degree than their willingness to share knowledge with others.

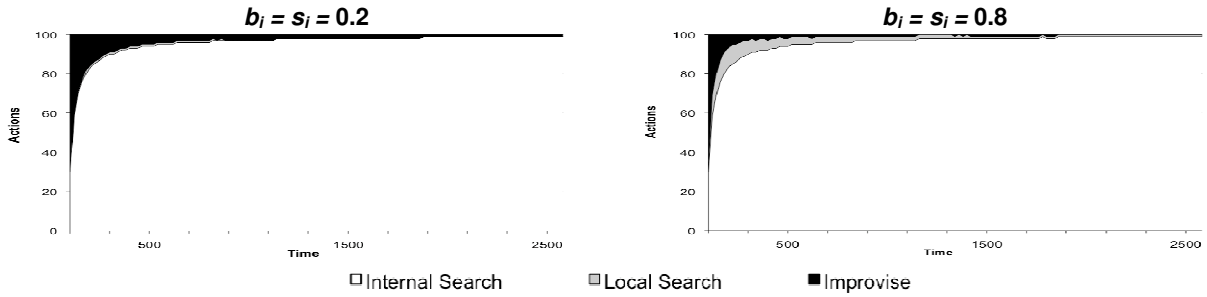


Figure 3: Organizational Knowledge Culture and Actions in Base Case Model ($N = 45$)

Simulation Results

In this section we describe and discuss the implications of our results. In order to assess the KMS' effectiveness we compare the organization's performance with the KMS (i.e., KMS Model) and without the KMS (i.e., Base Case Model). We further examine how the individuals seek and share knowledge in the KMS Model and discuss how these propensities and actions impact the KMS' impact of decision making performance. Finally, we propose an extension to the KMS Model that introduces processes changes as part of the KM initiative (as the KMSR Model) in order to demonstrate that changes to KM processes and routines may lead to sustainable performance gains.

Impact of KMS on Organizational Learning

The KMS implementation has a significant and positive impact on the organization's performance; however this impact is greater on the short term performance than on the long term performance (see Figure 4)[8]. Thus, the presence of a knowledge repository results in an increase in the short term performance of the organization, however this increase is not sustained over time and the long term performance is not significantly improved due to the presence of the KMS, especially when the problem complexity is high ($N = 63$). The degree to which the short term performance is improved due to the KMS implementation is governed by the knowledge buying and selling propensities of the organization's members. These findings imply that the KMS implementation leads to rapid diffusion of knowledge within the organization in the short term and improves decision making, but does not lead to a comparative increase in learning by the organization in the long term.

In the KMS Model, individuals can perform *Lookup* in addition to *Local Search* when the *Internal Search* fails. Therefore, we examine the influence of both the anonymous and interpersonal knowledge sharing propensities on the organization's performance by regressing the three performance measures (p_i, p_m, p_e) on complexity (N) and the knowledge buying and selling propensities (b_i, s_i, b_a and s_a). We find that b_a has a significant and positive impact on performance in both the long term and short term, while s_a, b_i and s_i do not have a significant impact on performance. However, the impact of b_a decreases with time ($\beta_{ba} \sim 0.0497$ at t_i, $\beta_{ba} = 0.0377$ at t_m, $\beta_{ba} = 0.0182$ at t_e). Since the impact of the KMS on organizational performance itself decreases with time, the influence of the organizational members' propensities for KMS usage also decreases with time.

[8] As in the Base Case Model we find that problem complexity (N) has an adverse impact on both the short term and long term performance of the organization in the KMS Model ($\beta_N < 0$ for all time periods). The impact of the interpersonal knowledge buying and selling propensities (b_i and s_i) also remain consistent with the Base Case Model results.

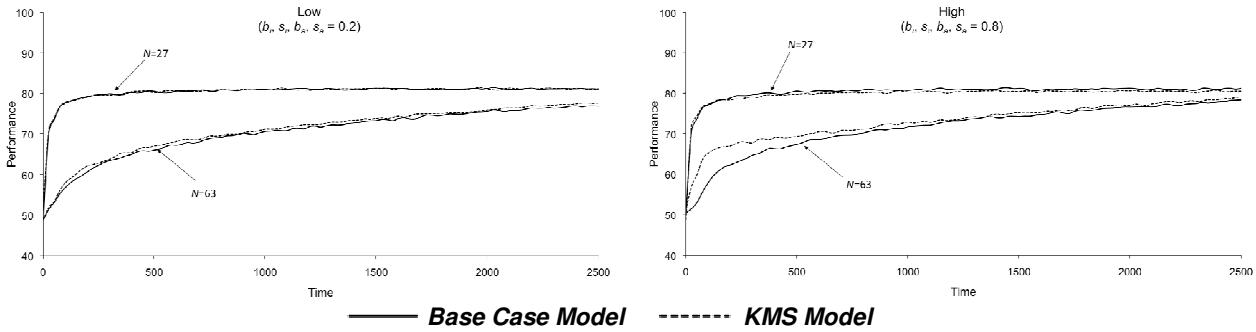


Figure 4: Decision Making Performance and Time in KMS Model & Base Case Model (N = 45)

The organizational members' propensity for knowledge selling has a positive and significant impact on the amount of *Local Search*. Since a *Lookup* occurs only when *Local Search* fails, b_i and s_i have a stronger influence than the b_a and s_a. Conversely, b_i and s_i have a significant and negative impact on the amount of *Lookup* ($\beta_{bi} < -0.2$ and $\beta_{si} < -0.06$), while the b_a has a significant positive impact ($\beta_{ba} > 0.35$) on the amount of *Lookup*. Interestingly s_a does not have a significant impact on the amount of *Lookup*. Thus individuals seek knowledge from the KMS only when they are disinclined to gain knowledge from interpersonal interactions with others. As in the Base Case Model, we find that the amount of *Lookup* and *Local Search* decreases with time and individuals primarily rely on their own knowledge (i.e., *Internal Search*) for decision making (see Figure 5).

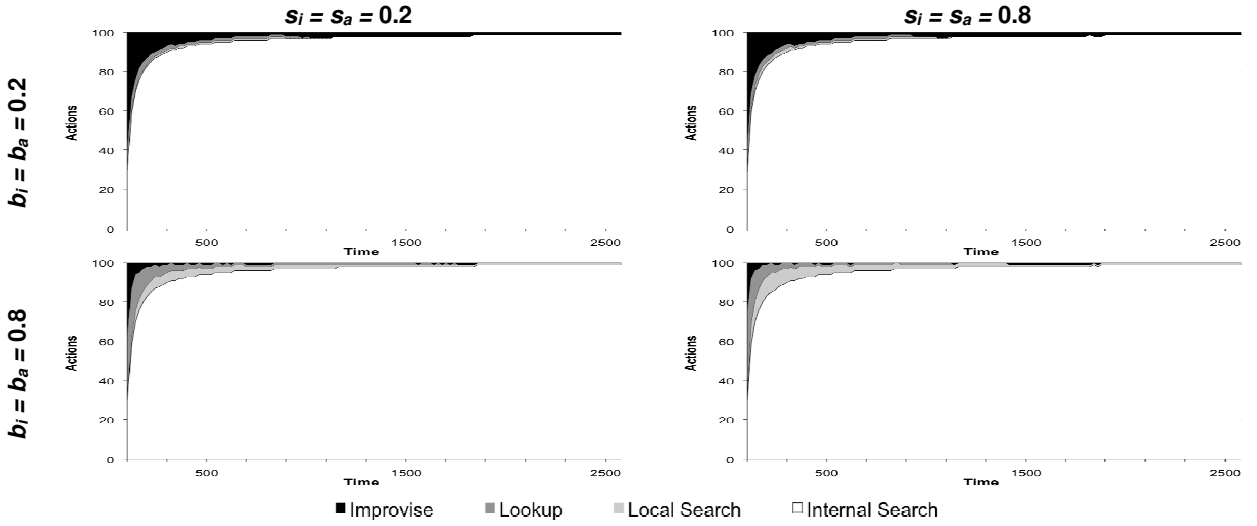


Figure 5: Organizational Knowledge Culture and Actions in KMS Model (N = 45)

KMS Implementation and Process Change

The two major implications of these findings are: (1) organizational members rely primarily on their own past experience, even though superior (or more accurate) knowledge may be available elsewhere in the organization, and (2) the organization's performance may be suboptimal due to the satisficing nature of the individuals' decision making process. The presence of the KMS implementation has a positive influence the organization's short term performance, which can be attributed to the higher levels of KMS usage (i.e., the amount of *Lookup*). Unfortunately, these usage patterns are not sustained, as reflected by the lack of long-term performance gains. Therefore, similar performance increases can be expected if these KM usage activities are sustained over time and individuals utilize knowledge sources other than their own memories even if they have the required experience.

The KMS Model described above is modified to integrate the knowledge repository more closely into the individual's decision making process in the following manner (this modified model is termed as KMS Rational or KMSR Model). Individuals evaluate the knowledge existing in the three sources available to them (namely, their own memories, their group members' memories and the knowledge repository), and choose the source with superior knowledge to create the expectation of the decision. In each decision making period, an individual evaluates the *confidence* of the knowledge pertaining to the assigned subproblem from the three knowledge sources. *Confidence* is

computed as the sum of the *yes* and *no* counts of feedback associated with each subproblem. This measure indicates the experience with the subproblem and can be used to rank the knowledge sources. We use experience with a subproblem as an indicator of the quality of knowledge, as higher experience levels result in more accurate computation of the expectation for the decision. The individual then uses the knowledge from the source with the highest *confidence* to create an expectation for the *yes* or *no* decision for the assigned subproblem. In what follows, we compare the original KMS Model (i.e., KMS Standard or KMSS Model) and the KMSR Model.

Under the KMSR Model, the diffusion of knowledge within the organization takes place more slowly when compared to the KMSS Model, resulting in lower organization's performance in the short term (than the KMSS Model). However, in the long term, the KMSR Model leads to higher levels of organizational performance, as the accuracy and the reliability of knowledge is taken into consideration while making decisions (see Figure 6).

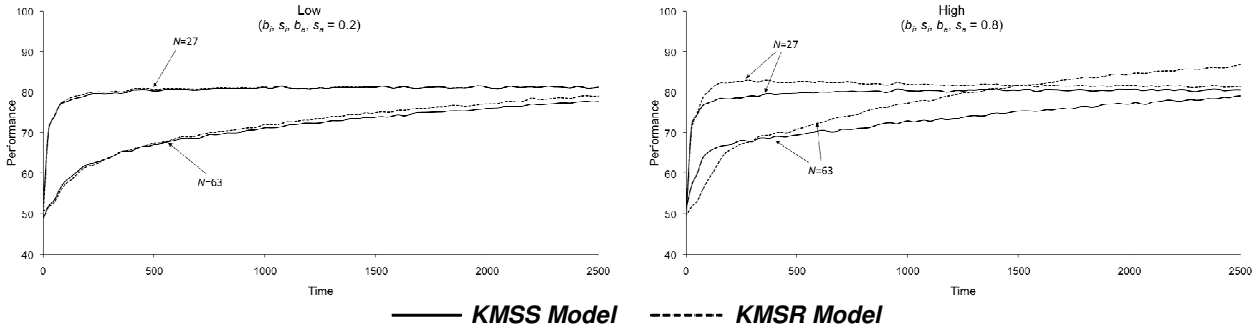


Figure 6: Decision Making Performance and Time in KMSS and KMSR Models

The implementation of the KMSR Model has a positive impact of the organization's long term performance. However, this impact is moderated by the knowledge buying and selling propensities of the organization's members. Using the same regression model employed in our analysis of the KMSS Model, we find that the knowledge buying propensities (b_i and b_a) have significant positive impacts on the short term and long term performance of the organization ($\beta_{bi} \sim 0.03$, $\beta_{ba} \sim 0.19$ for all time periods). In contrast, the interpersonal selling propensity (s_i) has a significant impact only on the short term performance, though this impact is negative ($\beta_{si} = -0.0235$, $p<0.001$ at t_i, and $\beta_{si} = -0.0122$, $p<0.05$ at t_m), while the anonymous selling propensity (s_a) has a positive and significant impact on the organization's short term performance only ($\beta_{sa} = -0.0117$, $p<0.05$ at t_i). These results imply that under the KMSR Model, the organization members rely on the knowledge repository to a greater extent than under the KMSS Model. Furthermore, organizations with high knowledge buying propensities (b_i and b_a) and high anonymous knowledge selling propensities (s_a) can benefit (in terms of long term performance) more from the implantation of the KMSR Model than organizations with lower knowledge buying and selling propensities.

To examine KMS usage in the KMSR Model, we regress the amount of *Local Search* and *Lookup* at t_i, t_m and t_e on complexity (N) and the knowledge buying and selling propensities (b_i, s_i ,b_a and s_a). The interpersonal knowledge sharing propensities (b_i and s_i) have a significant negative impact on the amount of *Lookup* that occurs in the KMSS Model. In the KMSR model, the interpersonal knowledge selling propensities (s_i) exhibits a similar negative influence ($\beta_{si} = -0.087$ at t_i), though the interpersonal knowledge buying propensity (b_i) exhibits a positive influence ($\beta_{bi} = 0.0954$ at t_i). The anonymous knowledge sharing propensities (b_a and s_a), on the other hand, have a much larger impact on the amount of *Lookup* in the KMSR Model than they do in the KMSS Model ($\beta_{ba} > 0.85$, $\beta_{sa} \sim 0.01$ for all time periods). In both KMSS and KMSR Models, we find that the interpersonal knowledge selling propensities (b_i and s_i) have a positive and significant impact on the amount of *Local Search* ($\beta_{bi} > 0.9$, $\beta_{si} > 0.34$ for all time periods). However, unlike in the KMSS Model while the anonymous knowledge sharing propensities (b_a and s_a) have significant negative impacts on the amount of *Local Search* in the KMSR Model ($\beta_{ba} < -0.13$, $\beta_{sa} < -0.002$ for all time periods).

The implications of these findings are that in the KMSR Model, the knowledge buying propensities have a greater influence on the proportion of decisions that are made based on knowledge transfers (from both group members and the knowledge repository). Since the individuals evaluate the *Confidence* of the different knowledge source prior to making their decision, they use the most reliable source available, given their propensity to utilize this source, thus deviating from satisficing knowledge searches. This course of action leads to a greater amount of both *Local Search* and *Lookup* within the organization (see Figure 7), especially when the knowledge buying propensities (b_i and b_a) are high.

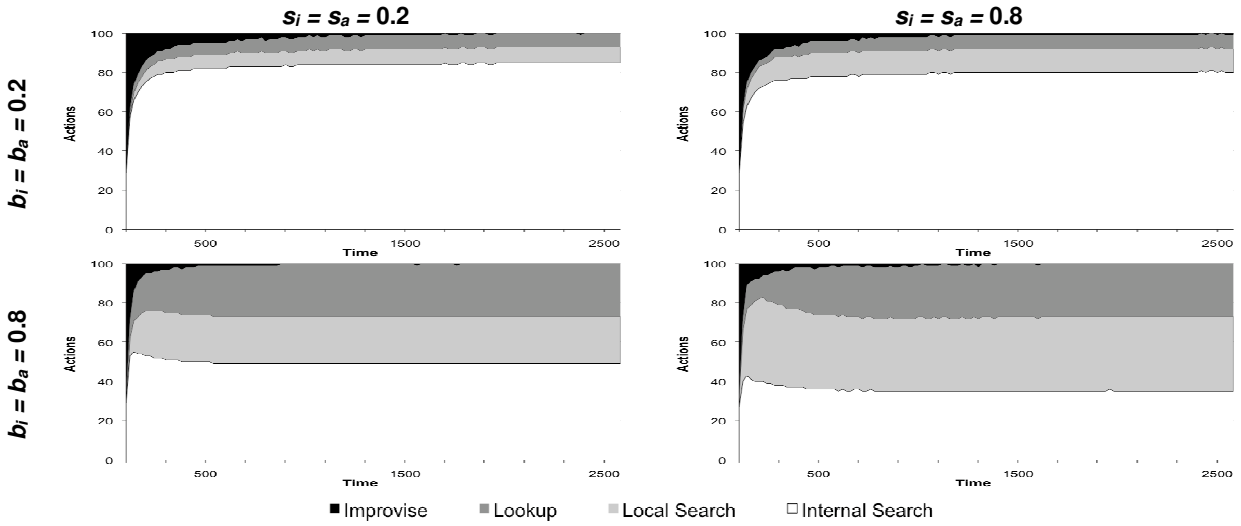


Figure 7: Organizational Knowledge Culture and Actions in KMSR Model (*N* = 45)

Conclusion and Discussion

This study investigates the relationship between the organization's cultural characteristics that govern individual knowledge sharing propensities and the effectiveness of KMS. More specifically, our focus is the cultural characteristics that govern the individuals' propensities to both share and seek knowledge from external sources. Moreover, we measure KMS effectiveness in terms of its impact on knowledge work, such as decision making. The findings of this study have a number of theoretical and managerial implications that are discussed below.

We find that the same KMS implementation yields varied outcomes in different organizational knowledge culture settings. The greatest performance gains from the KMS implementation are realized by organizations with cultural values that are conducive to both knowledge seeking and sharing, i.e., organizations whose members are highly predisposed towards knowledge buying and selling. Moreover, in the context of knowledge work where decision making performance is facilitated by knowledge sharing, we find that the employees' propensity to seek knowledge from external sources has a greater impact on decision making performance than their propensity to share their knowledge with others. Thus, the KMS' ability to facilitate appropriate knowledge exchange within the organization is governed to a greater extent by the cultural values that govern knowledge seeking propensities than those that govern knowledge sharing propensities of the employees.

Our findings have a number of implications of both practitioners and academics. As discussed previously, the majority of prior studies on intra-organization knowledge exchange have focused on the motivations for knowledge sharing, particularly from the knowledge sellers' perspective. This study contributes to the rich body of work on knowledge exchange in two ways: (1) we distinguish between knowledge seeking (i.e., buying) and sharing (i.e., selling) propensities and find that the knowledge seeking propensities have a greater impact on organizational learning and KMS effectiveness than the knowledge buying propensities; and (2) we distinguish between the interpersonal and anonymous knowledge buying and selling propensities and find that KMS effectiveness is greater when the anonymous knowledge buying and selling propensities are greater than the interpersonal knowledge buying and selling propensities.

Our findings lead to a number of interesting avenues for future research. In order to better understand the antecedents and impediments to KMS success, our findings suggest that future research should address the knowledge seeking propensities and behaviors of employees. By investigating the antecedents of "good" knowledge seeking behaviors in the context of KMS, we will be able to develop new insights for both theory and practice on how KM initiatives can create value for the organization. Since the employees' preferred medium for knowledge exchange (e.g., face-to-face or anonymously) is another factor that determines the effectiveness of the KMS in a particular organization, future studies that examine the relationships between knowledge buying propensities for different media may provide interesting insights on how to determine the appropriate KM strategy for the organization. For example, an organization where the predisposition for interpersonal knowledge exchange is high

may benefit from a KM initiative that is able to effectively exploit these propensities (e.g., personalization strategy) than a KM initiative that necessitates the institution of new behaviors (e.g., codification strategy).

From a managerial perspective, the implications of these finding are that before investing in KMS, the employees' attitudes towards knowledge sharing and seeking need to be gauged in order to predict if the KMS will yield the desired results. For example, if the employees in the organization are open to sharing their expertise but prefer to work independently and are disinclined to accept advice or knowledge from others, investments in KMS will yield poor returns. Managers in these organizations must take steps to induce appropriate knowledge sharing and seeking behaviors as part of the KM initiative prior to the actual implementation of the KMS.

The implications for IS theory and practice are that organizational characteristics such as culture and climate need to be given due consideration when designing and developing IS such as KMS that cannot be directly embedded into the work processes of the organization. Unfortunately, current system design methodologies do not provide frameworks that facilitate the prediction of IS outcomes in different organizational settings. Our simple model demonstrates how a single KMS implementation yields drastically different outcomes in different organizational settings. Similar tools or methodologies may be used to predict the intermittent and long-term outcomes of a particular IS implementation in a particular organization, taking into consideration its culture, structure and environment.

We also find that the KMS leads to substantial short term performance gains that are unfortunately not sustained. When we examine the employees' actual knowledge sharing activity, we find that the differences in the short term and long term performance gains can be attributed to the usage of the KMS. While the initial usage of the KMS is high, the system falls into disuse even when the contents are updated frequently. Therefore, when the KMS are implemented, the novelty of the system and sudden increase in the visibility and availability of the organizational knowledge may show encouraging intermittent outcomes. However, in order to realize sustainable performance gains, appropriate KMS usage has to be embedded into the organization's routines. When the KMS is implemented in conjunction with knowledge practices that encourage individuals to employ the most appropriate knowledge source for each task (as opposed to using external sources only when absolutely necessary), we find that both KMS usage and subsequent decision making performance increase. Moreover, when KMS usage is sustained over time, organizations operating in environments of high knowledge complexity and whose employees have high propensities to share (i.e., buy and sell) knowledge experience the highest performance gains. Nonaka (1991) argued that continuous knowledge processes were necessary for organizational knowledge creation. Our results suggest that these continuous knowledge processes are also necessary for the effective application of this knowledge. For example, the KMSR Model is an instance of a normative routine that yields significantly higher performance gains with the same KMS implementation. Investment in KMS implementations may not yield desired returns after the initial novelty of the system wears off unless the KMS initiative includes guidelines, incentives and policy changes that encourage employees to embed KMS usage into their routines.

This study is an exploratory study of the relationship between the organization's knowledge culture and KMS effectiveness. The simulation model developed in this study is a novel tool that captures the processes of an organization in a knowledge economy. Moreover, it allows us to measure organizational performance as an outcome of its knowledge creation and sharing abilities. However, as is the case with all model abstractions, it based on a number of assumptions. For instance, the organizations' environments are modeled as static environments, wherein the characteristics of the tasks/subtasks do not change over time. In this setting the employees engage in primarily what Argyris and Schoen (1978) defined as single-loop learning. KMS support and facilitate single-loop learning at the organizational level (Stein and Zwass 1995). In contrast, double-loop learning entails creative and exploratory thinking and learning (Argyris and Schoen 1978) and can either be impeded or aided by the KMS (Stein and Zwass 1995). Therefore, we believe that an interesting extension to this study would be to establish the impact of KMS on organizational performance related to creativity and innovation driven knowledge work, and to investigate how the organization's knowledge culture affects this relationship. Other modifications and extensions to our model can include different organizational structures (e.g., autonomous, hierarchical or flat) and personnel turnover. Our model is based on certain assumptions regarding the quality of both interpersonal and IT-enabled knowledge transfer, in that knowledge exchange between individuals is complete and without any loss. Our findings, therefore, represent the ideal scenario while in reality the expected performance gains due to the KMS may be lower. We leave it for future research to empirically investigate the impacts of the knowledge sharing behaviors on both short-term and long-term performance.

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