Dissertation Proposal

THE DYNAMICS OF ORGANIZATIONAL CULTURE AND KNOWLEDGE MANAGEMENT

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November 28, 2007

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CHAPTER 1:INTRODUCTION AND OVERVIEW

1.1. BACKGROUND AND MOTIVATION

In the current knowledge driven business environment, sustainable competitive advantage is enabled through efficient management of intellectual resources (Ashworth et al. 2004; Kogut and Zander 1992). In markets where the competitive landscape is dynamic and volatile, the manipulation of knowledge resources is especially critical (Grant 1996). Knowledge is widely recognized as a strategic asset, as organizations shift from being capital and labor intensive to knowledge intensive (Starbuck 1992). This shift also has implications for the role of Information Technology (IT) in the organizations. Previous generations of information system were implemented to increase productivity, reduce costs etc. Since organizations have automated most routine processes, new information systems initiatives focus on the knowledge resources of the firm, as there is a significant increase in both the knowledge content of all work and the proportion of workers who are knowledge workers[1] (Stewart 1997).

While organizations realize that creation and transfer of knowledge is the basis of competitive advantage (Argote and Ingram 2000) and acknowledge the importance of effective knowledge management, most struggle to achieve the desired outcomes from such initiatives (Fahey and Prusak 1998; McDermott 1999) as best practices and strategies have yet to be established. The lack of best practices and optimal strategies can be attributed to a number of reasons, including insufficient understanding of the organization's knowledge needs, the heterogeneity and inability to articulate the goals of knowledge management initiatives, incompatibility of the short term and long term

[1] The demand for knowledge workers will outstrip all other jobs by 2011. (Source: Austin, T., and Mann, J. "CIOs Must Lead the Shift from Automation to Augmentation," Gartner Research, *October 2005*)

objectives, and the incomplete understanding of how organizational members use the IT infrastructure for knowledge management activities and misalignment of incentive mechanisms.

The value generated from the implementation of an IT initiative can be realized from its complementarities with the related business process (Barua et al. 1995). In the case of IT initiatives dealing with an intangible resource such as knowledge, isolating relevant business processes and designing appropriate systems presents a major dilemma for CIOs. Unlike traditional information systems, the embedding of Knowledge Management Systems (KMS) into business processes is challenging due to the human component of managing knowledge. The IT component of knowledge management initiatives enables processes and procedure, however sustaining and replicating these knowledge management processes and procedures by knowledge workers is the actual determinant of the KMS's effectiveness. In the context of knowledge management, the organization's ability to effectively use the IT infrastructure to better reconfigure and execute business process to create competitive advantage is more vital than the direct impacts of the IT infrastructure (Pavlou and El Sawy 2006). In other words, the value created by a knowledge management initiative is dependent on the knowledge workers' behaviors and utilization of the KMS.

The behaviors of individuals in an organization are governed by the work environment and cultural values fostered by the organization. The necessity for compatibility between knowledge management initiatives and organizational culture has been acknowledged by both the academic community (Wade and Hulland 2004) and practitioners (Rubenstein-Montano et al. 2001). To address this issue, there is a growing

body of work that examines the relationship between organizational culture and knowledge management (for a review, see Leidner and Kayworth 2006). In the context of knowledge management, organizational culture has been acknowledged as a determinant of knowledge sharing behaviors and effective knowledge management within an organization in prior literature. Davenport and Prusak (1998) recognized the need to develop a knowledge-intensive culture that encourages knowledge sharing (both proactive seeking and offering knowledge). Alavi and Leidner (2001) and Nonaka (1991) also identify the relationship between an corporate culture and knowledge creation capabilities. For example, Janz and Prasarnphanich (2003) identify cultural characteristics that facilitate or impede knowledge sharing within organizations, while Nonaka and Takeuchi (1995) identify similar characteristics for knowledge creation. More recently, Alavi et al. (2005) identified the cultural values that are crucial for knowledge management initiatives, and how these values influence the use and outcomes of knowledge management tools. These descriptive studies identify specific cultural traits of organizations that influence the usage of IT by knowledge workers for specific knowledge management activities. While this stream of research enhances our understanding of the impact of organizational cultural on the knowledge sharing behaviors of individuals using IT, the implications of these relationships for the creation of competitive knowledge have not yet been established. This dissertation aims at extending this stream of research by examining the relationship between knowledge management initiatives and organizational culture for creating sustainable competitive advantage.

The resource based view of the firm states that organizations' resources and capabilities are the source of competitive advantage (Barney 1991). The capabilities of the firm can be classified as operational and dynamic, where the operational capabilities center around the operational functioning and reflect the firm's ability to perform the basic functional activities (Collis 1994), while dynamic capabilities aim at modifying the operational capabilities (Winter 2003; Zollo and Winter 2002). In other words, the operational capabilities are the firm's "how we earn a living" capabilities, while dynamic capabilities determine how firms develop new skills and routines that allow them to compete (Cepeda and Vera 2007). In the knowledge intensive environments, firms' operational and dynamic capabilities are governed by their knowledge management procedures and processes. At the operational level, the available knowledge configurations (such as knowledge management infrastructure, technology, personnel and procedures) determine firm capabilities (Cepeda and Vera 2007). On the other hand, knowledge management processes are closely intertwined with dynamic capabilities as the creation and evolution of dynamic capabilities require experience, accumulation and knowledge articulation (Zollo and Winter 2002).

This dissertation examines the moderating impact of organizational culture on knowledge management initiatives' impact on both the operational and dynamic capabilities of the firm. This dissertation will contribute to our understanding of knowledge management in two ways. First, by investigating the relationship between organizational culture and KMS, we will develop insights on how behaviors of organizational members can be leveraged while developing knowledge management initiatives in order to create the most value for the organization. Second, this research will

shed light on how knowledge sharing behaviors and activities contribute towards enhancing the organization's operational and dynamic capabilities in order to create sustainable competitive advantage.

1.2. DISSERTATION OVERVIEW

Figure 1.1 represents the overall research framework for this dissertation. The objective of this research is to examine the moderating impact of organizational culture on the effectiveness of knowledge management initiatives in terms of enhancing the capabilities of the organization. The two studies in this dissertation focus on the two classifications of firm capabilities: operational and dynamic.

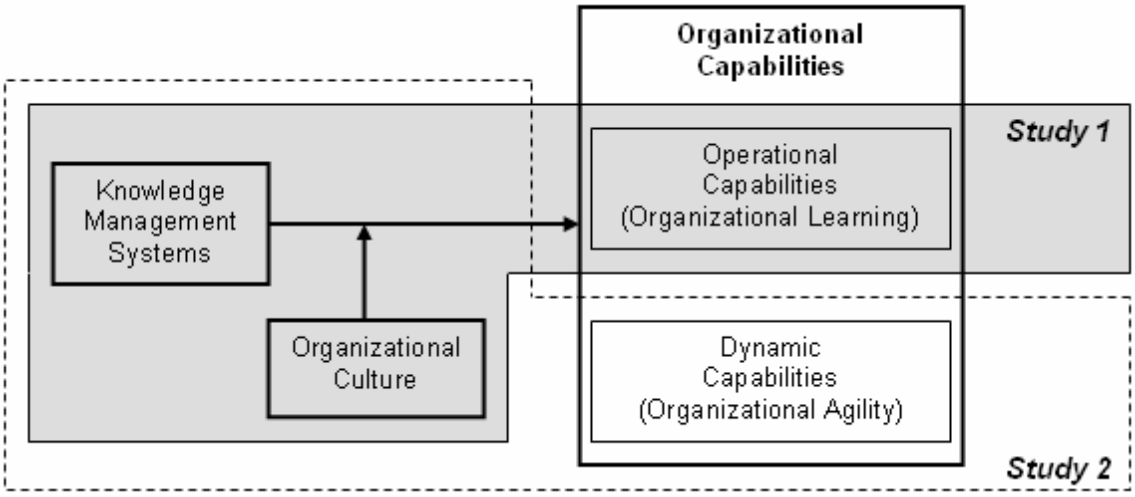

Figure 1.1: Research Framework

In the context of knowledge work, the organization's day-to-day functional activities involve information processing and decision making. The efficiency with which the organization carries out these activities is determined by its learning capabilities. We employ organizational learning as the measure of the operational capabilities of the firm in the first study, which examines the impact of knowledge management initiatives on organizational learning capabilities under the moderating effect of organizational culture.

The goal of the first study is to generate normative guidelines for the design of knowledge management initiatives that create sustainable competitive advantages by enhancing operational capabilities of the firm. These guidelines take into consideration the moderating effect of organizational culture on the ability of the organization to leverage the functionalities of the IT infrastructure used for knowledge management. The operational capability that is the focus of this study is organizational level learning. We develop a theoretical framework that establishes the relationships between these constructs, and use simulation methods to develop further theoretical insights. The computational model employed in this study extends and integrates existing models for organizational learning developed by Carley (1992) Miller et al. (2006).

Business agility, or the firm's ability to sense and respond to events in the external environment, reflects the dynamic capabilities of the firm (Sambamurthy et al. 2003). In addition to being a knowledge driven capability of the firm, business agility determines how the resources and capabilities need to reconfigured to maintain the firm's alignment with the changing environment. The second study focuses on this aspect of the organization's dynamic capability, and empirically investigates how organizational culture (manifested as knowledge sharing behaviors) moderates the impact of IT centric knowledge management activities on agility in distributed software development environments.

CHAPTER 2: THE INFLUENCE OF ORGANIZATIONAL CULTURE ON LONG TERM FIRM BENEFITS OF KNOWLEDGE MANANGEMENT INITIATIVES: A SIMULATION STUDY

2.1. INTRODUCTION

Knowledge management activities, such as acquisition and sharing rely on knowledge possessor' effort, and the potential benefits of knowledge management initiatives are dependent on their behaviors (Ba et al. 2001). The value derived from such initiatives relies largely on how they are used. For example, tools such as document repositories create value for the firm only if the members of the organization utilize them appropriately. If individuals rarely upload documents and are negligent towards categorizing and indexing them, relevant knowledge cannot be extracted when required. Conversely, even if documents are diligently uploaded and indexed, but seldom retrieved and referred to by others, the document repositories fails to serve its purpose. Therefore, the success of a knowledge management initiative is determined by the behaviors of the individuals in the organization. These behaviors, in turn, are governed by the cultural values of the organization.

The success of knowledge management initiatives in terms of immediate improvements in knowledge creation and sharing within the organization can be encouraging and perceived as indicative of positive long term impacts as well. On the other hand, the emergence of new or more efficient knowledge creation, sharing and utilization behaviors can be direct outcomes of the novelty of the IT and abrupt increase in the visibility of knowledge within the organization. The central paradox of March's (1991) seminal study, that certain behaviors or actions that are beneficial to the firm in the short term may be detrimental in the long term, is equally relevant in the context of the knowledge management initiatives. Long term benefits can be realized if immediate

positive outcomes (e.g., improved knowledge creation and sharing behaviors) can be sustained over time (e.g., improved organizational learning capabilities).

This study investigates the moderating effect of organizational culture on the success of knowledge management initiatives in terms of enhancing firm capabilities. The purpose of this study is to develop normative guidelines for designing knowledge management systems that are best suited to the existing organizational cultural values that govern knowledge sharing behaviors, in order to augment organizational level learning capabilities.

The theoretical framework that establishes the relationship between knowledge management and firm's organizational learning capabilities, and the moderating effect of culture on this relationship is developed in Section 2.2. This framework is based on three streams of research relevant to this study, namely organizational culture, organizational learning theory and knowledge management. Section 2.3 elaborates on the reasons why simulations were considered as the appropriate research methodology for this study, and outlines the guidelines developed by Davis et al. (2007) for such research. The proposed model for this study is developed in Section 2.4. This model is based on Carley's (1992) model for organizational learning, and incorporates certain elements from Miller et al.(2006). The proposed research design and analysis are outlined in Section 2.5 and 2.6. The expected contribution and implications of this study are discussed in the final section.

2.2. THEORY

The following discussion draws from prior research to establish the relationship between knowledge management and organizational culture. At the organizational level,

the purpose of a knowledge management initiative is to create competitive advantage, and the success of such an initiative is indicated by the degree to which firm capabilities are augmented.

Organizational learning has been studied extensively in a variety of academic disciplines. For example, in the economics literature, organizational learning capabilities have been found to effect the development of new industries and technology (Rosenberg 1976), the development of formal research and design as institutionalized learning mechanisms (Mowery 1981), productivity (Arrow 1962), and industrial structures (Dosi 1988). The theory of the firm also features organizational learning as a central theme of organizational capabilities (Teece et al. 1997) and enabler of innovation (e.g., Dodgson 1991) and new product introduction (e.g., Imai et al. 1985). Therefore, organizational learning is a key indicator of the firm's capabilities and source of competitiveness (Garratt 1987).

The framework developed below describes why the organization's culture is an important factor in determining the success of a knowledge management initiative. The three streams of research that are relevant to this study are knowledge management, organizational culture and organizational learning theory. The pertinent constructs for this study are identified based on the reviews of each of these streams of literature. The relationships between these constructs are then established to develop the research framework.

2.2.1. Knowledge Management

Knowledge management is rapidly becoming an integral business function for organizations as they realize that their competitiveness hinges on effective management

of intellectual resources (Grover and Davenport 2001). For organizations, the knowledge residing among its employees, both individually and collectively is one of their richest resources (Conner and Prahalad 1996; Hansen et al. 1999), and therefore effective management of knowledge is vital. The benefits of effective knowledge management can be realized at multiple levels, including firm performance (e.g., Davenport et al. 1998; Hansen 2002; Skyrme and Amidon 1998; Stata 1989 etc.), and operational level benefits (Alavi and Leidner 1999). The firm performance benefits include reduced costs in people and infrastructure, better decision making, innovation, improved corporate agility among others, while the operational benefits include enhanced communication, increased levels of participation among organizational members and efficiencies in problem solving.

Within the organization, knowledge resides in the organizational memory. Walsh and Ungson (1991) define organizational memory as "the means by which knowledge from the past exerts influence on present organizational activities, thus resulting in higher or lower levels of organizational effectiveness". Consequently, knowledge management can also be perceived as the management of organizational memory.

The goal of managing knowledge 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). Knowledge management activities include the generation, representation, storage, transfer, transformation, application, embedding and protection of organizational memory (Schultze and Leidner 2002). In other words, knowledge management initiatives' primary objective is to improve or increase the efficiency of two critical organizational activities: the creation (or acquisition) and the sharing of knowledge (Schulz 2001), which can be

achieved by improving the visibility, availability and utilization of the knowledge that resides both in the organizational memory as well as outside the organization.

While the potential benefits of knowledge management initiatives are attractive to many organizations, few are able to realize these benefits due to the challenges that effective knowledge management entails. First, exchange of knowledge within the organization is driven by the intrinsic motivations of the knowledge workers (Ba et al. 2001). The motivations for the knowledge sharing behaviors of the organizational members are intangible, and difficult to manipulate or exploit through policy and technology in order to create value for the organization.

Second, the inherent nature of knowledge itself makes it difficult to quantify, as the management of intangible resources such as knowledge is significantly different from the management of tangible resources. For instance, the tacit[2] nature of knowledge makes the identification of the knowledge used and needed by the organization a major challenge itself. Designing information systems that facilitate the creation and dissemination of this knowledge, thus, becomes a difficult task, which is further complicated when the knowledge needs of the organization are highly complex.

Finally, knowledge is not stored in one location but distributed across different parts of the organization, including the individual members' memories, their collective memories, the culture, the processes, structure, ecology and other external archives (Walsh and Ungson 1991). Therefore, managing knowledge must not only focus on the

[2] Knowledge is classified as being either *tacit knowledge* or *explicit knowledge* (Polanyi 1966). Tacit knowledge is knowledge possessed by individuals that is difficult to assess, including insights and intuitions that are cannot be codified, but can be exchanged through highly interactive social process and direct interactions in collocated, face-to-face work environments (Cohen 1998). Explicit knowledge, on the other hand, is knowledge that can be articulated, codified, and stored using certain media and be readily transmitted to others.

physical stores and artifacts, but also encompass other facets of the organization. The biggest challenge for effective knowledge management can be attributed to individuals, as knowledge residing in their memory is transient due to the limited cognitive abilities as well as personnel turnover. In order for a knowledge management initiative to create value for the organization in the long term, it has to take into consideration aspects of the organization mentioned above, with special emphasis on the behavioral characteristics of the organization's members.

2.2.2. Organizational Learning

The desired outcome of knowledge management initiatives is to create a positive impact on firm capabilities. When conceptualizing the organization as an information processing entity that uses knowledge residing in the organizational memory to make decisions (Galbraith 1977; Tushman and Nadler 1978), its ability to learn is the key to firm capabilities. The organization's learning capabilities influence its ability to make better and faster decisions for familiar problems, thus affecting the efficiency in decision making. These learning capabilities also influence the organization's ability to handle novel problems, thus affecting competitiveness, productivity and innovativeness (Dodgson 1993). Therefore, the value created by a knowledge management initiative can be assessed by the impact it has on the organization's learning capabilities.

Within the organization, learning takes place at the individual and the organizational level. While organizational level learning is a key determinant of firm performance and efficiency, it is imperative to take into consideration individual level learning, as the learning at the individual level aggregate to determine learning at the organizational level.

Individual learning is defined as the process of improving actions through better knowledge and understanding (Fiol and Lyles 1985). This perception of individual learning has been used in a number of studies (e.g., March and Olsen 1975) to model individuals as imperfect statisticians who adjust their expectations for decision outcomes based on information they receive over time. Therefore, individuals base future decision on their past experiences, or in other words, on their memory (e.g., Carley 1992; March 1991).

While organizational learning is not the sum of individuals' learning (Fiol and Lyles 1985), it does depend on the individuals' ability to learn (Hassti et al. 1984; Johnson and Kaplan 1987) as well as their collective memory (Garvin 1993). For example, cooperative learning theory (Johnson and Johnson 1989; Johnson et al. 1985; Johnson et al. 1989) recognizes that cooperative learning (or organizational learning) exists when team members work together to maximize their own as well as others' performance (Johnson et al. 1989). The learning company is one which "facilitates the learning of all its members and continually transforms itself" and "has a climate in which members are encouraged to learn and develop to their full potential"(Pedler et al. 1989). Therefore, in addition to just individual capabilities and actions, other organizational characteristics such as team orientation, collaboration and cooperation are major antecedents of organizational learning (Hult 1998; Hult et al. 2000; Janz et al. 1997; Senge 1990).

Individuals learn by augmenting and retrieving knowledge from their own memory, while organizational learning takes place when individuals learn from not only their own past experiences, but also from the past experiences of others within the

organization (Garvin 1993), i.e., the organizational memory. Organizational memory relies on knowledge that is spatially distributed throughout the processes, individuals, and knowledge artifacts within the organization and beyond its boundaries (Walsh and Ungson 1991). Therefore, learning from the organizational memory involves both interpersonal knowledge transfer as well as indirect knowledge transfer, through knowledge artifacts etc. In the context of knowledge management, this implies that organizational learning can be augmented by better communication, increasing the visibility of knowledge and the visibility of the individuals who possess knowledge within the organization

2.2.3. Organizational Culture

As discussed above, the organization's ability to learn is directly governed by the learning and knowledge sharing behaviors of its members which, in turn, are determined by the organizational culture. It is a well established belief that organizational culture is the most significant input to effective knowledge management and organizational learning, in that corporate culture determines values, beliefs and work systems that could encourage or impede knowledge creation and sharing (e.g., DeTienne and Jackson 2001; Hasan and Gould 2001; Janz and Prasarnphanich 2003; Kayworth and Leidner 2003; Leidner and Kayworth 2006; Schulz 2001 etc.). Organizational culture is a complex phenomenon, with many conflicting definitions, perceptions and interpretations. The following discussion provides an overview of these conflicting views, and identifies aspects of organizational culture that are most applicable to the study of knowledge sharing and learning behaviors of individuals within an organizational setting.

Organizational culture is defined as constituting of shared beliefs, ideologies and the norms that influence organizational action taking (Beyer 1981; Mitroff and Kilmann 1976). Schein (1985a; 1985b) identified three levels of organizational culture: basic assumptions, values and artifacts (see Table 2.1). Since we are interested in the knowledge sharing and learning behavior of the individual within an organization, the level of analysis that is most applicable is the values level. The organization's values reflect its basic assumptions, and determine the behaviors of its members. These values bring about a form of social control that defines which behaviors are appropriate for the individuals to display (O'Reilly and Chatman 1996), and have tight linkages with social group behavior (Nadler and Tushman 1988).

Cultural Level	Description
Basic Assumptions	The interpretive schemes that people use to perceive situations, make sense of ongoing events, activities, and human relationships, and to form the basis for collective action (van Maanen and Barley 1985)
Values	The set of social norms that define the rules or context of social interaction through which people act and communicate (DeLong and Fahey 2000; Nadler and Tushman 1988)
Artifacts	The most visible aspects of the culture, including visible and audible behavior patterns among others (Pettigrew 1979)

Table 2.1: Organizational Cultural Levels

The organization's cultural values determine the existence of certain characteristics in the work environment that may facilitate and encourage learning processes in terms of knowledge creation, sharing, and application (Mikkelsen and Gronhaug 1999; Slater and Narver 1995). The organization's values of risk taking, reward systems and the presence of a warm, supportive environment (Litwin and Stringer 1968) may determine its members' attitudes towards knowledge sharing. For example, open and caring environments have been found to be important for learning and

knowledge management because they encourage interactions among individuals (Cohen 1998; Davenport and Prusak 1998; Gold et al. 2001). Since the culture of the organization determines existing knowledge sharing and learning behaviors of its members, the success of knowledge management initiatives (in terms enhancing organizational learning capabilities) depend on how well it aligns with the existing culture and climate of the organization. This relationship is described in greater detail in the research framework presented at the end of this section.

There exist two conflicting perspectives of organizational culture, namely the integration and differentiation perspectives. The integration perspective is supported by cultural pragmatists (e.g., Deal and Kennedy 1982; Martin 1985 etc.) who are of the opinion that culture should be managed, while the differentiation perspective (e.g., Denison and Mishra 1995; Dougherty 1992 etc.,) acknowledges the existence of various local cultures within a global culture of the organization. While the latter perspective may be a more realistic depiction of large organizations, we adopt the integration perspective which assumes that a homogenous collection of values act as an integrative mechanism or social/normative glue that holds a potentially diverse group of organizational members together (Meyerson and Martin 1987) for two reasons. First, since we are interested in the learning and knowledge sharing behaviors of individuals within the organization, the cultural characteristics that influence these behaviors (such as risk taking, openness, reward systems etc.,) can be assumed to be uniform for all members of the organization. Second, subcultures within the organization are formed along the shared functional lines, job ranks etc., (e.g., Bloor 1994; Dougherty 1992; Schein 1985a etc.,). In the context of knowledge management, these subcultures can be interpreted to include individuals with

similar knowledge requirements. Therefore, the assumption that the organizational members targeted by a particular knowledge management initiative share the same cultural values can be made even in the context of large organizations.

2.2.4. Research Framework

Based on the above discussion, the following research framework is developed to establish the how the impact of knowledge management initiatives on organizational performance is moderated by its existing culture (see Figure 2.1).

The goal of a successful knowledge management initiative is to have a positive impact on long term firm performance and efficiency. These positive impacts can be realized by augmenting the organization's learning capabilities. Organizational learning entails the creation, exchange and application of knowledge, and is therefore affected by a knowledge management initiative's abilities of increasing the visibility, availability and the utilization of knowledge within the organization. Furthermore, the organization's ability to learn is directly determined by the learning and knowledge sharing behaviors of its members, which are in turn, governed by the organizational cultural values. Therefore, the impact of a knowledge management initiative on organizational learning is moderated by its culture.

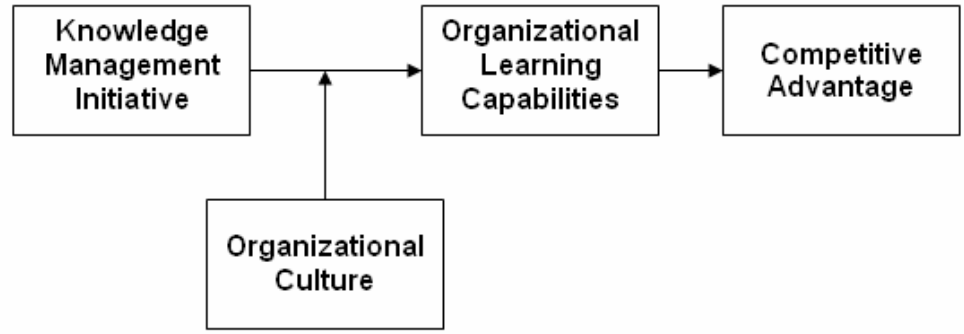

Figure 2.1: Research Framework

Organizational Culture

The organizational cultural values reflect the members' attitudes and govern their behaviors towards sharing knowledge with others. These behaviors can be classified as knowledge seeking (or knowledge buying) and knowledge sharing (or knowledge selling) behaviors. The knowledge buying and selling behaviors can be further classified as *anonymous* (the propensity of individuals to seek and share knowledge independently through artifacts) and *interpersonal* (the propensity of individuals to seek and share knowledge through interactions with others).

The organizational members' propensities for knowledge seeking and sharing influence organizational learning, in that they directly govern the individuals' collective knowledge creation, sharing and learning abilities. These behaviors are described in greater detail in Section 2.4.

Knowledge Management Initiatives

Knowledge management initiatives can be broadly classified as *codification* and *personalization* strategies (Hansen et al. 1999). Codification is the process by which individuals codify explicit knowledge and store it in a knowledge repository, where it can be accessed, applied and reused effectively by all members of the organization. The codification strategy is used in organizational environments that encourage the reuse of knowledge artifacts and require coordination and communication amongst large groups of people. In contrast, personalization strategies provide means of identifying individuals who possess the knowledge and provide a medium for communicating the knowledge directly (i.e., interpersonally) rather than storing it.

In organizations with cultural values that foster active knowledge seeking and sharing behaviors through interpersonal interactions (high propensity for *interpersonal knowledge buying* and *selling*), personalization strategies are able to support existing behaviors. Such strategies will increase efficiencies in the knowledge exchanges by improving the visibility of knowledgeable individuals and providing additional communication channels. Codification strategies, on the other hand, would not support the existing behaviors of the organizational members to the same degree as personalization strategies, as their focus is not on enhancing interpersonal knowledge exchange. Conversely, codification strategies support the behaviors of individuals in organizations whose cultural values foster *anonymous knowledge selling* and *buying* behaviors to a greater degree than personalization strategies. Furthermore, *knowledge selling* behaviors have a more profound effect on personalization strategies than on codification strategies, as *anonymous knowledge selling* behaviors can be induced by embedding knowledge management activities into the work flow, while the same cannot be done for *interpersonal knowledge selling* behaviors.

While we can intuitively predict the extent to which organizational members' behaviors can be supported by the different knowledge management strategies, the final outcomes of these strategies (in terms of enhancing organizational learning capabilities) in these organizational setting are more difficult to anticipate.

Personnel Turnover

Personnel turnover occurs when individuals leave the organization and are replaced by new personnel. One of the salient goals of knowledge management is to retain the knowledge of past members even after they leave the organization. In

knowledge intensive industries with high personnel mobility, organizations often experience the detrimental impact of personnel turnover, since the loss of knowledge worker includes the loss of his skills and knowledge as well.

Codification strategies can mitigate the negative impacts of personnel turnover as they capture the knowledge of individuals while they are still within the organization, and retain it after they leave. However, the knowledge retained by codification strategies lacks completeness as the tacit dimensions of knowledge cannot be stored. Personalization strategies, on the other hand, provide accessibility to the knowledge of only those individuals still in the organization.

The various tradeoffs associated with the two knowledge management strategies in the presence of personnel turnover and the complexity of the organization's knowledge needs, create further impediments in anticipating how knowledge management strategies will be perform in different organizational settings.

2.4. MODEL

This study employs Carley's (1992) model for organizational learning for the following reasons. Carley's (1992) model is effective in representing knowledge, and individual and organizational level learning. It also provides measures for organizational learning capabilities and knowledge complexity. The representation of knowledge demonstrates the individuals' abilities to both create and utilize knowledge, and can easily be extended to demonstrate the sharing of knowledge as well. This model also captures personnel turnover and individual memory in a manner that can be extended to organizational memory. However, it is limited in its ability to capture the cultural values that determine the knowledge sharing behaviors of the members of the organization.

These behaviors can be integrated into Carley's (1992) model by incorporating the representation of interpersonal learning from Miller et al.'s (2006) model.

As mentioned previously, knowledge management initiatives can broadly be classified as *codification* or *personalization* strategies and the significant difference between these two strategies is in their ability to transfer tacit knowledge (personalization strategies possess this characteristic, while codification strategies do not). The tacit dimension of knowledge as modeled by from Miller et al. (2006) is, therefore, also incorporated into the model.

An amalgamation of Carley's (1992) and from Miller et al.'s (2006) model is used as the base model for this study (see Figure 2.2). This base model captures organizational culture as the knowledge sharing behaviors of the individuals, in addition to individual and organizational learning. The impact of different knowledge management initiatives on the organizations' learning capabilities is analyzed by instantiating different knowledge management systems as experimental treatments on organizations with different cultural values.

2.4.1. Model for Organizational Learning

Carley (1992) modeled the organization as a collection of individuals, that operates across a sequence of decision making periods and is faced with a new problem (that is similar to, but not identical to previous problems) in each time period. In order to solve the problems, the organization relies on past experience, incrementally adapting its responses to similar problems as it receives feedback on prior decisions. The problem (or task) received by the organization in each time period is very general, involving stochastic pattern matching. In each decision making period, the organization must

determine which configuration of 1's and 0's in a binary word of length (or complexity) N[3] results in a *yes* (corresponding to 1) or *no* (corresponding to 0) answer. Initially, the organizational members are unaware that the correct pattern-response configuration is a majority classification.

Irrespective of the tasks' complexity, members of the organization are incapable of solving the task individually. Carley (1992) assumes that the individuals do not have access to all of the information nor the skills to comprehend all of the information necessary to make the decision on their own, however each member contributes to the final solution for the problem. In each time period, each member of the organization evaluates the information regarding the problem that is available to him or her (a subset of the problem[4]) independently and makes a *yes* or *no* decision. The final organizational level decision for the entire problem is the majority of the decisions of all the members. Once the organizational level decision is made, the organization receives feedback on this decision, which is the true or correct decision for the given problem. This feedback is then relayed to all the members of the organization, who learn from this feedback and use it to make future decisions.

The problems that an organization is presented with are modeled as binary strings of 0's and 1's. The true or correct decision for a given problem is *yes* (or 1) if it contains

[3] The complexity of the task is determined by its length N, and therefore for a given level of task complexity (N), there are potentially 2^N problems. Consequently, as task complexity increases, the probability of encountering the same problem in consecutive time periods alo decreases.

[4] Carley's (1992) study incorporated two types of tasks, namely non-decomposable tasks and decomposable-consensual tasks. For the purpose of this study, we shall only include non-decomposable tasks, where the problem or task is a word drawn from the set of 2^N words with replacement, such that all sub-problems are identical. By assuming that the tasks presented to organization are such that each members receives an non-identical sub-problem that is diagnostic of the final result, we can enforce the premise that all members of the organization have similar job responsibilities, and the decision to a sub-problem faced an individual in the past will be relevant to the decision for the same sub-problem currently faced by another individual.

more 1's than 0's, and *no* (or 0) otherwise. The task is further divisible into a set of subproblems, each of which is a portion of the word. All subproblems fall into a particular subproblem class, which is defined as a particular pattern of 1's and 0's. In an organization with *m* members, each member is assigned a distinct subproblem of length N/*m* to which the individual must respond to with a *yes* or *no* decision. The subproblem assigned to an individual can belong to any class with equal probability.

The individuals arrive at their decisions for a given subproblem in the following manner. For each subproblem class, individuals maintain counters for the number of times the feedback received (i.e., the true decision) for that class was *yes* and *no* in the past. These subproblem class decision counters represent the individual's memory, while the incrementing of the counters when feedback is received represents learning at the individual level. This learning process ensures that the individual learns the conditional probability that the true decision is *yes* (or *no*) for a given subproblem class. When the individual is presented with a subproblem in a subsequent decision making period, he or she first determines what class the subproblem belongs to, and then computes the expectation for a *yes* or *no* decision. If the value of the *yes* counter for the subproblem class is greater than the value of the corresponding *no* counter, then the individual's decision is *yes* and if the converse is true the decision is *no*. When the values of both counters are equal and/or zero, the individual makes a *yes* or *no* decision with equal probability (i.e., the individual guesses).

We make two additional assumptions to Carley's (1992) model. First, acknowledging the limitations of human memory, the number of subproblem classes that can be retained by the members of the organization is not boundless and is constrained to

a finite number of classes[5]. Second, the above representation of knowledge (as the expectation of *yes* or *no* decision for a subproblem class) can be extended to incorporate the tacit dimensions of knowledge by introducing the parameter of tacitness τ. τ represents the percentage of bits of the subproblem that are tacit and can be communicated exclusively through interpersonal interactions[6].

Organizational learning ability is quantified using two measures: (a) the final level of learning and (b) rate of learning. The final level of learning is defined as the percentage of correct decisions that are made at equilibrium, and is a measure of how much the organization can learn, and consequently how well it can ultimately perform. Equilibrium is reached when the learning by the organization stabilizes. The rate of learning, on the other hand, is the average number of time periods it takes until the organization is able to increase its ability to make correct decisions by 10%.

2.4.2. Personnel Turnover

In Carley's (1992) model, personnel turnover occurs when the members of the organization leave and are immediately replaced by new personnel. The organization loses the expertise and knowledge of the individual who leaves and gains the knowledge of the individual who joins the organization. Therefore, there are two aspects of personnel turnover: the frequency with which turnover occurs and the experience of the individuals who join the organization.

The individuals who leaves the organization is determined randomly, and their exit is modeled as a Poisson process, where the turnover rate (λ) is defined as 1 over the

[5] The number of subproblem classes that an individual can store in his memory is less than or equal to the number of possible classes, given the complexity of the problem (N).
[6] While the tacitness of knowledge does not have particular significance in the base model developed below, it is a significant consideration in the presence of different knowledge management initiatives. The implications of the tacitness are discussed in more details subsequent sections.

mean number of decision periods between the exits. The individuals who enter the organization are determined by the recruiting policies of the organization. We assume that all individuals entering the organization have moderate levels of experience with the type of problems that the organization is faced with. The new recruit's memory contains randomly selected subproblem classes and randomly assigned *yes* and *no* counter values.

2.4.3. Interpersonal Learning

Carley's (1992) model effectively captures individual memory and learning, wherein each member of the organization is able to acquire and retain knowledge (which is modeled as the conditional probability of the decision associated with the different subproblem classes). Organizational learning is captured by the structure of the organization, in order to investigate the impact of employee turnover. However, this model does not provide sufficient means to capture organizational memory and interpersonal interactions. Therefore, the following elements from Miller et al.'s (2006) model are incorporated.

Miller et al. (2006) extend March (1991) exploration vs. exploitation model to incorporate interpersonal learning in conjunction to learning from the organizational code. Interpersonal learning implies that in addition to learning from their own past experiences, individuals learn from the experiences of others in the organization. Miller et al. (2006) modeled interpersonal learning, as follows: members of the organization learn from superior performing members with certain probabilities. Each organization member has a local network or neighborhood, within which a *local search* is performed to identify a better performing individual. If such an individual is found, then the focal

member learns from this better performing individual. On the other hand, if the focal member is the best performing individual within his network, then an organization wide or *distant search* is performed to locate a better performing individual from whom to learn. The social relationships between individuals is an important aspect of interpersonal learning (Levinthal and March 1993) as individuals tend to share knowledge within close knit networks (Robertson et al. 1996). There exists an inherent bias towards searching locally and learning from proximate neighbors rather than searching in an extended network and learning from a distant individual (Cyert and March 1963; Granovetter 1973). The probabilities with which individuals perform the *local* and *distant searches* can be conceptualized as the knowledge sharing behaviors of the individuals of the organization.

Knowledge transfer can be analyzed at either the nodal level (focusing on behaviors of one party), or the dyadic level (focusing on the joint behaviors of both parties) (Gupta and Govindarajan 2000). Miller et al. (2006) model knowledge transfer at the nodal level, and assume that if an individual seeks knowledge, then the possessor of the knowledge makes it available. This assumption is restrictive in that it limits the representation of organizational culture. Under the knowledge market perspective of the firm (Cohen 1998; Davenport and Prusak 1998), knowledge transfer depends on the behaviors and motivations of both the knowledge seekers (or buyers) and sellers (sharers) (Lin et al. 2005). Therefore, the level of analysis is at the dyadic level and knowledge sharing behaviors of the members of the organization are decomposed into knowledge buying (or seeking) behaviors and knowledge selling (or sharing) behaviors.

The knowledge buying behaviors represent individuals' propensity for actively seeking knowledge from other sources. These behaviors can be classified as *anonymous* and *interpersonal* knowledge buying behaviors, which represent the individuals' propensity to learn from other sources independently (i.e., on their own) and propensity to learn from other individuals through social interactions respectively. We make this distinction to highlight the differences in cultural values of organizations in their ability of fostering open and caring work environments that facilitate active knowledge seeking behaviors.

The knowledge selling behaviors, on the other hand, represent individuals' propensity to share knowledge with those seeking it. These behaviors can also be classified as *anonymous* and *interpersonal* knowledge selling behaviors, which represent the individuals' propensity to make their knowledge visible and accessible to others and propensity to share knowledge with others through interpersonal interactions.

Based on the above discussion, the cultural values of the organization that govern knowledge sharing behaviors can be modeled in the following manner. Each individual in the organization possess both knowledge buying and selling characteristics. A knowledge buyer seeks knowledge *anonymously* with the probability b_A and seeks knowledge *interpersonally* with the probability b_I. A knowledge seller, similarly, shares knowledge *anonymously* with the probability s_A and shares knowledge *interpersonally* (when approached with a request) with the probability s_I. We assume that the *anonymous* and *interpersonal* knowledge buying and selling behaviors are independent variables, as individuals' propensities for anonymous and interpersonal knowledge exchange are

mutually exclusive (for example, individuals may display low or high propensities for both interpersonal and autonomous knowledge exchange).

Miller et al.'s (2006) modeling interpersonal learning is adopted in the following manner. The members of the organization are situated in a circular path, where each individual has two neighbors (left and right). When presented with a subproblem, the individual performs an *internal search*, wherein he or she attempts to create an expectation for a *yes* or *no* decision based on his or her past experiences as described above. If this *internal search* yields inconclusive results (both *yes* and *no* counters are equal and/or zero), then a *local search* is performed with a probability b_I[7].The *local search* can yield an individual within the local network who has encountered the class of subproblems the most number of times[8]. The individual identified by the *local search* shares his or her knowledge (the expectation for a *yes* or *no* decision) with the seeker with a probability s_I. If the *local search* fails to yield conclusive results, the individual can *guess* the decision (*yes* or *no* with equal probability).

[7] The individual will *guess* the decision, as in the case of the base model, with the probability $(1-b_I)$
[8] Experience with a class of subproblems is computed as the sum of the values of the corresponding *yes* and *no* counters.

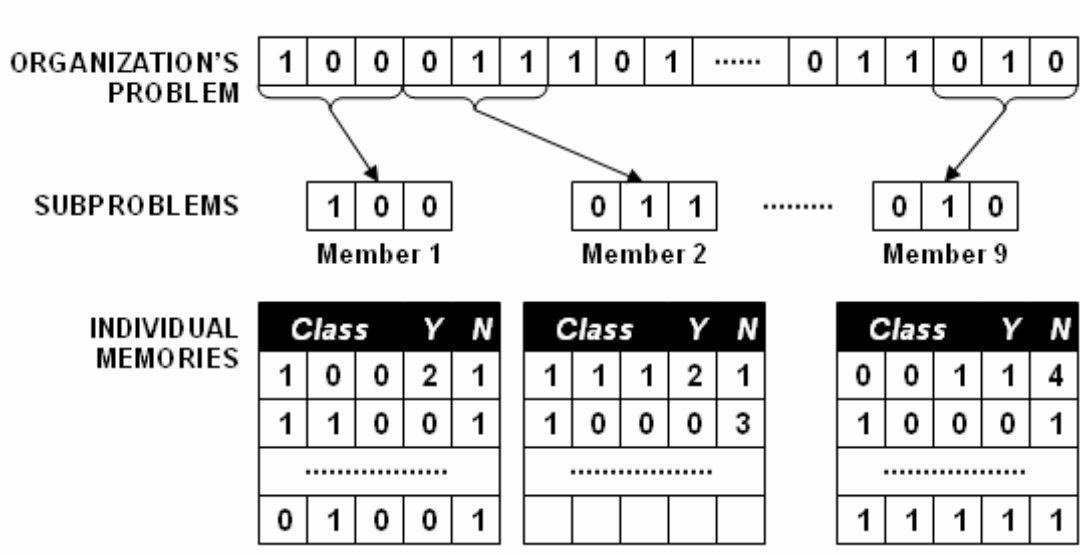

Figure 2.2: Base Model for Organizational Learning

2.4.4. Knowledge Management

The base model described above is used to determine the organizational performance of different cultures in the absence of knowledge management systems. Once equilibrium is reached and learning at the organizational level stabilizes, knowledge management initiatives are instantiated as experimental treatments in order to analyze their impact on the behaviors of the organizational members and organizational learning ability. The two types of knowledge management initiatives that are considered in this study are the codification and personalization strategies. The modeling of these strategies is described in the following discussion.

Codification Strategies

The codification strategies provide tools that increase the visibility and availability of explicit knowledge artifacts within the organization, and aim at increasing the dissemination and reuse of existing knowledge. Such strategies are incorporated into the model developed by introducing the implementation of a knowledge repository that stores the explicit dimensions of subproblem classes and the corresponding expectation

of *yes* and *no* decisions. The knowledge repository is modeled similarly to the individual memory, in that it comprises of counters for the *yes* and *no* decisions for each subproblem class (see Figure 2.3). However, it differs from the individual memory in two ways. First, the knowledge repository is not constrained by the limitations of human memory and there are no bounds on the number of classes that can be retained at a given point of time. Second, knowledge repositories can store only codified knowledge (e.g., documents, reports etc.,) and therefore only the explicit dimensions of knowledge can be captured. Therefore the subproblem class descriptions stored in the knowledge repositories are more general than the classes retained by individuals[9].

The implementation of the knowledge repository results in certain changes in the learning processes of the members of the organization. Firstly, upon receiving feedback on past decision, individuals as knowledge sellers choose to update the knowledge repository with this new knowledge with the probability s_A. This process determines how much knowledge is contained within the knowledge repositories and made accessible to the others in the organization. Secondly, individuals as knowledge buyers have access to another resource for knowledge in addition to their local networks. When an *internal search* yields inconclusive results, the individual has two options: to perform a *local search* or query the knowledge repository. Individuals choose to query the knowledge repository over performing a *local search*, if their propensity for anonymous knowledge buying (b_A) is greater than their propensity for interpersonal knowledge buying (b_I).

[9] For example, consider two subproblem classes for complexity N/m=5: (10111) and (10101). When tacitness τ=0.5, the first three elements of both the sub-problem class are explicit, while the remaining two elements are tacit. Consequently, in the knowledge repositories, both these sub-problem classes will be treated as the same class (101??).

Conversely, if b_A is less than b_I, individuals will perform a *local search* in the manner described in the base model.

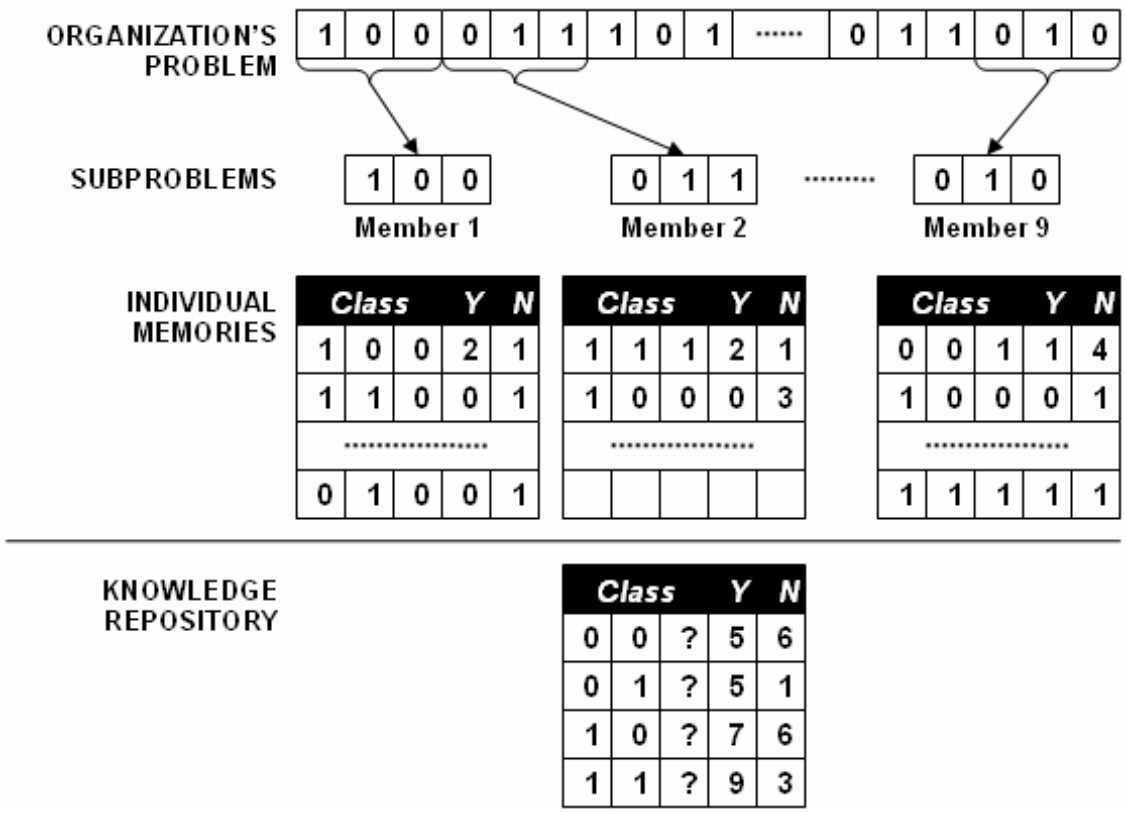

Figure 2.3: Model of Codification Strategy

Personalization Strategies

Personalization strategies provide tools that increase the visibility of the knowledge possessed by all members of the organization. These strategies are modeled as personnel directories that contain a history of the different subproblem classes encountered by each member of the organization (see Figure 2.4). Unlike the codification strategy, the personnel directories cannot be used to compute the expectations for the *yes* and *no* decisions for the subproblem classes, as the actual feedback for the different classes is not retained. However, as in the case of the codification strategies, the

personnel directories can contain only the explicit dimensions of the knowledge, and therefore, the subproblem classes stored in the personnel directories are more general than the classes retained in the individuals' memories. The members of the organization utilize the personnel directories to locate individuals within the organization who possess the knowledge they need, and the actual knowledge transfer takes place through interpersonal interactions.

The personnel directories are incorporated into the organization members' learning process in the following manner. As in the case of the codification strategies, individuals as knowledge sellers choose to update the knowledge repository with this new knowledge with the probability s_A. This process determines the extent to which the personnel directories are updated and accurately represent the knowledge residing in the organization. Using the personnel directories, individuals as knowledge seekers need not rely solely on their local networks. When both the *internal* and *local searches* yield inconclusive results, the personnel directory is used to locate the individual with the most experience for the given subproblem. This potential knowledge seller is approached by the knowledge buyer and chooses to share knowledge with the buyer with a probability s_I.

In addition to the metrics for organizational learning used by Carley (1992), the utilization rates of the different knowledge management tools can also be measured. The utilization of knowledge management tools includes both the buying and selling aspects of knowledge sharing. At a given point of time, the average number of individuals who contribute to the knowledge management system represents the effectiveness of the system in acquiring and storing knowledge. Similarly, at a given point of time, the

average number of individuals who utilize the knowledge management system for retrieving knowledge represents the effectiveness of the system in increasing the visibility of knowledge within the organization. The correlation between the utilization rates of the knowledge management tools and the changes in organizational learning ability can be used to draw additional insights.

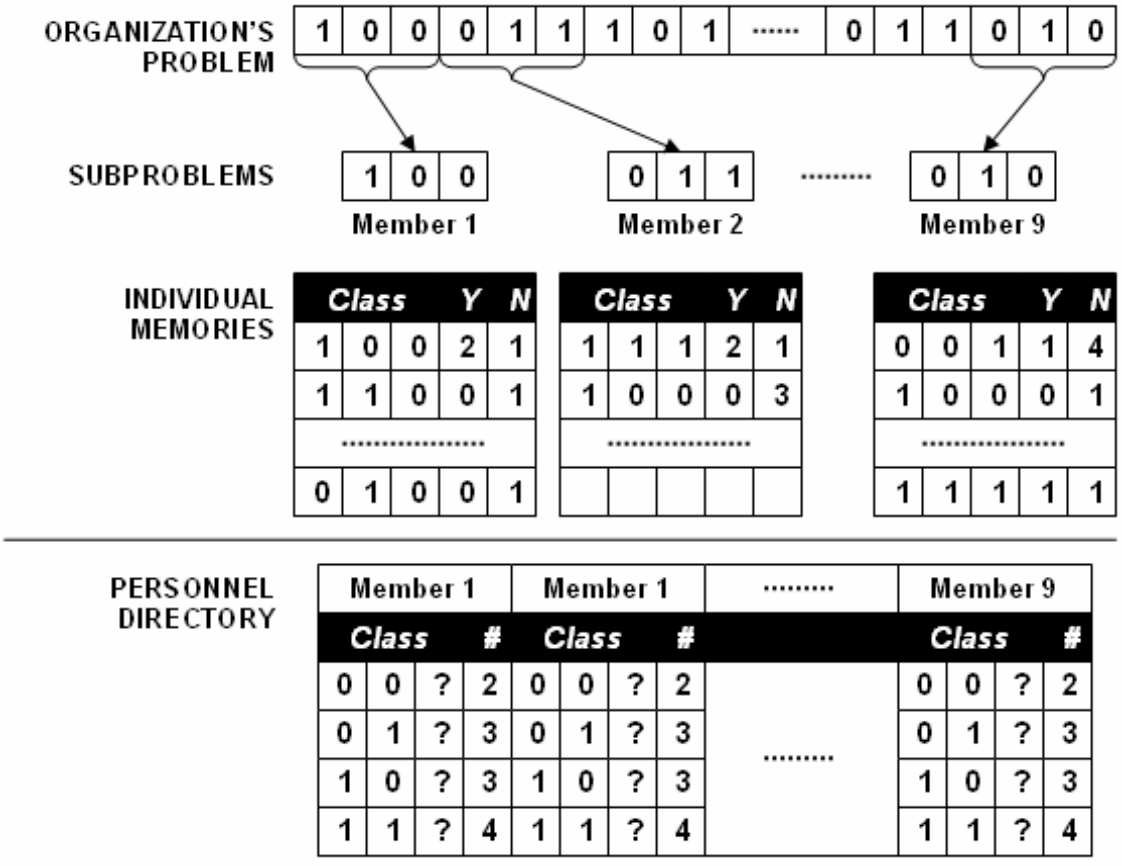

Figure 2.4: Model for Personalization Strategy

2.5. RESEARCH DESIGN

2.5.1. Model Calibration

The model calibrations that will be used for the simulations and subsequent analysis are summarized in Table 2.2. Carley (1992) modeled organizations as comprising of $m = 9$ members. The members of the organization are characterized by their knowledge sharing behaviors. As described in the previous section, these knowledge sharing behaviors are represented by four parameters: *anonymous* and *interpersonal* knowledge buying propensity (b_A and b_I respectively) and *anonymous* and *interpersonal* knowledge selling propensity (s_A and s_I respectively). Since this study takes the integration perspective of culture, all members within the organization are assumed to exhibit uniform behaviors and possess the same values for the four parameters. These four parameters represent probabilities and can take values between 0 and 1. Though probabilities are continuous random variables, for the purpose of this study, we only assign the values of Low (0.2), Medium (0.5) and High (0.8) to each of these parameters in order to classify organizations based on the cultural traits. 81 unique organizational cultures are identified by the permutations of the values assigned to these four parameters. In addition to the culture, organizations are also characterized by the turnover rate. We model only two turnover rates: Low ($\lambda = 0.01$) and High ($\lambda = 0.1$). The turnover rate is kept constant for all stages of the simulation. When characterized by the culture and the turnover rate, there are 192 organization types that will be examined in this study.

Table 2.2: Model Calibration

Parameter	Calibration
Organization Characteristics	
Organization Size (m)	9
Organization Culture :	
Anonymous Knowledge Buying Propensity (b_A) *	Low (0.2)
Interpersonal Knowledge Buying Propensity (b_I) *	Medium (0.5)
Anonymous Knowledge Selling Propensity (s_A) *	High (0.8)
Interpersonal Knowledge Selling Propensity (s_I) *	
Turnover Rate (λ)	Low (0.01)
	High (0.1)
Task Characteristics	
Tacitness (τ)	0.5
Complexity (N)	Low (27)
	Medium (45)
	High (63)

* These variables are continuous random variables, however we consider select discrete values in order to simplify the classification of organizations based on the calibrations of their cultural characteristics.

The complexity of the problems that the organizations have to solve is represented by N. Three levels of task complexity are examined: Low (N=27), Medium (N=63) and High (N=405). The complexity of the subproblems and the number of subproblems classes associated with the different task complexities are summarized in Table 2.3. The tacitness of knowledge (τ) is assumed to be a constant for all the simulations at $\tau = 0.5$. This implies that for the numbers of explicit elements (computed as ceiling[$\tau \times N/m$]) of the subproblem classes for Low, Medium and High complexity are 2, 3 and 4 respectively. Finally, the number of subproblem classes that can be retained in an individuals' memory is restricted to 8 (corresponding to Low task complexity).

Table 2.3: Task Complexity Calibrations

Complexity (N)	Subproblem Complexity [Explicit | Tacit Dimensions]	Subproblem Classes
Low (27)	3 [2|1]	8
Medium (63)	7 [4|3]	128
High (405)	15 [8|7]	32768

2.5.2. Simulation Stages

Each run of the simulation will be carried out in two stages. In the first stage of the simulation, the base model for each type of organization will be used to determine its organizational learning ability in the absence of any knowledge management tools. The end of the first stage is indicated by the stabilization of learning by the organization.

In the second stage of the simulation, the two types of knowledge management initiatives (codification and personalization strategies) will be applied for each organization as independent experimental treatments. The observed impact of the two types of knowledge management system on the knowledge sharing behaviors and organizational learning ability for each organizational culture type, will allow us to isolate the moderating effect of culture on firm performance. The above setup will be repeated for different task complexity values in order to validate the generalization of the results

2.5.3. Proposed Analysis

Monte Carlo analysis will be used for this study, where each of the 192 organization (identified by the combination of the values for the four parameters representing the culture) will be simulated 500 times. The analysis of the simulation results will be conducted in two phases.

First, in following with Davis et al.'s (2007) guidelines, we will validate the simple theory developed in Section 2. To validate the basic premise that knowledge sharing behaviors of individuals are determined by the cultures traits of the organization, we will perform tests on the results of the first stage of the simulation to show that organizational learning capabilities are significantly different for unique cultures. To

validate the moderating affect of organizational culture on the ability of knowledge management systems to enhance organizational learning, we will test the results of the second stage of the simulation to show that the same knowledge management strategies result in different levels of changes in the organizational learning ability in different organizational cultures.

In the second phase, we will analyze the results of the simulations to develop extensions to the simple theory. These extensions will include the identification of cultural characteristics that are best suited for the two types of knowledge management systems in (a) the presence of personnel turnover, and (b) for different levels of knowledge complexity.

2.6. CONCLUSION

The purpose of this study is to examine the moderating effect of organizational culture on the success of a knowledge management initiative in terms of enhancing firm capabilities. We develop a theoretical framework that establishes the relationships between the knowledge management initiatives, organizational learning capabilities and organizational culture. This framework is the basis for the development of a model of organizational learning that incorporates organizational culture as knowledge sharing behaviors of individuals. The proposed research design will examine the different knowledge management initiatives affect the organization's learning ability in different organizational cultures. The results of the proposed simulations will be used to develop normative guidelines for the design of knowledge management initiatives best suited to an organizations existing culture.

The study proposed above attempts to follow the roadmap suggested by Davis et al. (2007) for developing theory for organization sciences using simulation methods. We have identified a theoretically relevant research questions. This area of research follows prior studies where simulations have been identified as being effective methodological tools (namely organizational learning studies such as March (1991), Miller et al. (2006), etc.). In order to answer the research question, we have developed a simple theory that integrates three disciplines (knowledge management, organizational culture, and organizational learning theory). In order to test this theory, we have also developed a simulation model that extends prior well established models in the organizational sciences literature (namely Carley (1992) and Miller et al. (2006)). The model developed is the computational representation of the theoretical constructs and logic of the simple theory. We also propose appropriate model calibrations for the testing and verification of the simple theory using the computational model. We plan on experimenting with this model by instantiating the two classes of knowledge management initiatives (codification and personalization strategies) and observe their impact on firm performance (in terms of organizational learning ability) in different organizational settings, in order to develop further insights and extensions of the simple theory. The external validation of the theory using empirical data is beyond the scope of this study and is left for future research.

This study contributes to existing theory by bringing together three diverse streams of literature and developing a framework to broaden our understanding of the factors that contribute to the long term effects of knowledge management initiatives for the organization. This study also applies well established simulation models from the organizational sciences in the context of knowledge management. Finally, from the

practitioner's point of view, this research will offer insights and directives for the design of knowledge management initiatives that align with existing cultural traits of the organization and lead to long term benefits.

In addition to empirical validation of the results, the study proposed above can be extended in a number of ways. The model developed above assumes a flat organizational structure wherein all the members of the organization have an equal say in the final decision. This assumption can be relaxed in future research to include other organizational structures (e.g., hierarchical) to explore the moderating effects of organizational structure as well as culture. Similarly, other organizational phenomenon, such as environmental volatility, etc., can be incorporated into the study. From the knowledge management perspective, this study focuses on the nature of IT that comprises the knowledge management initiative. The investigation of the moderating effect of organizational characteristics (such as culture, structure etc.,) on the impact of other facets of a knowledge management systems (such as incentive mechanisms) on long term firm performance can be an interesting extension of this study.

CHAPTER 3: I.T. AND ORGANIZATIONAL AGILITY: A BEHAVIORAL PERSPECTIVE

3.1. INTRODUCTION

Business agility is a relatively new paradigm patented as a solution for maintaining competitive advantage during times of uncertainty and turbulence in the business environment (Sharifi and Zhang 2001). Agile organizations are characterized by their resourcefulness and ability to respond quickly and adapt to their environment (Baskerville et al. 2005). Business agility comprises of two primary functions (van Oosterhout et al. 2006): (a) the ability to sense relevant events in the external environment that have strategic and/or operational implications for the firm (b) responding to these events effectively and efficiently by making strategic and/or operational level changes in responses to these events in a timely manner. As both these functions are knowledge driven, organizations are increasingly relying on Information Technology (IT) (including knowledge and communications technologies) to enhance their agility (Sambamurthy et al. 2003).

Enterprise agility is especially crucial to competitive performance in globally distributed software development environment (Lee et al. 2006). The rapidly changing technological landscape and the knowledge intensive nature of this industry create an environment where an organization's competitiveness hinges on its ability to be innovative, flexible, and adaptive. The existence of temporal, geographical and socio-cultural distances within the organizations increases their reliance on Information and Communication Technology (ICT) for critical project management activities such as communication, coordination and control (Ågerfalk and Fitzgerald 2006) creating additional challenges to achieving business agility.

Recent studies have examined the relationship between organizational agility and IT in knowledge intensive environments has from a variety of perspectives. These studies examine both the direct (Haeckel 1999) and indirect (Overby et al. 2006) impacts of IT on enterprise agility, as well as the use of IT at the strategic and operational levels to enhance agility (Lee et al. 2006). While these studies acknowledge knowledge, knowledge management capabilities and IT competence as antecedents of business agility, the impact of the behavioral aspects of knowledge management on an organization's agility has not been established.

The purpose of this study is to investigate the relationship between knowledge sharing behaviors and organizational agility in a distributed software development environment. We aim at identifying the behavioral characteristics of organizational members (using ICT) that enhance the agility of virtual teams. Drawing from prior research on knowledge sharing behaviors in virtual teams, we develop propositions that identify different behavioral patterns that augment agility in environments where ICT are the primary medium of knowledge transfer and communication. These hypotheses are tested using data from Open Source Software Development (OSSD) environment.

The OSSD context is characterized as a highly distributed environment, with cooperative and rapid product development, and rapid evolution as the environment changes (Feller and Fitzgerald 2000) and is chosen as the data source for the empirical verification of the theoretical propositions for a number of reasons. Firstly, it is a knowledge intensive industry, mandating continuous creation and sharing of knowledge within project teams. The OSSD community is comprised of voluntary members who appreciate cultural values of openness and collaboration, which influence their

knowledge sharing behaviors and provide an ideal setting for observing these behaviors. Second, the instability and turbulence of the environment (which can be attributed to unstable and changing user requirements, technology obsolescence, and market structure among others) ensures that agility is essential to the success of the project team. Finally, the OSSD community comprises of geographically distributed individuals who rely exclusively on IT for communication and knowledge sharing, allowing us to isolate the impact of their behaviors using ICT on agility.

3.2. THEORETICAL DEVELOPMENT

3.2.1. Organizational Agility

Enterprise level agility is an important determinant of firm success in turbulent environments, especially in the dynamic knowledge intensive business environments (Baskerville et al. 2005) such as software development. Organizational agility is defined as the capability to sense and respond to predictable and unpredictable events from the external environment (Baskerville et al. 2005). The key aspect of agility is time, i.e., the speed with which the organization can respond to external events (such as customer requirements, market dynamics, and emerging technology options, among others). The time taken for an organization to respond includes (a) the time to sense the relevant events in the external environment, (b) interpret what is happening and assess the consequences for the organization, (c) explore the available options and (d) decide what actions to take and (e) the time to implement the appropriate actions (Haeckel 1999).

The two primary elements of agility (namely sensing and responding to relevant events from the external environment) are knowledge intensive processes. Sensing external environmental changes necessitates organizational members to be aware of the

operational and strategic activities and goals, but also apply this knowledge to identify external events and predict their implications for the organization. Similarly, responding to external events necessitates informed decisions on courses of action that need to be taken, as well as the implementation of these decisions in a timely and efficient fashion. Agility can therefore be cultivated through efficient knowledge management that increases the visibility and availability of knowledge within the organization.

IT has been established as an important enabler of enterprise agility, both directly and indirectly (Overby et al. 2006). Lee et al. (2006) identified IT strategy, infrastructure and project management as the three interrelated components of IT that enable agility in a globally distributed software development environment (see Figure 3.1). While the IT strategy is needed to suit changing business needs, the infrastructure enables the formulation and enactment of this strategy. The impact of strategy and infrastructure can be categorized as the direct impact of IT on the organization's ability to sense and respond to relevant events in the external environment. The flexibility of the IT strategy of the organization directly determines its ability to adapt to environmental changes, such as market needs etc. (Lee et al. 2006). Similarly, the impact of the IT infrastructure, defined by the IT platforms and its applications (Weill et al. 2002), can also be categorized as a direct impact. For example, the IT infrastructure provides the firm with adequate IT capabilities to sense relevant changes in the environment due to advances and obsolescence in technology (Haeckel 1999).

IT project management, on the other hand, has indirect impacts on organizational agility. Project management is the coordination and control in systems development projects and includes decentralized knowledge management skills. The focus of this

study is the indirect impact of these decentralized knowledge management skills on enhancing agility in distributed software development environment in the context of OSSD.

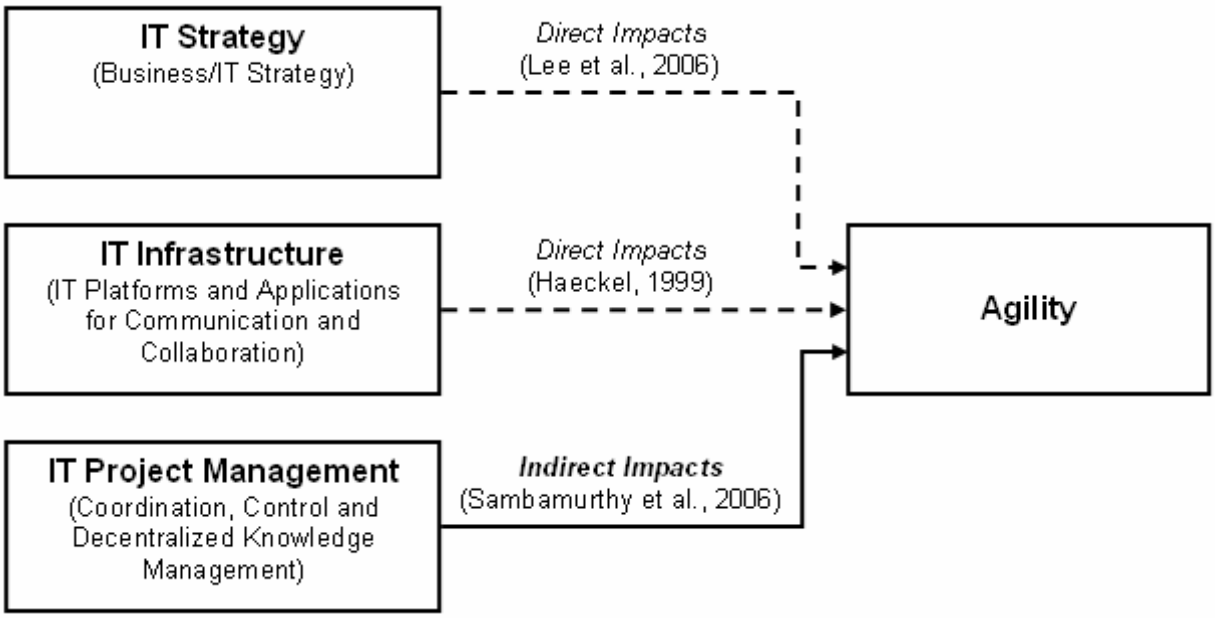

Figure 3.1: Agility Enabling Components of IT in Globally Distributed Software Development Environments

In distributed software development environments, knowledge management activities (including creation, storage, retrieval, transfer and application) are carried out through asynchronous ICT. These technologies can be categorized as what Sambamurthy et al. (2003) define as *digital options*, or IT-enabled capabilities that may or may not be applied to emerging opportunities. The purpose of these technologies is to enhance the reach and richness of a firm's knowledge[10] which lead to improvements in the firm's ability to sense and respond to changes in the environment. The extent to which these

[10] *Knowledge reach* refers to the comprehensiveness and accessibility of codified knowledge, while *knowledge richness* refers to quality of knowledge (timeliness, accuracy, descriptiveness and customization, etc.) that is available to the firm (Sambamurthy et al. 2003).

technologies are able to increase the reach and richness of the firm's knowledge is determined by how they are used by individuals.

3.2.2. Individual Behaviors.

Organizational cultural beliefs and values govern how individuals use ICT for knowledge management activities (Alavi et al. 2005). While the cultural beliefs and values are indicative of general attitudes and motivations towards the utilization of IT, the impacts of these values are realized through the observable behaviors of the individuals with respect to IT usage. In other words, the potential benefits (in terms of enhancing agility) of IT cannot be realized unless individuals exhibit the desirable knowledge sharing behaviors that are a reflection of the organization's cultural beliefs and values.

Since time is a key aspect of agility, efficiencies of the knowledge management activities, in terms of increasing the reach and richness of knowledge, enhance the efficiency and effectiveness of sensing and responding to environmental events. In the following discussion, we identify observable knowledge sharing behaviors using ICT in distributed software development environments that enhance agility (by increasing the reach and richness of knowledge) and develop propositions for the same. These propositions are represented in Figure 3.2.

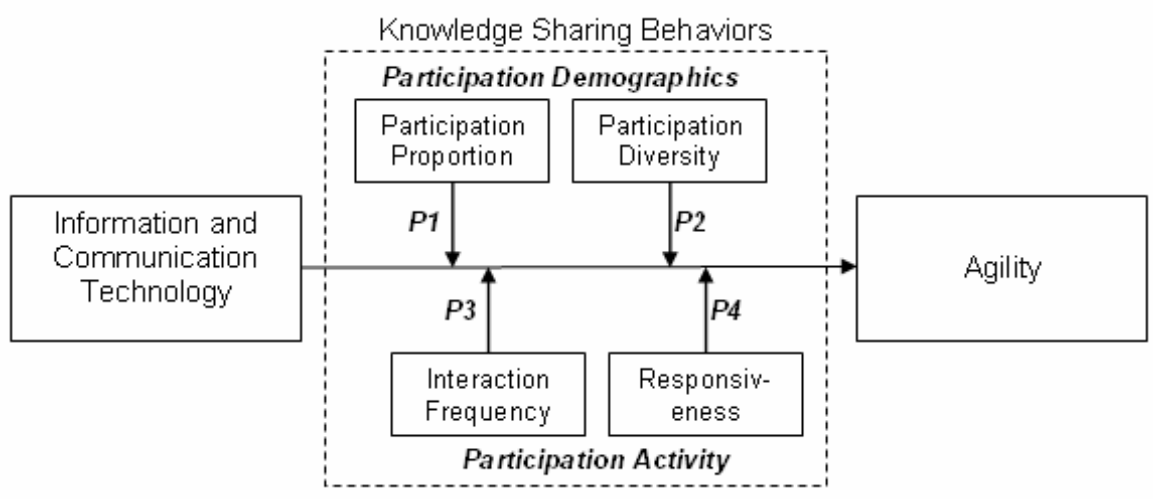

Figure 3.2: Research Framework and Propositions

Participation Demographics

The demographics of the organizational members who use ICT for knowledge management activities are one of the most visible aspects of knowledge sharing behaviors of the organization. The participation demographics isolate the characteristics of the knowledge workers who are actively involved in the creation and exchange of knowledge.

Prior studies on small groups recognize that the creation of transactive knowledge systems necessitate knowing one's own expertise (Fisher and Fisher 1998; Stewart 1997; Wegner 1986) as well as the expertise and knowledge of others in the group (Moreland 1999; Wegner 1986). Such transactive knowledge systems enable the retrieval of the knowledge from others in the group in an efficient and effective manner (Liang et al. 1995; Moreland et al. 1998) as well as enable the group to implement knowledge as needed (Larson and Christensen 1993; Stasser 1998). The ability to retrieve and utilize knowledge determines group performance, including agility. In a distributed software development environments where ICT are the primary medium for communication, the participation demographics are indicative of the extent to which individuals are aware of

each other's knowledge and expertise, and consequently the group's agility. The two metrics that we use to measure the participation demographics are (a) the proportion of individuals who actively participate in the knowledge management activities (b) the diversity in the functional areas of the individuals who actively participate in the knowledge management activities.

The most basic characteristic of the participation demographics is the proportion of group members who actively participate in ICT centric knowledge management activities. When a larger number of individuals actively participate in the knowledge management activities, their efforts result in increasing the visibility of a larger pool of knowledge. For example, when using ICT such as message boards or mailing lists, the knowledge exchanges are also accessible to individuals who did not participate in the original exchange. Therefore, the participation of a large proportion of individuals not only reduces the redundancy of knowledge, but also increases the efficiency with which relevant knowledge can be identified, accessed and retrieved. These efficiencies in knowledge sharing through IT lead to efficiencies in sensing and responding to external events, as increased visibility and availability of knowledge leads to faster knowledge retrieval.

P1: *The proportion of team members who use ICT for knowledge management activities has a direct positive impact on agility.*

The second characteristic of participation demographics is the diversity in the functional areas of the organizational members actively participating in the knowledge management activities. Individuals within a group fulfill different roles and their contributions to the pool of knowledge are related to their respective job functions.

Consequently, individuals develop a more holistic perspective of the organization's activities and goals as they become aware of knowledge from functional areas other than their own. This in turn enhances the organization's capabilities in recognizing opportunities and changes in the external environments. Furthermore, when individuals from different functional areas of the organization communicate with each other, they exchange not only information, but also different perspectives and paradigms. Such interactions lead to higher levels of exploratory and innovative behaviors, which in the context of agility results in enhanced ability to respond to changes in the external environment.

P2: *Interactions between individuals from diverse functional areas using ICT for knowledge management activities has a positive impact on agility.*

Participation Activity

The visible activity on ICT used for knowledge management activities provides a descriptive assessment of the knowledge management related interactions of the members of the organization. Participation activity, while being a more subjective estimate of the organizational members' behaviors, quantifies the nature of the interactions that result in the exchange of knowledge. These measures isolate the specific knowledge creation and sharing behaviors that are prevalent within the organization.

The frequency of interactions between members of the organization is a measure of how actively individuals participate in the knowledge management activities using ICT. The frequency of interactions is indicative of two aspects of knowledge management: (a) visibility of knowledge and (b) effectiveness of knowledge transfer.

Information is pooled more effectively through thorough discussions (Larson et al. 1996; Larson et al. 1994), or more frequent interactions between individuals. The frequency of interactions indicates how much knowledge transfer is taking place using the ICT, and how thorough these knowledge exchanges are. The knowledge exchanged using ICT is visible to others in the organization, and consequently, the frequency of interactions determines the visibility of knowledge within the organization. Increased visibility of knowledge within the organization, as described above, has a positive impact on agility, as it promotes faster identification, retrieval and application of knowledge needed to sense and respond to events from the environment.

The effectiveness of communicating knowledge is improved by the existence of a shared understanding (of both the sender and the recipient) of the context of the knowledge. The limitations of ICT in their ability to convey context-specific transient information can be overcome through thorough discussions between the participants of the knowledge transfer process (Gold et al. 2001). Frequent interactions among the individuals using ICT for knowledge transfer improves their understanding of peripheral contextual information, thus increasing their efficiency in conveying and receiving knowledge. Consequently, frequent interactions increase their perceptiveness of relevant information outside the organization (in other words sensing relevant events from the external environment) and subsequently their ability to apply relevant knowledge to respond appropriately.

P3: *Frequent interactions between individuals using ICT for knowledge management activities have a direct positive impact on agility.*

The responsiveness of the organizational members to queries from others is a measure of the organizational members' behaviors that is indicative of how involved they are in the knowledge management activities. For example, when the individuals are quick and thorough in their responses to requests from others, such behaviors are evidential of high involvement in knowledge management activities. From the perspective of the responder, high involvement in the knowledge management activities signals increased familiarity with the knowledge, and therefore superior abilities to sense and respond to changes in the external environment in a timely manner. Conversely, from the perspective of the knowledge seekers, quick responses to requests and queries reduces the time taken to acquire the knowledge they need, and consequently apply this knowledge faster, thus increasing their abilities to sense and respond to changes in the external environment in a timely manner.

P4: *Rapid responses to open requests for knowledge made by other members of the organization using ICT, has a positive impact on organizational agility.*

3.3. RESEARCH METHODOLOGY

This section describes the proposed data collection and empirical model that will be used to test the propositions developed in the preceding section.

3.3.1. Data Collection and Variables

SourceForge.net, one of the largest online repositories of open source application will be used as the primary source of data for this study. In addition to providing free hosting to Open Source software development projects, it also provides additional services such as centralized resources for managing projects, issues and code, and communication tools such as mailing lists. It also provides statistics for all aspects of the

projects, including downloads, web traffic, mailing lists activities, bug reports, feature requests etc. Currently SourceForge.net has over 150,000 registered projects and over 1,700,000 registered users.

The sample of projects that will be used in this study will include all public Open Source software projects registered on SourceForge.net that actively used the mailing lists for communication within the development community and have had at least one release. Projects that do not utilize the mailing lists or use the mailing lists for other purposes are excluded from the sample in order to isolate the projects where the knowledge sharing behaviors of the team members can be observed. The sample will also exclude projects that do not have sufficient data regarding the project releases, bug fixes and feature requests.

Dependent Variables (Measures of Team Agility)

The measures of agility that will be employed approximate the efficiency of the project team in its ability to acknowledge and respond to changing requirements from the external environment (i.e., the users). SourceForge.net collects detailed information regarding the bug reports and feature requests, including the open and close dates associated with each report, priorities etc. which can be used to approximate organizational agility. The two measures of agility that will be used are *BugResponse* and *FeatureResponse*, which represent the how fast the project team is able to resolve reported bugs (errors and defects in the software) and feature requests respectively. We employ these two measures as they represent two distinct types of environmental events. Since bug reports are issues that have to be resolved as soon as possible, they represent environmental events that are critical to the project and mandate attention. Feature

requests, on the other hand, are suggestions and opportunities for improving the project and the team's response to them is voluntary.

BugResponse will be computed as follows. The time taken to resolve a bug is the difference between the date the bug is reported and the date that the bug is closed. Each bug report is assigned a priority by the individual reporting it. This priority indicates the severity of the bug, wherein high priority bugs are critical and require immediate attention. Therefore in order to normalize the effect of bug priority, *BugResponse* will be computed as a weighted measure of the priority and response time. Similarly, as feature requests are also assigned priorities, *RequestResponse* will be computed in the same way as *BugResponse*.

Independent Variables (Measures of Team Members Observable Behaviors)

SourceForget.net provides project teams with a number of tools for communication, including mailing lists and wikis. The later tool is a recent addition and not used as extensively by a majority of the projects and is therefore excluded from this study. Project teams use the mailing lists for a number of purposes, including build release information, announcements, as well as for communications among the team members. Since this study pertains to the behaviors of team members in sharing knowledge, we only include data from the developer mailing lists in order to isolate knowledge sharing behaviors of the individuals within the development team. The data that will be used to identify the following independent variables will be extracted from the individual messages in the mailing lists. This data extraction will be partially automated (exclusion spam messages, redundant text etc.,) and while the determination of message types will be done manually.

The independent variables that will estimate project demographics include *Participation* and *Diversity*, which represent the proportion of the project team that are actively participating in the mailing lists and the diversity in their function role within the team respectively. *Participation* will be computed as the percentage of the team members who have contributed to the mailing list. Project team members have different responsibilities and roles within the team, such as Project Manager, Developer, Translator, Tester, Web Designer etc. *Diversity* will be computed as the average number of roles/positions of the participants of each active topic thread in the mailing list.

The independent variables that will capture project activity include measures for the frequency of the interactions and the speed with which team members respond to questions and information requests. The frequency of the interactions can be estimated using the following three variables: *AvgNewConversations, AvgActiveConversations, AvgPosts,* and *AvgTimeBetweenPosts. AvgNewConversations* is computed as the average number of new topic threads that are started by team members within a time frame. *AvgActiveConversations* is computed as the average number of topic threads that are still active, but were initiated in preceding time frames. *AvgPosts* is computed as the average number of new messages (including responses) in the mailing lists within a time frame, and *AvgTimeBetweenPosts* is computed as the average time between new messages (including responses) in the mailing list for the duration of one time frame. The speed with which team members respond to queries is captured by the variable *AvgResponseTime*, which is computed as the average time taken to for the first response to a new query to appear for all new conversations within a time frame.

Project and team characteristics will be used as controls in order to isolate the effects of the independent variables which represent the observable knowledge sharing behaviors of the team members. The project characteristics that we will control for include *DevelopmentStage* and *Popularity*. *DevelopmentsStage* represents the stage of the development of the project life cycle, and is also indicative of the age of the project. By controlling for *DevelopmentStage* we can include projects that have been released, but are not yet stable (Alpha testing, Beta testing stages).We control for *Popularity*, which will be computed as the cumulative number of times that the project has been downloaded, since projects with large user bases will have more feature requests and bug reports than project with smaller user bases.

Project team characteristics that we will control for include *TeamSize* (computed as the number of members of the project team), *TeamDiversity* (computed as the number of different roles/positions that exist within the team) and *Activity* (computed as SourceForge.net's measure of project activity which represents how active the development process is). The variables described above are summarized in Table 3.1.

3.3.2. Proposed Analysis

Since the data for each project spans across extended periods of time, each project cannot be represented by a single data point, as the behaviors of the team members can be expected to change over time. Therefore, each project will result in multiple data points, where each data point corresponds to the time frame of one month.

In addition the preliminary descriptive analysis of the data, a linear regression model will be used to test the propositions developed in the previous section. The

following linear regression model will be used to test the impact of the different behaviors of the organization members on the agility of the organization.

$$Y = \alpha + \beta_1 Participation + \beta_2 Diversity + \beta_3 AvgNewConversations + \beta_4 AvgActiveConversations + \beta_5 AvgPosts + \beta_6 AvgTimeBetweenPosts + \beta_7 DevelopmentStage + \beta_8 Popularity + \beta_9 TeamSize + \beta_{10} TeamDiversity + \varepsilon$$

Where Y is the dependent variable *BugResponse* or *FeatureResponse*.

Positive and significant parameter estimates will indicate a positive impact of the corresponding factor, and provide support for the corresponding propositions. Additional longitudinal analysis will also be carried out in order to identify how cumulative behaviors account for organizational agility.

Table 3.1: Summary of Variables

Variable	Description
Dependent Variables (Measures of Team Agility)	
BugResponse	The average weighted measure of bug priority and time taken to close a bug report within a time frame.
FeatureResponse	The average weighted measure of feature priority and time taken to close a feature request within a time frame.
Independent Variables (Project Demographics)	
Participation	The percentage of the team members who have contributed to the mailing list within a time frame.
Diversity	The average number of roles/positions of the participants of each topic thread in the mailing list within a time frame.
Independent Variables (Project Activity)	
AvgNewConversations	The average number of new topic threads that are started by team members within a time frame.
AvgActiveConversations	The average number of topic threads that are still active within a time frame, but were initiated in preceding time frames.
AvgPosts	The average number of new messages (including responses) in the mailing lists within a time frame
AvgTimeBetweenPosts	The average time between new messages (including responses) in the mailing list for the duration of one time frame.
AvgResponseTime	The average time taken to for the first response to a new query to appear for all new conversations within a time frame.
Control Variables (Project Characteristics)	
DevelopmentStage	The stage of the development of the project life cycle for the duration of the time frame.
Popularity	The cumulative number of times that the project has been downloaded.
Control Variables (Team Characteristics)	
TeamSize	The number of members of the project team
TeamDiversity	The number of different roles/positions that exist within the team
Activity	SourceForge.net's measure of project activity (team member activity in the development process)

3.4. CONCLUSION

The purpose of this study is to examine the moderating effect of organizational members' observable behaviors on the impact to knowledge management IT on organizational agility. Organizational agility can be realized as an outcome of knowledge management initiatives, as these initiatives aim at increasing efficiencies in knowledge transfer and availability, which in turn enhances the organizations' ability to sense and respond to changes in the external environment, which are the two primary elements of organizational agility. In the above proposal, we develop a theoretical framework that establishes the relationship between knowledge and communication oriented IT and organizational agility, and identifies the moderating effects of the observable behaviors of the organization members' on this relationship. Based on this framework, we identify observable behaviors of organization members that positively influence the ability of ICT in enhancing organizational agility. An empirical study is proposed to support the theoretical propositions by in the Open Source software development setting.

This study contributes to the growing body of literature that examines the behavioral aspects of knowledge management and the value generated by the IS. Agility is an area of research that has recently been gaining attention, and is being recognized as a crucial capability for the firm. The theoretical framework developed in this study, contributes to this stream of research, by identifying how knowledge management initiatives and behaviors can enhance organizational agility.

CHAPTER 4:CONCLUSION

4.1 CURRENT STATUS

Both the studies in this dissertation are still in progress. For the first study, we follow the guidelines put forward by Davis et al. (2007) to conduct simulations studies in order to develop theory. An extensive review of the different streams of literature has been conducted to develop the theoretical framework. The model for the proposed simulation study has also been designed. The implementation of this model and the analysis of the simulation results remain to be completed.

The research framework for the second study has also been developed and the preliminary research design of the empirical analysis that will be employed to find support for the theoretical model has been completed. Data collection and the analysis of the data remain to be carried out.

4.2. EXPECTED CONTRIBUTIONS

Overall, this research contributes to our understanding of the antecedents to the success of knowledge management initiatives in terms of creating long term firm benefits. The antecedents that are the focus of this dissertation are the behavioral and cultural characteristics of the organization. The theoretical framework developed for the two studies are derived from diverse streams of research, and shed light on the significance of taking organizational culture into consideration while designing information systems for the management of intangible resources, such as knowledge and intellectual property.

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