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THE IMPACT OF KNOWLEDGE MANAGEMENT TECHNOLOGIES ON LEARNING WITHIN ORGANIZATIONS:

AN EMPIRICAL ANALYSIS

By

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In memory of a dear

grandmother, Olive Brooks,

father, Patrick S. B. Jones,

and

brother, Alan M. B. Jones

I wish that I could have shared this with you.

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ABSTRACT

Given the strategic significance of knowledge, many organizations are adopting a new class of information technologies (ITs) to support their knowledge management and organizational learning activities. ITs such as portals, groupware, and data warehouses, collectively referred to as knowledge management technologies (KMTs) in this study, have been deployed to support enterprise-wide knowledge creation, sharing, and integration. But how are they fulfilling this goal?

As new information technologies, KMTs have been studied from a technical perspective and are under-researched from organizational and behavioral perspectives. Therefore, the main objective of this research was to address some of these gaps in prior work by developing and empirically testing a comprehensive framework that identifies the processes through which KMTs contribute to learning within organizations.

This research is based on the Vandenbosch and Higgins (1996) study that empirically tested and found support for direct positive relationships between knowledge acquisition behaviors (focused search and scanning) and individual learning (mental model maintenance and mental model building) . The current research empirically tested an extension of the Vandenbosch and Higgins model incorporating: 1) a broader conceptualization of knowledge-based activities (acquisition, sharing, and analysis and interpretation) facilitated by technologies designed to support knowledge work, 2) consequences of post-adoptive behavior in the form of specific organizational learning outcomes (decision-making impacts and intentions to innovate with an IT), 3) the effect of certain perceived working climate characteristics (that reflect learning and innovation orientation) on usage behaviors (KMT use and knowledge use), and 4) the effect of specific individual characteristics (personal innovativeness in IT, computer self-efficacy, and prior related knowledge) on both of the aforementioned usage behaviors.

Associated hypotheses were tested in cross-sectional field studies using survey data from two independent samples from two sites. Both research sites were non-profit organizations that had implemented a data warehouse at least four years prior to the study being conducted. The research findings indicate that use of a KMT for various knowledge-based activities results in an incremental or radical change in the mental models of those who use them. In addition, perceived organizational climate for learning and innovation influences 1) the extent to which a KMT is used, and 2) the extent to which individuals actually apply or intend to apply new knowledge. Furthermore, personal innovativeness in IT, computer self-efficacy, and prior related knowledge have a significant combined effect on KMT use and knowledge use.

The contributions of this research are two fold. From a practical perspective, these results provide evidence that the use of KMTs contribute significantly to the gathering and use of organizational intelligence. Also, working climate can inhibit or enhance the extent to which these benefits are realized. Theoretically, the comprehensive research model provides a framework for examining the relative effects of various dimensions of perceived organization climate and individual characteristics on learning and learning outcomes.

CHAPTER 1

AN OVERVIEW

1.1 Introduction

Global competition, rapidly changing technology, and deregulation are among the factors forcing organizations to constantly rethink their strategies and adapt their operations accordingly (Beer and Eisenstat, 1996). Companies must continuously learn and innovate in order to ensure survival in such dynamic and complex environments. Although information technology (IT) has the potential to facilitate such learning through its ability to capture and disseminate the crucial organizational resource of knowledge, IT deployment in organizations has been criticized for replicating familiar functions of organizations, and failing to fulfill its sensemaking potential (Boland , Tenkasi, and Te'eni, 1994.) Several writers have argued that IT has been applied successfully to transaction processing tasks but has been less successfully applied to the support of cognition and decision making processes of organizational members (Feldman and March, 1981; Preston, 1991; Silver, 1991), critical antecedents of organizational learning.

However, such criticisms may no longer be warranted with the advent a new class of technologies designed specifically to support organizational learning activities and knowledge management. Knowledge management is defined as a collection of processes that govern the creation, dissemination, and leveraging of knowledge to fulfill organizational objectives (Gurteen, 1998). Knowledge management uses technologies such as document management, groupware, data mining, and data warehouses, to capture, distribute, and leverage corporate knowledge (Porter-Roth, 1998). For the purposes of this study, these will be referred to as knowledge management technologies (KMTs).

Due to its multi-faceted nature a KMT lends itself to a myriad of uses and, like other advanced technologies, is implemented in the hope of enhancing communication, coordination, and cooperation among organizational members, and ultimately improving organizational performance (Huber, 1990). Beyond these secondary objectives, however, its primary function is to support enterprise-wide knowledge creation and integration. But how are these technologies fulfilling this goal? That is the overarching question that this dissertation seeks to investigate empirically.

1.2 Research Objectives

As new information technologies, KMTs have been primarily studied from a technical perspective and are under-researched from organizational and behavioral perspectives. In a recent review of the extant knowledge management literatures, Alavi and Leidner (2001) identified a number of gaps that currently exist in the KMT domain and suggested avenues for future research in this area The broad objective of this paper therefore is to address some of these gaps in prior work by identifying the processes through which these KMTs are contributing to learning within organizations. Within this context, the study specifically seeks to:

- Empirically assess the nature of use of a KMT.
- Examine the effects of organizational environment on the usage behavior.
- Determine how use of a KMT contributes to individual learning.
- Identify some of the actual and potential benefits that can result from ensuing knowledge.
- Outline ways in which organizational environment facilitates or inhibits the application of knowledge derived from a KMT.

An underlying goal of this research is also to examine some consequences of post-adoptive behaviors as they relate to the on-going use of a technology that is no longer novel in an organization. With this in mind, the research objectives outlined above will be accomplished by undertaking a field study of end users in organizations that have implemented these technologies for at least a year and are actively using them.

1.3 Organization and Presentation

The remainder of this dissertation is organized as follows. Chapter Two reviews and synthesizes the relevant literature into a conceptual framework for understanding the relationship between technology use and learning within organizations. Specifically, this study is grounded in theories of organizational learning and IT implementation. In Chapter Three the relationships to be investigated are presented through a research model, and specific hypotheses are developed. Chapter Four describes the details of the research methodology that is used to empirically test the research model. Analysis of results will be presented in Chapter Five. Chapter Six concludes the dissertation with discussions of results, strengths and limitations of the study, practical and theoretical contributions, and directions for future research.

CHAPTER 2

CONCEPTUAL MODEL AND LITERATURE REVIEW

2.1 Introduction

From a strategic perspective, the most valuable asset in any organization today is its intellectual capital, and knowledge creation and integration are considered the main drivers of competitive advantage (Grant, 1996). Given the strategic significance of knowledge assets, many organizations are actively engaging in knowledge management practices in order to improve their learning capabilities and derive value from their knowledge assets.

Knowledge management involves the implementation of formal and informal processes and structures that facilitate the acquisition, sharing, interpretation, and utilization of knowledge (Mack, Ravin, and Byrd, 2001). Successful knowledge management requires the right mix of people, processes, and technology because organizational knowledge resides in multiple repositories: databases, documents, practices, and individual minds. It further requires an internal organizational environment that motivates individuals to use whatever means available to share their expertise, experiences, and insights, support their decision making, and develop creative business solutions (Greengard, 1998). Many organizations have adopted KMTs to support their organizational learning activities and, aside from the usual anecdotal evidence, more studies are needed to formally assess the behavioral impacts of these technologies. This study seeks to gain some insight into how KMTs support knowledge work and to understand how an organization's values, beliefs and practices can affect the way in which these technologies are used. In order to achieve these objectives, the study examines relationships between cultural perceptions, usage behaviors, learning, and learning outcomes at the individual level of analysis. The underlying theory for the conceptual model is primarily derived from two main streams of literature: 1) organizational learning and 2) information technology (IT) implementation. Subsequently, this chapter is devoted to using these two bodies of literature to lay the groundwork for the conceptual model. The chapter is divided into three major sections. The literature on organizational learning and IT implementation are reviewed in sections one and two respectively. Once the theoretical groundwork is laid, the conceptual model is presented and discussed in section three, and the chapter concludes with a summary of the main arguments.

2.2 Organizational Learning

The purpose of this section is to review the relevant streams of thought in the organizational learning literature. The review begins by highlighting the strategic importance of organizational knowledge. Next, organizational learning is examined from different perspectives with a view to defining the concept. This is followed by an explanation of the relationship between organizational learning and innovation, and an overview of the dynamics of learning. The review concludes with a discussion of facilitators of organizational learning.

2.2.1 Organizational Knowledge as a Source of Competitive Advantage

Knowledge has always been critical to organizational success. However, in current times, when continuous innovation is key to economic survival in a dynamic global economy, where goods and services are more knowledge-intensive, where organizational forms are flexible, sometimes even virtual, and where advanced technologies provide the means for integrating diverse activities (Prusak, 1997), knowledge has taken center stage as the most crucial organizational resource.

Theorists such as Kogut and Zander (1992), Nonaka and Takeuchi (1995), and Grant (1996) have adopted the knowledge-based view (KBV) as a means of evaluating a firm's competitive strengths and weaknesses. The KBV considers a firm to be a social knowledge system, and views learning as the means through which it remains competitively viable. This perspective is derived from the resource-based view (RBV) of the firm, which describes the firm as a collection of productive resources and proposes that firm-specific resources and competencies are the sources of profit and competitive advantage (Penrose, 1959; Wernerfelt, 1984; Barney, 1991). A central argument in the RBV theory is that organizational resources – capital, know-how, and routines – are combined in unique ways that make them difficult to imitate. Whereas the RBV considers all assets important, the KBV focuses on intellectual capital as the most strategic resource, and argues that a firm's competitive advantage is primarily derived from its ability to leverage its knowledge assets. The implication is that firms must constantly reassess what they know and how they learn in order to continuously improve their competencies and capabilities.

A related theory, the theory of absorptive capacity, posits that an organization's ability to innovate is a function of its ability to assimilate external knowledge (Cohen and Levinthal, 1990). Deemed an organization's absorptive capacity, this capability is a function of the level of the organization's prior related knowledge. The latter enables the organization to recognize the value of new knowledge and to exploit such insights for competitive gain (Cohen and Levinthal, 1990).

Kogut and Zander (1992) extend this argument by proposing that firms develop combinative capabilities, the ability to synthesize and apply current and acquired knowledge. The underlying premise is that knowledge develops in a path-dependent manner. In other words, the ability to generate new knowledge depends on current capabilities. If these capabilities are not maintained, they may be difficult to replace or acquire when needed. Hence, firms need to renew their capabilities by continuously acquiring new but related knowledge and skills. This can be achieved by engaging in a combination of internal learning (e.g. reorganizing, improvising, and experimentation) and external learning (e.g. acquisitions, joint ventures, hiring). From this perspective, the knowledge of the firm can be considered a portfolio of options with current and future value. Therefore, firms need to know what they know, who knows it, and how to use it. They also need to know when to renew, acquire, and retire their knowledge assets.

Based on the above, it is evident that organizational learning is important from a strategic standpoint. Organizations need to adopt a learning orientation in order to remain competitively viable. The following sub-section will take a more in-depth look at the concept of the organization learning and what it amounts to in practice.

2.2.2 Organizational Learning Defined

While the concept of organizational learning has gained popularity, like most social science paradigms, it has attracted its fair share of debate and has been studied from multiple perspectives. At the heart of the debate is whether an organization, as a collective, is actually capable of learning or it is the individuals within it who learn (Jones,1995). To paraphrase Argyris and Schön (1978), although organizations learn through individuals, organizational learning is more than individual learning.

Furthermore, different perspectives have different foci. For example, the organizational development view focuses on human development within the organizational context, addresses factors associated with cognition, context, and learning styles, and is concerned with the transition from individual to collective learning (Easterby-Smith, 1997). Alternatively the management science view takes an information processing approach to organizational learning and explores such concepts as knowledge, memory, and single and double loop learning (Easterby-Smith, 1997).

Understandably, definitions of organizational learning are also varied. According to March (1981), learning is the means through which organizations innovate, change their routines and standard operating procedures, and achieve flexibility. Similarly, Schein (1996) defines organizational learning as the ability to create new organizational forms and processes and to innovate in both the technical and organizational arenas. Huber (1991) proposes than an entity learns if, through its processing of information, the range of its potential behaviors is changed. He advocates that "an organization learns if any of its units acquire knowledge that is recognized as potentially useful to the organization...organizational learning occurs when more and varied interpretations are developed...and when organizational units develop uniform comprehensions of the various interpretations"(pp. 90-92). Levitt and March (1988) theorize that organizations are seen as learning when shared meanings become encoded into routines that guide organizational behavior.

A common thread through these definitions is that an organization learns indirectly or directly through its individual members, however, individual learning, while necessary, is not sufficient for organizational learning. The latter requires knowledge assimilation by the collective. One source of distinction however is whether or not there has to be enactment, or the application of new knowledge, before learning is said to have taken place. Huber's (1991) definition differs from the others in that respect. While the other definitions argue that learning is reflected in a change of behavior, Huber argues that learning occurs when the range of potential behavior is expanded. That is, the acquisition of new knowledge structures, or an improved understanding of existing ones, need not necessarily result in a change in behavior. The application of new knowledge may depend on a host of situational factors such as the timing, availability of resources, and applicability to specific issues.

How one defines organizational learning further impacts another important issue: the distinction between innovation and organizational learning. The following sub-section will take an in-depth look at this issue.

2.2.3 Organizational Learning and Innovation

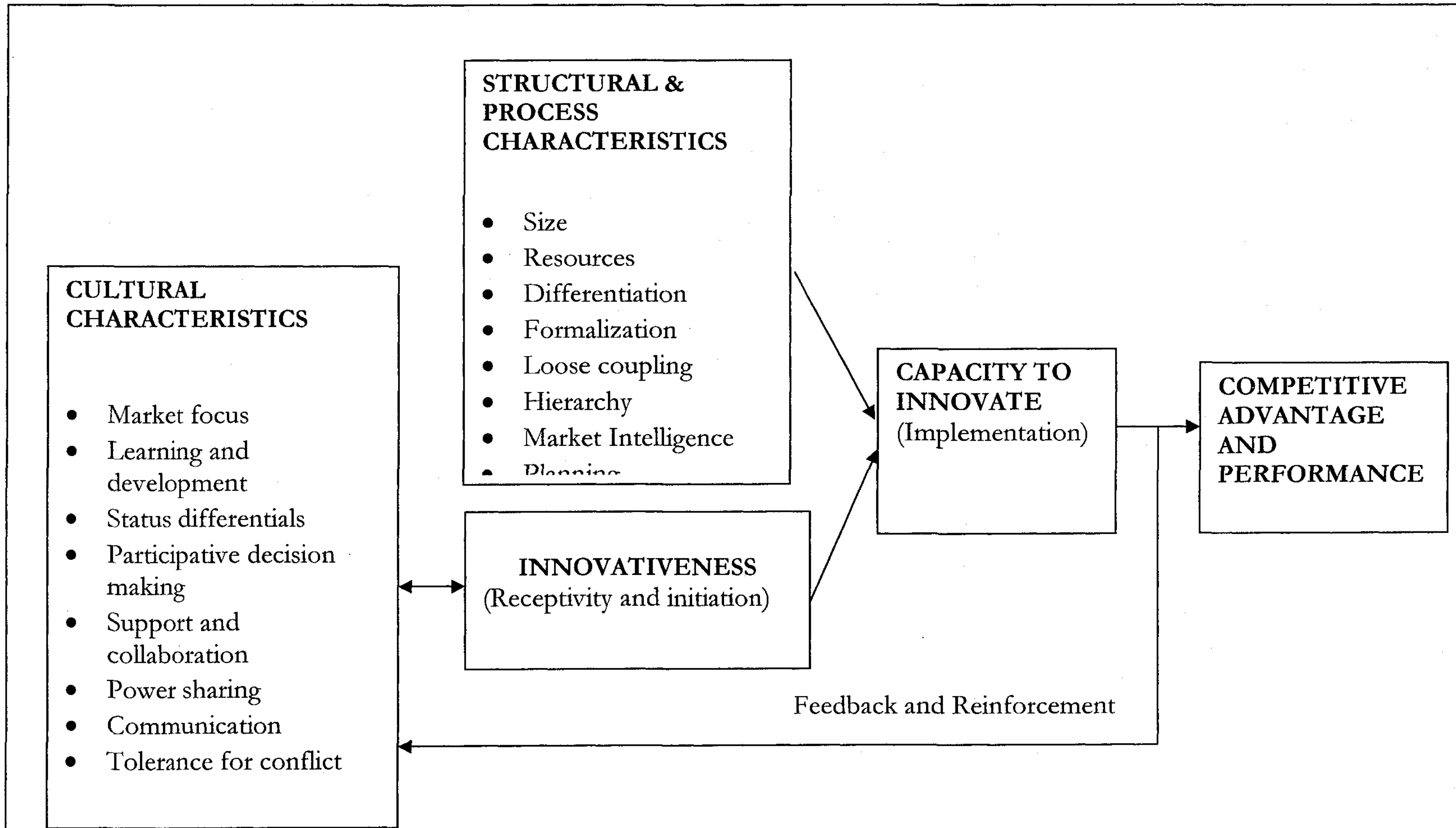
Innovation is the means through which organizations adapt to their environments and remain competitive. Innovative behavior occurs when organizational members learn, share knowledge, and incorporate it into organizational activities (von Krogh, 1998). There is no doubt that innovation and learning are intertwined, however, their distinction or lack thereof is dependent on one's point of view with regards to enactment.

In general, learning is considered the development of knowledge and insights, and innovation is the implementation of new ideas, products, services, and processes. Rogers (1983) describes an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption". Van de Ven (1986) noted that new ideas are not usually considered innovations unless successfully implemented.

If one considers organizational learning to be the development of new insights that have the *potential* to influence behavior (Huber, 1991), then learning is a crucial antecedent of innovation. Alternatively, if organizational learning is believed to culminate in behavior modification (Fiol and Lyles, 1985; March, 1991), then organizational learning and innovation are essentially equivalent. Hurley and Hult (1998) address this issue by reviewing the extant literature, and they present a conceptual model that summarizes their findings. That model is depicted Figure 2.1.

Although developed within a marketing context, the appeal of this model is that it provides a synthesis of the organizational factors that contribute to learning and innovation within organizations, and it is generally applicable across a wider domain. This model posits two main categories of organizational characteristics as antecedents of innovative behavior within organizations: 1) structural and process characteristics such as age of the organization, the degree of formalization, and hierarchy, and 2) cultural characteristics such as communication, participative decision making, and learning orientation.

Accordingly, learning orientation (an aspect of organizational culture that indicates a general commitment to learning) and other cultural characteristics are key antecedents of



Taken from Hurley, R. F., and Hult, G. T. M., "Innovation, Market Orientation, and Organizational Learning: An Integration and Empirical Examination," *Journal of Marketing*,, 62(3), July 1998, p.45.

Figure 2.1: Innovation, Market Orientation, and Organizational Learning

innovativeness, defined as the initiation of and receptivity to innovation within the organization. In turn, innovativeness, resource availability, and other structural and process properties determine an organization's ***capacity to innovate***, defined as the ability to adopt or implement new ideas, processes or products successfully (Burns and Stalker, 1961).

From the Hurley and Hult perspective, organizational learning culminates in the initiation and implementation of innovations, i.e., behavior modification. Hence, creativity and innovation represent the final stages of organizational learning. However, the position taken in this paper is the one advocated by Huber (1991), where organizational learning entails a new understanding or added knowledge, which is not necessarily applied immediately or at all.

In short, learning is manifest in a new way of thinking that may or may not result in a change in behavior. Learning can result in actual benefits if that knowledge is applied. Learning can be also potentially beneficial if there is an intention to apply new insights to future behaviors. The Hurley and Hult (1998) model has been adapted to capture this perspective and the modified model appears in Figure 2.2.

The essence of the original model remains unchanged. The direct relationships between organizational characteristics and learning outcomes remain intact but the feedback loops, while still relevant, have been omitted for simplicity's sake. In the revised model, learning outcomes are categorized as being actual or potential, and learning is introduced as mediating the relationship between organizational characteristics and learning outcomes. Hence from this perspective, an organization's culture, structure, and processes are viewed as influencing the extent to which that organization learns. Furthermore, if new insights are used in the generation and subsequent implementation of new ideas, then learning produces

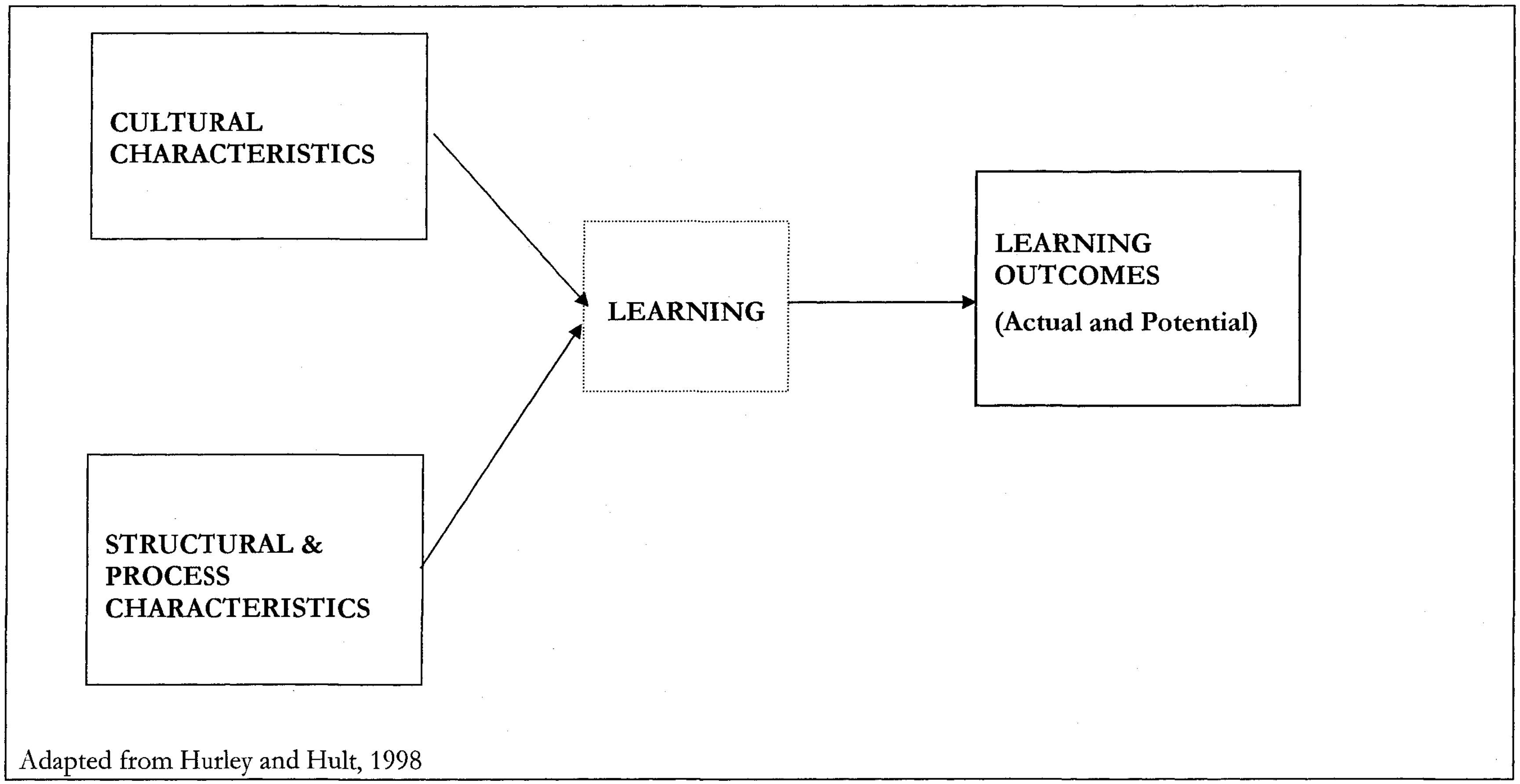


Figure 2.2: Learning within Organizations

actual benefits. However, if this knowledge is stored, with the intention of applying it to future behavior, then learning produces potential benefits.

Zahra and George (2002) make similar arguments in their reconceptualization and extension of the theory of absorptive capacity. They conceptualize two subsets of a firm's absorptive capacity (or its ability to value, assimilate, and apply knowledge): 1) *potential capacity*, which represents the ability to acquire and assimilate knowledge, and 2) *realized capacity*, which represents the ability to apply knowledge. They argue that both capabilities have a separate though complementary effect on the ability to improve performance. Furthermore, potential capacity is an antecedent of realized capacity.

Throughout the preceding discussion of organizational learning and innovation, previous literature was used to justify the position that, while closely related, learning and innovation are conceptually distinct. The argument was also made that learning can produce actual as well as potential benefits to the organization. These relationships lie at the very heart of the conceptual model (Figure 2.3) and will be discussed in more detail later in the chapter.

Having defined what learning means in an organizational context, the next sub-section reviews the processes through which learning unfolds.

2.2.4 The Dynamics of Learning

A number of frameworks have been developed to categorize knowledge and explain the process of learning within organizations. Kogut and Zander (1992) propose that a firm's knowledge is social knowledge, embedded within individuals and organizing principles. They categorize knowledge into information or *know-what* (something means) and *know-how* (to do something). They further extend this to include *know-why*, which represents context-specific knowledge, not easily duplicated and transmitted. Though all three categories of knowledge are important, it is primarily the application of *know-why* to the creation of good and services, organizational structures, and processes that makes firms unique and enables them to derive economic value from their knowledge base.

From this perspective, the dynamic of organizational learning begins with personal expertise. Through processes of interaction and communication (i.e., *socialization*) that foster learned values and a shared language across organizational groupings, individual knowledge is translated to social knowledge that is ultimately manifested in organizing principles. Also, from this social knowledge, organizational and technological opportunities arise.

Other perspectives on the nature of knowledge and the dynamics of learning include the dominant cognitivist and constructionist perspectives, as outlined by von Krogh (1998). Constructionists such as Nonaka and Takeuchi (1995) conceptualize knowledge as having two dimensions: *tacit* and *explicit*. Explicit knowledge is formal, systematic, and can be codified. Tacit knowledge (Polanyi, 1962) is very personal and hard to formalize, explain, or share with others. Nonaka (1994) proposes a theory of knowledge creation based on the dynamic interaction between tacit and explicit knowledge, and on knowledge transfers between individuals, groups, and organizations. This ongoing cycle involves four processes: socialization, externalization, combination, and internalization. Socialization is the process of creating tacit knowledge through the sharing of experiences. Externalization is the process through which tacit knowledge becomes explicit in the form of metaphors, analogies, or models. Combination is the exchange and combination of different bodies of explicit knowledge. Internalization occurs when individuals internalize explicit knowledge. This is experiential learning that comes through doing.

From the cognitivist perspective, knowledge is manifest in cognitive maps or mental models, which are representations of how events and objects are related. Mental models exist at multiple levels of analysis: individual, group, inter-group, organizational, and inter-organizational. Learning involves the changing of these knowledge structures to accommodate new knowledge. Within this perspective, Argyris(1992) describes two types of learning – single loop learning and double loop learning. Single-loop learning occurs when errors are detected and corrected. This involves changing behaviors or actions to achieve consequences without questioning the assumptions that govern those behaviors or actions. Double-loop learning involves correcting actions by first examining the underlying beliefs, values, or assumptions. Argyris(1992) argues that both forms of learning are important - single-loop in routine, repetitive situations, and double-loop in complex situations. Single-loop learning can be considered **doing things better**, as a result of incremental changes in knowledge structures. Double-loop learning involves **doing things differently** as a result of radical shifts in knowledge structures. This parallels Schein's (1985) adaptive and generative learning where adaptive learning means doing better at what the firm is already doing, and generative learning entails doing something new. Argyris and Schön (1978) discuss a third mode of learning called duetero learning. Duetero learning involves the reassessment and development of organizational learning mechanisms. In order for organizational learning to be effective, duetero learning should be an ongoing activity.

Based on the previous discussion of organizational learning processes, it is clear that much of an organization's knowledge resides in its people, and much of the learning is socially constructed or context specific. Through the interactions of its organizational members, individual knowledge is interpreted, aggregated, and distributed at the organizational level in a process of organizational sensemaking. This knowledge "filters up" and becomes embedded in organizational routines and practices, thereby superceding specific individuals.

It is therefore crucial for managers to create a working environment where individuals are free to think and act creatively, and are encouraged to share their experiences and insights. The following discussion will further explore this issue by looking at specific managerial interventions that may have a direct impact on an organization's ability to learn.

2.2.5 Factors that Promote Organizational Learning

Theorists have long advocated the importance of organizational context in determining an organization's ability to learn, and ultimately, innovate successfully. A recent study of several organizations in Europe and the United States revealed that one of the biggest difficulties these organizations faced in managing their knowledge was the (organizational) culture (Ruggles, 1998). As defined by Schein (1996), a culture is a set of basic tacit assumptions about how the world is and ought to be that a group of people share and that determines their perceptions, thoughts, feelings, and to some degree, their overt behavior. Within organizations, culture represents patterns of shared values and beliefs that produce behavioral norms for solving problems. Organizational culture is a broad concept and there is no consensus on what constitutes cultural values and norms. This makes it difficult to observe or measure. Alternatively, researchers have often used climate as an indicator of culture. Climate describes how an organization operationalizes its culture through structures and processes that facilitate the achievement of the desired behaviors (Schein, 1990).

With regards those aspects of organizational climate that have an impact of organizational learning, certain themes are recurrent in the literature. Sinkula, Baker, and Noordeweir (1997) suggest that a learning organization is characterized by a commitment to learning, a shared vision, and open-mindedness. Garvin (1993) suggests that creating a learning orientation requires that an organization become adept at problem solving, experimenting with new approaches, learning from their own experience, following the best practices of others, and transferring knowledge quickly and efficiently though the organization. Agarwal, Krudys, and Tanniru (1997) propose that organizations can proactively become learning oriented by: 1) establishing a learning context that defines various dimensions for measuring organizational and individual performance, 2) implementing procedures and management initiatives that facilitate individual learning, and 3) establishing norms to encourage learning.

Senge (1990) proposes that the learning organization should subscribe to five basic tenets: personal mastery, building a shared vision, systems thinking, mental models, and team learning. Similarly, Nonaka and Takeuchi (1995) identify the following factors as enabling conditions for organizational knowledge creation: autonomy, intention, fluctuation or creative chaos, redundancy, and requisite variety.

The predominant theme among these myriad perspectives is that organizational learning must begin at the individual level. It must begin with individuals who are motivated to explore new frontiers and given the autonomy to do so. New thinking comes by way of individuals who are not constrained by rigid structures to maintain the status quo. Coupled with this is a commitment to personal mastery. The learning organization needs individuals who are dedicated to improving their skills and competencies. This goes beyond expertise - it encompasses a commitment to personal growth in a way that is beneficial to both self and organization.

The existence of a highly skilled work force, however, is necessary but not sufficient for effective organizational learning. Knowledge has to transcend the individuals and permeate the organization. Then as a unit, members of an organization need to channel their creative energies, albeit in diverse activities, towards a common goal. Nonaka and Takeuchi (1995) refer to this as intention. At an organizational level, intention is manifest in organizational visions and policies and provides the basis for justifying new knowledge and determining its value. Senge (1990) underscores the importance of having a shared vision because it provides the focus, motivation, and energy for learning. Not only does it signal managerial commitment, it provides inspiration and an organization-wide sense of purpose.

Another condition that facilitates organizational learning is requisite variety. Ashby's (1956) law of requisite variety stipulates that an organization must be as complex as its environment. Related to this line of reasoning is the concept of systems thinking, which Senge(1990) deems necessary for learning. He argues that we need to move away from the notion of cause and effect as a linear relationship, and instead envision loops of causality. Hence effects result from dynamic interactions between a complex network of factors. In practice this translates to an organization having access to a wide variety of information from multiple sources, assimilating multiple points of view, and being able to dynamically adjust its structure to suit a changing environment (Nonaka and Takeuchi, 1995).

Team learning is yet another activity that promotes learning (Senge, 1990). Work groups play a pivotal role in organizational life and are a focal point of learning within organizations. Team members need to act in unison to accomplish collective goals and, as such, need to operate under a common set of assumptions. Yet they must avoid the pitfalls of groupthink - conformity to a static point of view. In order to effectively learn, team members must establish open lines of communication that enable them to discuss ideas, critique them, and constantly reassess their purpose. Nonaka and Takeuchi (1995) extend this line of reasoning by advocating the need for redundancy within organizations. The road to learning begins with the sharing of multiple perspectives, thus dialogue among organizational members is essential. Experience also provides opportunities for learning. Hence, enabling individuals to have multiple experiences, for example through job rotation or cross-functional training, helps them to better understand multiple organizational perspectives and better equips them to take a systemic approach to problem solving.

Based on the above, it is clear that employees must be empowered and enabled to learn and solve problems creatively. It is therefore up to managers and leaders to play an active role in fostering an organizational environment in which learning behaviors and outcomes are highly valued.

2.2.6 Organizational Learning Key Points

It is evident from the preceding discussion that learning within organizations can take place in many ways. In addition, learning behaviors and outcomes are, to a large extent, influenced by the cultural characteristics of an organization. In other words, an organization's working environment can facilitate or inhibit the extent to which and the nature in which knowledge is acquired, shared, interpreted, and stored. In the short run, an organization's values and customs, and subsequently its propensity to learn, can be shaped by deliberate managerial actions. This is an important consideration as organizations begin to invest in KMTs to support their knowledge management efforts. Beyond the appeal of the technology, value-added technology use will only occur where positive values regarding the technology are reinforced. Hence, the cultural influence on the technology use is important and this relationship is reflected in the conceptual model in Figure 2.3.

2.3 Information Technology Implementation

This section on IT implementation provides a theoretical framework for studying the consequences of post-adoptive IT behaviors. The ensuing review of IT implementation is organized as follows. The section begins by explaining the role of IT in the learning organization. Next is an overview of two complementary technologies that contribute to knowledge management. This is followed by a description of post-adoptive behaviors in the context of KMTs. The section concludes with a discussion of the influence of individual characteristics on IT use.

2.3.1 The Role of Information Technology in Organizational Learning

IT facilitates organizational learning through the development and diffusion of organizational intelligence. Huber (1990) contends that the use of such technologies for the storage and acquisition of information "leads to organizational intelligence that is more comprehensive, timely, and available." Similarly, Quinn (1992) proposes that the capture and storage of organizational knowledge in IT databases enables organizations to eliminate errors and leverage intellect.

King (1996) proposes that IT fulfill its responsibilities to the learning organization by providing a set of infrastructures that ensure the effective and efficient pursuit of the learning objective. This entails 1) establishing communications and task infrastructures that facilitate teamwork; 2) sharing work practices via inter and intra organizational alliances; 3) creating a knowledge-based infrastructure that fosters knowledge creation and diffusion, and facilitates reflection, experimentation; and training, 4) developing a human asset infrastructure that identifies the people and skills available in the organization, and 5) implementing a strategic-capabilities infrastructure for identifying, developing, and nurturing the core capabilities of the organization.

Based on the above, it is clear that the effective support of learning processes within and across organizations require IT capabilities that are complex and multifaceted. There is no doubt that KMT solutions can provide the required capabilities. However, the daunting challenge is for organizational leadership to create a cultural environment such that organizational members will come to regard IT resources as valuable tools in the fulfillment of their learning objectives and use them accordingly.

2.3.2 Information Technology Support for Knowledge Management

A number of technologies are being used to support knowledge management in organizations. The core corporate KMT is the portal. Early versions of portals provided a single online access point to distributed online information. Yahoo! is an example of a popular public Web-based portal (Mack et al., 2001). However, corporate portals have evolved into ***knowledge*** portals and provide an integrated knowledge workplace that supports a full range of knowledge-based activities (Mack et al., 2001). In short, they provide an easy-to-use, integrated environment similar to Web portals, but are customized to the tasks of a company's employees (Watson and Fenner, 2000).

Embedded in knowledge portals are various component technologies. These include electronic mail, databases and data warehouses, group support systems, intranets, the Internet, browsers and search engines, and expert systems (O'Leary, 1998). These technologies are capable of supporting organizational learning activities (knowledge acquisition, sharing, interpretation, and storage) in various ways. For example, electronic mail primarily supports the sharing of rich dialog but has limited analytical capabilities. On the other hand, groupware such as Lotus Notes can seamlessly support an array of activities including document handling, electronic mail, computer conferencing, and group decision support (DeSanctis and Jackson, 1994). Despite varying levels of sophistication, these technologies capture knowledge in forms and through processes that enable organizations to share their intelligence and build organizational memory (Ruggles, 1998)

The following discussion focuses on two types of KMTs: groupware and data warehouses. These technologies are interesting because they are important components of organizational memory yet they contribute to knowledge management in different but complementary ways. Groupware provides tools that enable people to work together through communication, collaboration, and coordination. Unstructured information is often the by-product of such activities. Data warehouses are repositories of highly structured operational data (devoid of context), that have sophisticated graphical and analytical tools designed to facilitate knowledge discovery. Both technologies are used for knowledge integration but in different ways. A brief discussion of each technology will follow.

2.3.2.1 Data Warehousing

A data warehouse (DW) is similar to a physical goods warehouse because it is populated with a wide variety of data from different suppliers (internal and external sources), according to specific instructions (i.e. metadata), into an inventoried end-product (i.e. data), which is stored in a way that allows for easy retrieval by individual customers (i.e. users) (Van de Hoven, 1997). Simply put, it is a very large database with special sets of tools to extract and cleanse data from operational systems, and to analyze data (Songini, 2002).

The advanced analytical capabilities provided by a data warehouse can be broken down into two categories: 1) OLAP – online application processing and 2) Knowledge Discovery.

OLAP tools provide multidimensional data analysis, superior to existing data manipulation languages, for computing summaries and breakdowns along many dimensions (Fayyad, Piatesky-Shapiro, and Smyth, 1996).

Knowledge discovery (KD) in databases refers to the overall process of discovering useful knowledge from data. Models are inferred using statistical pattern recognition, applied statistics, machine learning, and neural networks. Data mining represents a key step in the process – the application of specific algorithms for identifying patterns and relationships that can be used to predict behavior. The final step in KD involves organizing and presenting the knowledge gained in a useful format (Rawlings, 1999).

There is a fundamental difference between OLAP and KD. OLAP is end-user driven, whereas the KD is based on artificial intelligence. Though complementary, the following highlight the different types of questions that can be answered by each technique (Rawlings, 1999):

1. OLAP: Which customers spent the most last year?
   KD: Which customer should be targeted for the next promotion?
2. OLAP: Which store failed to meet target last year?
   KD: What is the optimum size and location of the next store?

According to Fayyad and Uthurusamy (1996), the true value of data is derived from the ability to extract useful information from it for decision support or exploration. Major issues and challenges faced when implementing a data warehouse include integrating large volumes of data form multiple sources, providing users with appropriate tools and techniques to achieve their goals in a rapid-response environment, managing changing data and knowledge, handling non-standard and multimedia data, and using appropriate models and statistical techniques to fit data (Fayyad et al.,1996).

Work is ongoing in KD applications in a number of areas. Efforts are focused on easing the burden of managing and analyzing enormous data sets, overcoming obstacles to Web mining and Web knowledge discovery in the vast resources of the Internet, and integrating numeric, non-standard, and multimedia data (Fayyad et al., 1996; Meehan, 2002). Successful applications continue to appear and it is hoped will fulfill their promise of helping organizations acquire and use information more effectively (Meehan, 2002).

2.3.2.2 Groupware

Groupware facilitates the integration of context-laden, unstructured information. It is designed to support the free flow of rich dialogue. Like data warehouses, they incorporate information from a variety of internal and external sources. Unlike data warehouses, the information is not transaction-oriented. Knowledge resources include manuals, letters, customer support information, competitor intelligence, and knowledge derived from work processes (O'Leary, 1998). They typically map sources of internal expertise, track best practices, and support issue analysis, and drill down access.

The primary purpose of groupware is to support sensemaking through messaging and collaboration. These systems give individuals a means of forming communities of practice (Lave and Wenger, 1991; Brown and Duguid, 1991) or knowledge networks, thereby providing a forum for the exchange and interpretation of ideas and practices. Like the DW, groupware is surrounded by a complex set of issues regarding integration, maintenance, what gets stored, and how and when knowledge is retired.

In sum, data warehouses and groupware are designed to support knowledge creation in organizations. Table 2.1 provides a synopsis of the main characteristics of each type of technology. Although they accomplish the task in different ways, the overall goal is the same – to facilitate organizational learning. The following sub-section will take a more detailed look at how routine use of these technologies is expected to contribute to the accomplishment of this goal.

Table 2.1: Knowledge Management Technologies

DIMENSIONS	**Groupware**	**Data Warehouses**
Degree of structure	Context is "wrapped around" information	Context limited to metrics
Degree of context	Structured, semi-structured, and unstructured information	Highly structured. Explicit codified information.
Scope	Enterprise-wide integration of knowledge from multiple sources: internal and external: documents, conversations, email, web pages, directories, audio, video, best practices.	Enterprise-wide integration of data from multiple operational databases.
Temporality	On going	Snapshots at points in time
Individual/Group Use	Groups and Individuals	Individuals
Interpretive flexibility	High interpretive flexibility. Facilitates creation, representation, and sharing of interpretations in diverse formats.	High interpretive flexibility. Technology has the capability to detect patterns and trends. In addition, an array of visualization tools can be used to present/format results.
Analytical capabilities	Simple: search and access tools that support issue analysis and focused help.	Complex: knowledge discovery and OLAP capabilities that support high-end mathematical and statistical analyses.
Currency of data/information	Past, current, and future.	Past and current.
Knowledge-based activities supported	Knowledge sharing, acquisition, interpretation	Knowledge acquisition and interpretation
Problems/Issues	Who determines what goes in and how it is catalogued. Also (how) do you retire knowledge?	*Technical:* Validating, cleaning and integrating information. *Value added access*: end user search for appropriate tools to mine data

2.3.3 Consequences of Use: The Case of KMTs

In general, the literature on IT implementation has primarily focused on the factors that affect the initial adoption of an IT, and there has been little research done on the consequences of on-going IT use. This lack of research on consequences is not peculiar to the IT domain, but is a shortcoming of much of the research in the diffusion of innovations, as noted by Rogers (1995). Rogers attributes the lack of research on consequences of adoption to 1) a pro-innovation bias, where it is assumed that consequences of adoption will be positive, 2) the inappropriateness of the usual survey methods for investigating consequences, and 3) the difficulty in measuring consequences.

Within the IT domain, it is recognized that post-adoption behavior is critical to IT success, and there is a growing body of work that has sought to examine the dynamics of such behavior. IT success has been represented by a variety of variables such as associated with use, or consequences of use such as decision-making performance, user satisfaction, user confidence, and user attitudes (Alavi and Joachimsthaler, 1992). Trice and Treacy (1988) propose that system use is the necessary condition through which IT can affect (organizational) performance. However use is not a sufficient condition for implementation success (Taylor and Todd, 1995; Houdeshel and Watson, 1987). Within the realms of KMTs, which fall within the larger category of decision support systems, success typically is measured by the extent to which these systems enable individuals using them to improve their decision-making processes and/or derive value from using them (DeLone and McLean, 1992.) As suggested by Delone and McLean (1992), IT success should be considered a process construct that consists of interdependent stages. This view underscores the importance of examining higher order effects of IT use, i.e. consequences of IT use, when studying the impacts of IT implementation. In accordance with this guideline, IT success will be depicted as causal link between IT use and consequences of such use. Within this context it is proposed that use of a KMT will result in individual insights that may subsequently lead to innovative behavior.

Cooper and Zmud (1990) introduced a six-stage sequential model of IT implementation model that examined how the use of an IT evolved over time. They identified six stages of IT implementation: initiation, adoption, adaptation, acceptance, routinization, and infusion. The last two stages are most pertinent because they focus on the use of an IT after it has been incorporated into daily organizational practices and procedures. *Routinization* refers to the alterations that occur within work systems to account for IT applications such that these applications are no longer perceived as novel. *Infusion* occurs when IT applications become more deeply embedded within the organizations work systems.

Infusion represents the use of technology to its full potential and this is a result of users' improved understanding of the IT and the context in which it is being applied (Saga and Zmud, 1994). Hence, infusion is a direct consequence of an individual continuously using an IT for his/her work. Accordingly, infusion is multifaceted and is manifest in three types of use (Saga and Zmud, 1994):

Extended use – using more of the IT's features

Integrative use – using the IT for a wider range of work tasks (i.e. to establish or enhance workflow linkages).

Emergent use – using the IT to re-conceptualize work processes (i.e. to accomplish new tasks or reengineer existing ones).

Nambisan, Agarwal, and Tanniru (1999) make the compelling argument that IT innovation research needs to move beyond the current emphasis on acceptance and examine more thoroughly the factors that influence a users' ability to create new uses for an IT. This research is in response to the need they identify. It examines the factors that influence users' creative applications of KMTs, which is an example of a higher order outcome of KMT use. Due to their multifaceted nature, or malleability, these technologies naturally lend themselves to a wide variety of applications. Furthermore, KMTs are organizational memory banks and as such have the potential to provide insights to those who use them about the work context in which they are implemented. Hence, the innovative use of the knowledge derived from using these technologies can also be considered a higher order outcome of KMT use.

Based on the above, it is proposed that continuous use of a KMT can result in new insights about the technology and the work environment that enable individuals to: 1) rethink the way they work and thereby reinvent their work tasks, 2) create new uses for the KMT within their work context, and 3) make better decisions

2.3.4 The Effect of Individual Differences on IT Usage Behaviors

In addition to the social factors previously discussed, individual characteristics also play an important role in predicting and explaining human behavior. The theory of planned behavior (Ajzen, 1991) focuses on dispositional predictors of human behavior. In this framework it is argued that behavioral achievement depends jointly on perceived behavioral control and intention. Perceived behavioral control refers to extent to which an individual believes the desired behavior is easy or difficult to perform and is also a predictor of intention along with subjective norms and attitude toward the behavior (Ajzen, 1991). Importantly, perceived behavioral control has been likened to Bandura's (1977) concept of perceived self efficacy and is context specific (Ajzen, 1991.)

More specifically and within the IT domain, the influence of individual differences on IT implementation has been the focus of several studies. A meta-analysis of decision support systems research (Alavi and Joachisthaler, 1992) found that user-situational variables such as training and experience, when compared to psychological factors, have a greater impact on IT implementation success. In that study, implementation success was defined as the realization of the intended benefits of the decision support systems and included variables such as system use and decision-making performance.

When taken together, these theories suggest that individual characteristics are important determinants of behavior, but the ones considered should be relevant to a given context.

2.3.5 IT Implementation Key Points

The primary goal of this section was to examine the role of a KMT in an organizational learning context. The key points to take away from the discussion are as follows. In general, the role of a KMT is to enhance one's ability to learn. More specifically, if a KMT is used routinely, it will enable users to learn more about their work environment and the KMT itself. Such insights are expected to result in improved decision-making and may induce individuals to creatively apply KMTs to new tasks or to reinvent existing tasks around them. These relationships are portrayed in the conceptual model in Figure 2.3. The following section formally presents the conceptual model and explains the relationships that it depicts.

2.4 Conceptual Model

The conceptual model in Figure 2.3 provides the foundation for this work. It is comprised of five theoretical constructs: organizational internal environment, KMT use, individual characteristics, individual learning, and organizational learning outcomes. The central argument is that (continuous) use of a KMT can lead to individual learning that in turn can result in organizational learning outcomes.

In theory knowledge has to be acquired before it can be actually or potentially applied. As previously argued, within organizations, knowledge is acquired by individuals. Hence, individual learning is a prerequisite to organizational learning and subsequent organizational learning outcomes. The organizational learning outcomes of interest are the actual or potential innovative behaviors that can result from the insights gained through KMT use. In other words, as users interact with a KMT, they are expected to become more knowledgeable about their work environment as well as the technology itself. If this knowledge is applied then the organization stands to derive actual benefits. If this knowledge is intentionally stored for future application, this represents a potential benefit to the organization.

In addition to individual learning, individual characteristics are also believed to have an impact on learning outcomes and are therefore included as antecedents of innovative behavior.

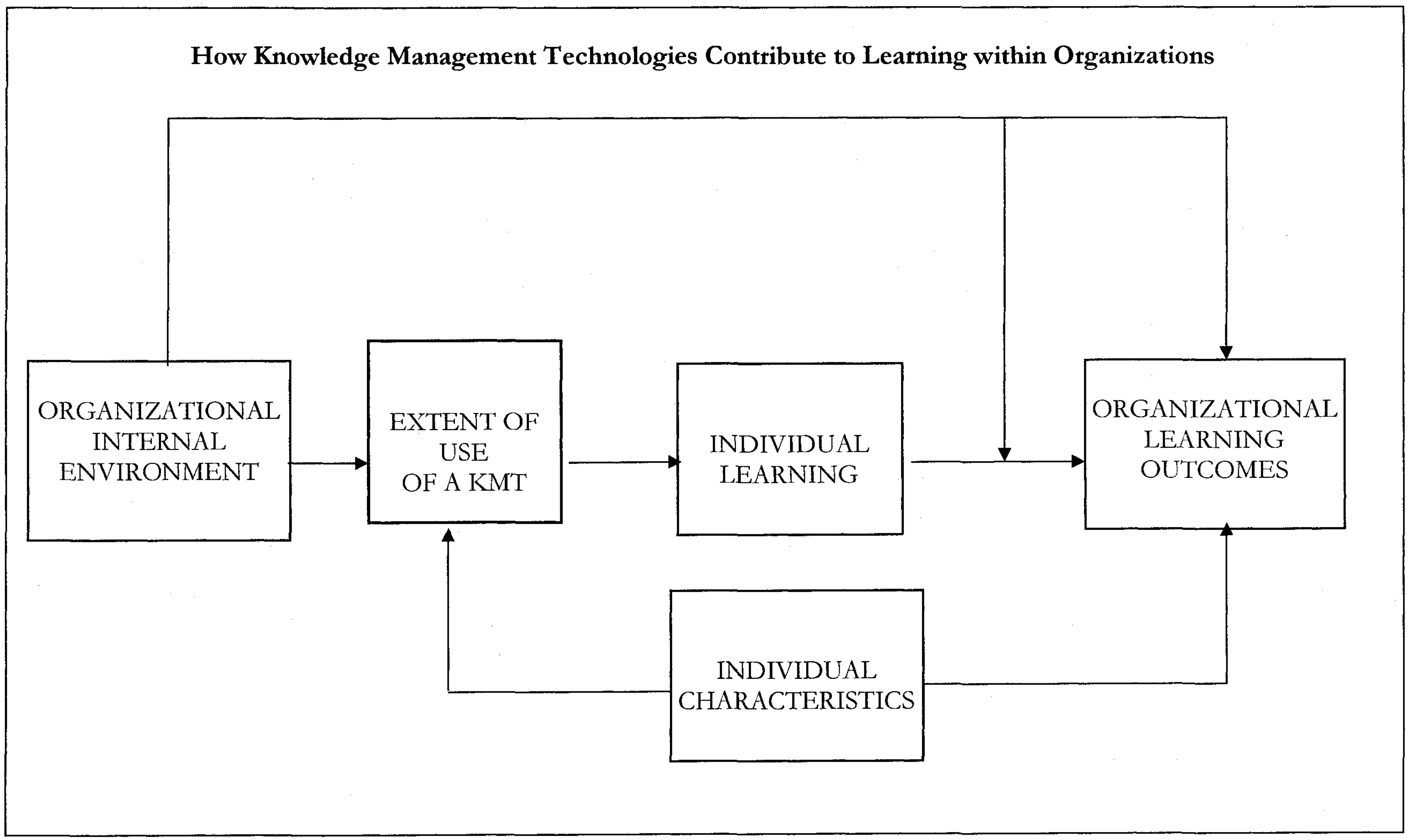


Figure 2.3: Conceptual Model

While the main intent is to explore the relationship between KMT use and innovative behavior, it is proposed that there are certain cultural characteristics of an organization that will have an impact on this relationship. Throughout the theoretical discussion, it has been argued that internal environmental factors influence individual thought and action within organizations, specifically those organizational values and policies that promote learning and innovation. Such policies may include rewarding innovative behavior or providing adequate resources and opportunities for learning to take place.

It is proposed that organizational environment, in addition to being a core antecedent of KMT use, will also have a direct impact organizational learning outcomes and will moderate the relationship between individual learning and organizational learning outcomes.

To sum up the conceptual model, individual learning is an expected outcome of technology use, and this knowledge may further be applied to the improvement of organizational intelligence and the implementation of innovative business solutions that, in the long run, may improve organizational effectiveness. However, the extent to which learning results in new ways of working, better decision making, or the integration of technology into one's work context is determined by the internal organizational environment, individual understanding, and individual characteristics.

2.5 Chapter Summary

The overall intent of this discussion was to derive a framework to be used to investigate the impact of KMTs on learning within organizations. The relevant literature was reviewed in order to justify the theoretical constructs and their relationships that were present in the conceptual model. In turn the conceptual model provided the foundation for the research model and hypotheses that are presented in Chapter Three.

CHAPTER 3

RESEARCH MODEL AND HYPOTHESES

3.1 Introduction

The primary goal of this research is to empirically determine the extent to which the use of knowledge management technologies contributes to individual learning within organizations. The study also seeks to determine the degree to which certain cultural characteristics of an organization are expected to influence the nature and extent of technology use and to examine some actual and potential benefits that can result from individual learning. With this in mind, the purpose of this chapter is to develop a research model that depicts these relationships and put forth a number of hypotheses, based on discussions in the previous chapter, that will be used to test the model.

Figure 3.1 depicts the research model that guides this study. This framework provides the basis for empirically assessing the nature of learning within the context of knowledge management technologies (KMTs). Hypotheses will be not presented in the natural order in which the constructs appear, from left to right. Instead, the discussion will commence with the relationship between technology use and individual learning, which forms the core of the model, followed by arguments and hypotheses related to antecedents of technology use and consequences of individual learning. For easy reference, a list of

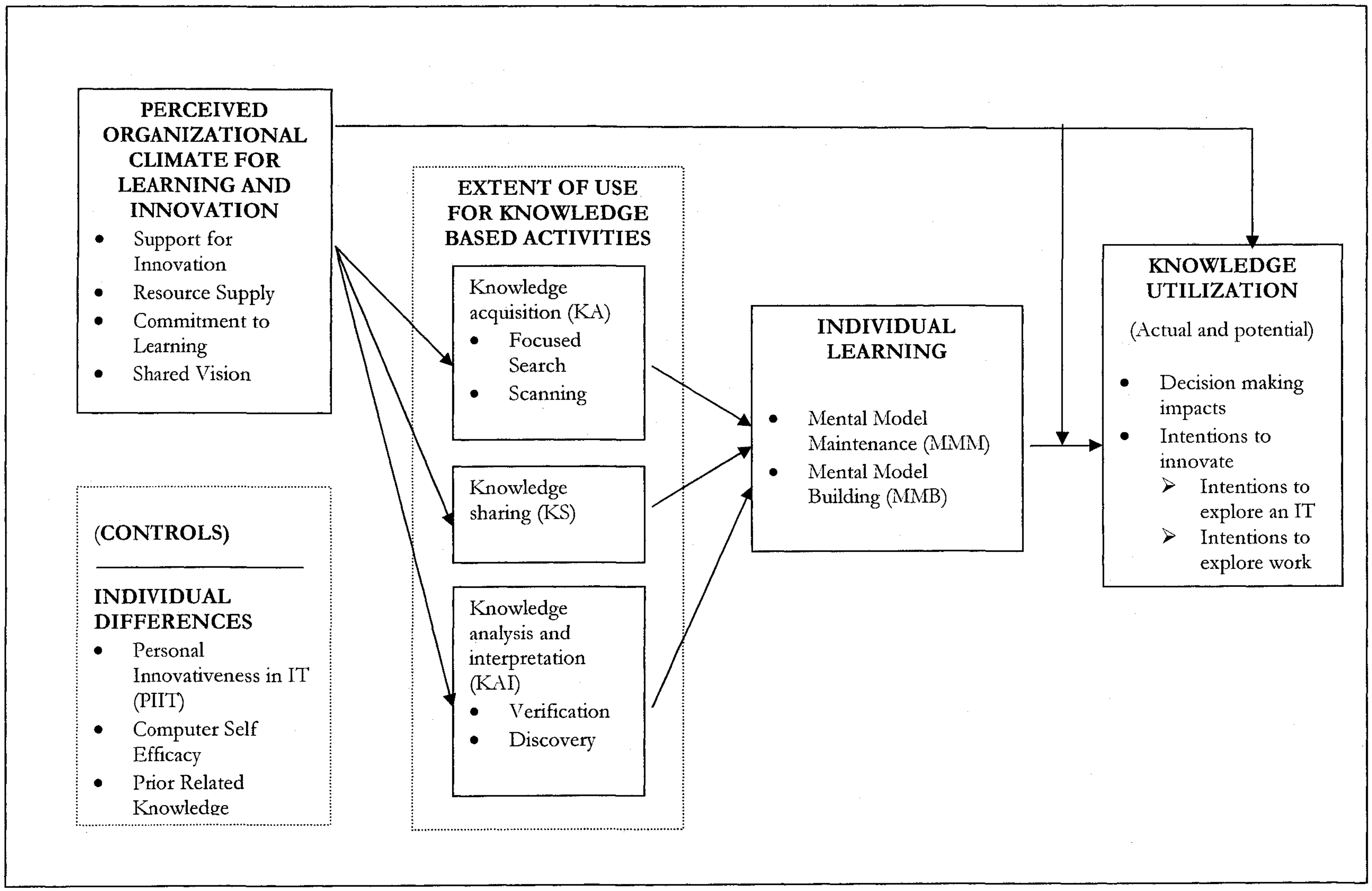


Figure 3.1: Research Model

Table: 3.1: Research Variables

VARIABLES	DEFINITIONS
Perceived Organizational Climate for Learning and Innovation	**The degree to which organization members perceive an organizational climate as supportive of learning and innovation. This construct consists of the following dimensions.**
Support for Innovation	The degree to which individual views the organization as open to change, supportive of new ideas from its members, and tolerant of member diversity (Scott & Bruce, 1994).
Resource Supply	The degree to which resources are perceived as being adequately supportive of innovative efforts within and organization (Scott & Bruce, 1994).
Commitment to Learning	The degree to which an organization values and promotes learning.(Sinkula, et al., 1997).
Shared Vision	The extent to which organizational members share a common sense of purpose (Sinkula, et al., 1997).
Extent of Use	**The perceived extent to which an IT is used for each of the following activities:**
Knowledge Acquisition (KA)	Use of an IT to acquire information related to one's work context. Knowledge acquisition can take place by focused search or scanning.
Focused Search	Focused search occurs when organizational members actively search in a narrow segment of an organization's internal or external environment, often in response to actual or suspected problems or opportunities (Huber, 1991).
Scanning	Relatively wide sensing of an organization's external environment (Huber, 1991).
Knowledge Sharing (KS)	Use of an IT to share knowledge related to one's work context.
Knowledge Analysis and Interpretation (KAI)	Use of an IT to analyze and provide multiple perspectives related to one's work context. Verification and discovery are examples of analytical capabilities.
Verification	The apriori selection of data mining algorithms by the end user.
Discovery	Allowing the intelligent capabilities of data mining applications to determine which algorithms to apply to a data set.

Table 3.1 continued

VARIABLES	DEFINITIONS
Individual Learning	**The development of knowledge, skills, and insights. Learning is manifested through mental model maintenance and mental model building.**
Mental Model Maintenance (MMM) (Single loop learning)	Minor adjustments to an individual's knowledge structures by detecting and correcting errors in them. An individual's reliance on existing knowledge structures to interpret and reinforce new information (Vandenbosch & Higgins, 1996).
Mental Model Building (MMB) (Double loop learning)	An individual's development of new rules to handle novel situations. This reflects a radical adjustment to an individual's knowledge structures by rethinking the assumptions on which they are built (Vandenbosch & Higgins, 1996).
Knowledge Utilization	**Comprised of actual and potential use of knowledge. Actual use refers to the application of knowledge to decision making activities. Potential use refers to intentions to innovate.**
Decision–Making Impacts	The impact on decision processes and outcomes as a result of IT use.
Intention to Innovate	Two dimensions: User's intention to create new applications of an IT in their work context (Nambisan et. al., 1998) User's intention to find potential uses for the knowledge/information derived from the use of an IT.
Individual Differences	
Prior Related Knowledge	Prior experience related to an individual's work context.
Personal Innovativeness in IT (PIIT)	Willingness of an individual to try out any new information technology. (Agarwal & Prasad, 1998)
Computer Self-Efficacy	An individual's judgment about his/her capability to use an IT to perform tasks within his/her work context (Compeau & Higgins, 1991).

Table 3.2: Research Hypotheses

Use of an IT for knowledge-based activities and Individual Learning.
H1: Use of an IT for knowledge -based activities will have a positive effect on Individual Learning. H1a: Use of an IT for Knowledge Acquisition will have a positive effect on Individual Learning. H1b: Use of an IT for Knowledge Sharing will have a positive effect on Individual Learning. H1c: Use of an IT for Knowledge Analysis and Interpretation will have a positive effect on Individual Learning.
H2a: Focused Search is more likely to result in MMM than in MMB. H2b: Scanning is likely to result in MMB and MMM. H2c: Verification is more likely to result in MMM than in MMB. H2d: Discovery is likely to result in MMB and MMM.
Perceived Organizational Climate for Learning and Innovation and use of an IT for knowledge-based activities.
H3: Perceived Organizational Climate for Learning and Innovation will have a positive effect on the extent to which a KMT is used for knowledge-based activities. H3a: Perceived Organizational Climate for Learning and Innovation will have a positive effect on the extent to which a KMT is used for Knowledge Acquisition. H3b: Perceived Organizational Climate for Learning and Innovation will have a positive effect on the extent to which a KMT is used for Knowledge Sharing. H3c: Perceived Organizational Climate for Learning and Innovation will have a positive effect on the extent to which a KMT is used for Knowledge Analysis and Interpretation.
Perceived Organizational Climate for Learning and Innovation and Knowledge Utilization.
H4: Perceived Organizational Climate for Learning and Innovation will have a positive effect on Knowledge Utilization.
Individual Learning and Knowledge Utilization
H5: Individual Learning will have a positive effect on Knowledge Utilization
Moderating effect of Perceived Organizational Climate for Learning and Innovation on the relationship between Individual Learning and Knowledge Utilization
H6: Perceived Organizational Climate for Learning and Innovation will moderate the relationship between individual learning and knowledge utilization such that high Individual Learning will be more likely to result in Knowledge Utilization in the presence of, rather than in the absence of, a pro-innovative working climate.

variables and their definitions is presented in Table 3.1 and a list of hypotheses is presented in Table 3.2.

3.2 KMT Use and Individual Learning

At the heart of this study is the relationship between technology use and individual learning, which has its foundations in previous research done by Vandenbosch and Higgins (1996) on executive information systems. The relationship between these constructs is replicated from their work. Central to their argument is the notion that different types of knowledge acquisition behavior using information technologies will have differential effects on individual learning.

These arguments are applicable within a knowledge management context because knowledge work pervades all levels of the organizational hierarchy, and knowledge management technologies are designed to provide decision support to a wide cross-section of end users.

3.2.1 Technology Use

In the Vandenbosch and Higgins (1996) study, technology use was classified in terms of two knowledge acquisition behaviors: Focused Search and Scanning. Focused Search occurs when individuals search in a narrow segment of an organization's internal or external environment, in response to actual or suspected problems opportunities, whereas Scanning refers to the relatively wide ranging sensing of an organization's external environment (Huber, 1991).

This study extends the Vandenbosch and Higgins (1996) model by looking at a broader conceptualization of technology use in the context of technologies that are specifically designed to support knowledge-based activities. As noted by Boland, Tenkasi, and Te'eni (1994), in order for an IT to support organizational learning, such a system should facilitate individual sensemaking and self discovery by allowing users to represent and exchange their individual understandings/interpretations in as rich and flexible a way as possible without an overwhelming emphasis on convergence. Since KMTs are capable of supporting such activities, technology use was reconstructed in order to reflect a wider range of learning activities than those used in the Vandenbosch and Higgins (1996) model.

Huber (1991) identified four means through which organizational learning takes place: knowledge acquisition, information distribution, information interpretation, and organizational memory. Knowledge acquisition is the process by which information or skills are acquired. Information distribution involves the sharing of information from myriad sources. Information interpretation is the process by which shared meanings or understandings are ascribed to new information. Organizational memory is the means by which information is stored for future use.

Huber's (1991) knowledge-based activities were used to re-classify the nature of use of a KMT. Therefore, KMTs are forms of organizational memory that can support the three other types of knowledge-based activities: Knowledge Acquisition, Knowledge Sharing, and Knowledge Analysis and Interpretation. Knowledge Acquisition (KA) refers to the use of a KMT to acquire knowledge related to one's work context. KA can take place by Focused Search or Scanning. Knowledge Sharing (KS) refers to the use of a KMT for sharing knowledge about one's work context. Knowledge Analysis and Interpretation (KAI) refers to the use of a KMT to analyze and interpret knowledge related to one's work context. KAI was further classified into two activities: Verification and Discovery. These two activities parallel the two modes of analysis provided by a data warehouse (DW), one of the KMTs of interest. In verification mode, the user specifies the algorithms to be run. In discovery mode, the intelligent capabilities of a DW determine which algorithms are most appropriate for a data set.

3.2.2 Individual Learning

Vandenbosch and Higgins (1996) conceptualized individual learning as a change in an individual's mental model. Mental models are internal images of how the world works and provide a means for individuals, and ultimately organizations, to create and share understandings (Hill, 1995). Mental models are theorized as changing incrementally or radically. Mental model maintenance (MMM) is the incremental change that occurs when existing knowledge structures are used to interpret and reinforce new information. Mental model building (MMB) is the radical change that occurs when new rules are developed to handle novel situations (Vandenbosch and Higgins, 1996). MMM and MMB are synonymous with Argyris and Schön's (1978) single-loop learning and double-loop learning, discussed previously.

3.2.3 The Relationship between KMT Use and Individual Learning

The relationship between technology use and learning will be discussed using a series of examples to highlight ways in which MMM and MMB may occur as users interact with each type of KMT. A DW is geared toward the individual user and as such, the KS capabilities are limited. However, there exist extensive capabilities to support KA and KAI activities. When using a DW for KA, a focused search may include running predictable queries that follow standard formats and are required on a regular basis, such as a sales report by region, product, and sales person. While informative, this information is most likely to produce MMM. However, exceptional results may trigger scanning behavior and with the use of drill down capabilities, analysis may reveal unexpected results. Hence, there is also the potential for MMB to occur.

A DW can be used for verification analysis or discovery-oriented analysis. OLAP is end-user driven and would be considered verification-oriented since the user selects the dimensions to be viewed and/or "sliced and diced." Alternatively, data mining is discovery-oriented because the DW determines the analytical techniques to be applied to a data set, the goal being to unearth trends, patterns, or relationships. Such information has typically been used for detecting fraud, identifying customers' buying patterns, market basket analysis, or providing early warning signs of potential problems. For example, combining information across divisions may result in the discovery of ways to streamline operations, or it may reveal unusual performance measures or marketing opportunities. These kinds of insights may trigger MMM or MMB, depending on the end users relevant knowledge and receptivity to new information. A DW also offers highly sophisticated visualization tools that provide alternative formats of data representation, which in turn may help users to gain a clearer understanding of underlying relationships in data sets.

Groupware facilitates the capture of context-rich information and primarily supports KA and KS activities by providing access to documents, database information, project records, email, discussion groups, bulletin boards, and group work areas. A Web interface supports KA by providing a gateway to myriad sources and types of information, both internal and external. Typical uses of groupware may include accessing lessons learned from a repository of best practices, selecting and preparing a project team using information from past related activities, locating specific sources of expertise, and collaborating on-line on a project. Such rich contextual information, laden with implications and interpretations, has the potential to promote MMM and MMB.

Although some KAI capabilities may be provided through groupware's database function, these capabilities are typically limited to standard data analyses. Nevertheless, these analytical results may prove insightful.

The preceding discussion highlights ways in which KMTs can be used to support the creation, dissemination, analysis, and interpretation of knowledge, thereby enabling those who use them to work smarter. Therefore it is hypothesized that

H1 : *Use of an IT for knowledge-based activities will have a positive effect on Individual Learning.*
H1a: *Use of an IT for Knowledge Acquisition will have a positive effect on Individual Learning.*
H1b: *Use of an IT for Knowledge Sharing will have a positive effect on Individual Learning.*
H1c: *Use of an IT for Knowledge Analysis and Interpretation will have a positive effect on Individual Learning.*

In accordance with prior literature, it can also be argued that different types of knowledge-based activities have different effects on MMM and MMB. Vandenbosch and Higgins (1996) argued that the potential for MMB is greatest when individuals engage in scanning, since scanning implies the absence of preconceived notions of what to look for and what will be found. However, MMM is the likely result if an individual is not receptive to new information and/or scanning does not unearth anything novel. Hence scanning may result in both MMM and MMB. Alternatively, focused search would be more likely to result in MMM, as the user seeks answers to specific questions or solutions to well-defined problems. However, unexpected results may in turn trigger scanning behavior. These arguments were empirically supported in their study. Similar arguments can be made regarding data mining techniques. Verification is more likely to result in MMM since the DW is limited to verifying the user's hypothesis, and discovery is likely to result in MMM and MMB since the DW is not given a priori hypotheses, and is set free to decipher patterns in the data, using an array of techniques. Subsequent results may be confirmatory or unexpected in nature. Therefore it is proposed that:

H2a: *Focused Search is more likely to result in MMM than in MMB.*
H2b: *Scanning is likely to result in MMM and MMB.*
H2c: *Verification is more likely to result in MMM than in MMB.*
H2d: *Discovery is likely to result in MMM and MMB.*

3.3 Organizational Influences on KMT Use

As noted earlier, knowledge management practices within organizations promote an integrated approach to capturing, retrieving, sharing, and evaluating an organization's knowledge. This knowledge originates from the experiences of organizational members, and for the most part is tacit, residing in the minds of employees. Knowledge management therefore requires a strong focus on a knowledge-oriented culture and on long-term rewards for those who create, share and apply knowledge (Davenport, 1998).

The implementation of a KMT plays a key role in the knowledge management process by providing a mechanism for knowledge creation and transfer. A KMT supports structured and unstructured problem solving, but it is the ability to do the latter that adds value to the knowledge creation process and fosters innovative behavior by individuals. These are malleable technologies that provide a wide range of functions capable of supporting enterprise-wide knowledge work. In addition, they capture knowledge that is specific to an organizational context, such as sources of expertise or individual interpretations about aspects of the work context, which can be used to contribute to the development of novel solutions to unstructured problems.

The availability of these systems, however, does not guarantee effective use. The cultural environment promotes a set of shared values that ensures such mechanisms produce real learning and are not merely used as a ritual (Lipshitz, Popper, and Oz, 1996). As one executive noted, the most difficult part of implementing a KMT is building the climate around it (Degnan and Petersen, 1999). Within this context therefore, the intent is to identify those climatic factors that promote on-going use of a KMT for problem solving.

3.3.1 Perceived Organizational Climate for Learning and Innovation

Thus far, it has been argued that learning and innovation are two distinct yet related behaviors. It has also been argued that organizational climate influences both sets of behaviors. The purpose of this sub-section therefore is to identify those aspects of an organization's climate that influence learning and those that influence innovation.

Within the context of organizational learning, prior literature suggests that an organization's learning orientation influences behavior within organizations by giving rise to a set of organizational values that influence the propensity to create and use knowledge (Sinkula, et al., 1997). Learning orientation is comprised of three dimensions: commitment to learning, open-mindedness, and a shared vision (Sinkula, et al., 1997). An organization committed to learning encourages individuals to improve their knowledge and skills through formal means such as training and through informal means such as sharing ideas and experimenting. An open-minded organization encourages transparency and fosters a willingness to question the status quo. A shared vision ensures that learning take place with a collective understanding of a shared objective thereby minimizing the risk or organizational units working at cross purposes. Taken together, having a shared vision, fostering a commitment to learning, and encouraging open-mindedness are believed to be facilitating conditions for organizational learning.

With regards to encouraging innovation, Scott and Bruce (1994) propose that an organization's "psychological climate for innovation" is a contributing factor to innovative behavior. For individuals, climate is a cognitive interpretation of an organizational situation and represents "signals concerning organizational expectations for behavior" (Scott and Bruce, 1994). Psychological climate for innovation is defined as the degree to which organization members perceive an organizational climate as supportive of innovation. This construct has two dimensions: support for innovation and resource supply (Scott and Bruce, 1994). Support for innovation reflects the degree to which individuals view the organization as open to change, supportive of new ideas from its members, and tolerant of member diversity (Scott and Bruce, 1994). Such an organization may: 1) be empowerment and teamwork oriented, 2) encourage the cross-pollination of ideas across functional, hierarchical and organizational boundaries, and 3) be characterized by change-oriented management. Resource supply is indicated by the degree to which resources (such as technology, facilities, finances, and time) are perceived as being adequately supportive of innovative efforts within an organization (Scott and Bruce, 1994).

Based on the above, the multi-dimensional construct *Perceived Organizational Climate for Learning and Innovation* was developed to represent those aspects of an organization's working environment expected to influence both learning and innovation. It is defined as the degree to which organization members perceive an organizational climate to be supportive of learning and innovation. Perceived organizational climate for learning and innovation is comprised of four dimensions: support for innovation, resource supply, commitment to learning, and shared vision. Open-mindedness was omitted because of the conceptual overlap with support for innovation.

Thus the argument is made that an organizational climate, in which there is support for innovation and a willingness to invest resources in learning and innovative activities, is more likely to motivate individuals to use organizational learning mechanisms such as KMTs to engage in proactive learning. KMTs support a range of knowledge-based activities by providing capabilities to acquire, analyze, and disseminate knowledge, and it is expected that perceived organizational climate for learning and innovation will influence the extent to which these technologies are used to support these activities. These expectations are reflected in the following hypotheses:

H3 : *Perceived Organizational Climate for Learning and Innovation will have a positive effect on the use of a KMT for knowledge-based activities.*
H3a: *Perceived Organizational Climate for Learning and Innovation will have a positive effect on the use of a KMT for Knowledge Acquisition.*
H3b: *Perceived Organizational Climate for Learning and Innovation will have a positive effect on the use of a KMT for Knowledge Sharing.*
H3c: *Perceived Organizational Climate for Learning and Innovation will have a positive effect on the use of a KMT for Knowledge Analysis and Interpretation.*

3.4 Knowledge Utilization

The ultimate objective in organizational learning is a behavior change that results in an improvement in organizational performance (Slater and Narver, 1995). Zaltman (1986) conceptualized knowledge utilization as an innovation and suggested that although knowledge utilization instrumentally begins with the individual, when knowledge is produced and applied within an organizational context, it is the organization that is essentially the user. Menon and Varadarajan (1992) outlined three ways in which learning can affect behavior. First, action-oriented use occurs when knowledge is directly used to solve problems. Second, knowledge-enhancing use results in changes in the user's knowledge and understanding that may be used to change behavior at some point in the future. The third type of use is affective use – knowledge use that results in greater satisfaction or lesser dissatisfaction with past behavior.

For the purposes of this research, knowledge utilization will be conceptualized as having two dimensions: actual use and potential use. Actual use maps to Menon and Varadarajan's (1992) action-use and represents the application of knowledge to an individual's decision-making processes. It is intended to reflect the instrumental use of knowledge for decision making (such as the generation of more decision alternatives or timelier decision-making) and not affective use (such as satisfaction with the quality of past decisions). Potential use maps to Menon and Varadarajan's (1992) knowledge-enhancing use and reflects the likelihood of future use through intentions to innovate. For the purposes of this research, two sets of intentions will be considered: 1) intentions to find new uses for the KMT and 2) intentions to find new ways of applying the knowledge gleaned from the KMT.

Intentions are significant for two reasons. First, prior literature has established that they are strong predictors of behavior (e.g., The Theory of Reasoned Action (TRA) meta-analysis by Sheppard, Hartwick, and Warshaw, 1988). Second, knowledge application may be dependent on an appropriate situational context. Unless that context exists, the behavior may not occur. Hence, intentions are more determinable.

To sum up what has been presented so far in this section, it has been argued that perceived organizational climate for learning and innovation will have a direct influence on individual use of a KMT by providing cues about incorporating these technologies into work activities. Similarly, one would also expect perceived climate for learning and innovation to have a direct effect on innovative behavior, in this case knowledge utilization.

Innovation within organizations can be viewed as three-step process that originates with shared understandings about the goals of the organization. This translates to creativity (the generation of ideas) and ultimately results in innovation (the implementation of these ideas). Damanpour (1991) suggests that creativity is a function of an individual or a small team, however innovation is the product of an organization and thereby depends on an array of organizational factors (process, structural, and cultural). Damanpour (1991) further states that organizational facilitators and inhibitors of creativity and innovation may vary by industry or sector. Hence, an organization operating in competitive environment that requires complex advanced technologies may require a climate more conducive to innovation and a flexible structure, and an organization operating in a less competitive environment that uses simple technologies may require a more bureaucratic structure and climate less conducive to innovation.

A working environment that promotes change and innovative behavior would encourage the active exchange of ideas and increased communication flows, which would ultimately be reflected in an atmosphere of inventiveness, creativity, and the willingness to take chances (Miles, 1978). Thus it is expected that the more KMT users perceive their working climate as being supportive of learning and innovation, the more likely they will be to explore new ways of doing their job and to find new applications for the KMT within their work context. These expectations are reflected in the following hypothesis:

H4 : *Perceived Organizational Climate for Learning and Innovation will have a positive effect on Knowledge Utilization.*

3.5 Individual Differences

The research focuses on the impact of working climate on the innovative intentions of individuals as they relate to the use of a KMT. However, prior research has established that individual differences play an important role in the implementation of technologies in general (Rogers, 1995) and more specifically in IT implementation (e.g., Zmud 1979; Agarwal and Prasad, 1999).

Although a variety of individual difference variables have been investigated in IT research (Alavi and Joachisthaler, 1992), this study examines those individual variables that are pertinent to IT-related individual learning. These variables fall into two categories: 1) prior related knowledge and 2) willingness and ability to use an IT. Prior related knowledge reflects a familiarity with organizational goals and operations. Drawing on the theory of absorptive capacity (Cohen and Levinthal, 1990), innovative ability is contingent on the ability to assimilate new knowledge, which in turn is a function of prior related knowledge. For the purposes of this study, indicators of experience are an individual's tenure in the organization, tenure in his/her current position, years of computer use, and years of KMT use.

Personal innovativeness in IT and computer self-efficacy are the chosen indicators of willingness and ability to use an IT. Personal innovativeness in IT (PIIT) indicates the willingness of an individual to try out new information technologies (Agarwal and Prasad, 1998). Whereas the organizational context may externally motivate an individual to use an IT, PITT is considered to be a source of intrinsic motivation (Agarwal & Karahanna, 2000). Computer self-efficacy is an individual's judgment about his/her capability to use a computer to perform tasks within his/her work context (Compeau and Higgins, 1991). In addition to influencing a user's perception of his/her ability to perform specific tasks, these factors are crucial influences on future intentions (Agarwal and Prasad, 1998; Marakas, Yi, and Johnson, 1998).

The individual differences outlined above are not of direct interest and will be controlled for in the empirical analysis. They are expected to influence the research model in two ways based on previous arguments. First, these variables will have a direct impact on an individual's ability to effectively use a KMT in his/her work context as outlined above. Thus, knowledge of the job and knowledge of the technology will impact the extent to which an individual is able to appropriately use a KMT on the job. Second, these variables will have a direct impact on knowledge utilization. For example, one would expect a strong relationship between PIIT and intentions to innovate with IT. However, previous arguments indicate that this relationship would be moderated by the perceived climate for learning and innovation.

3.6 Chapter Summary

This chapter has presented a research model to be used for understanding how KMT usage behaviors can facilitate individual learning. As such, five sets of hypotheses were developed relating the variables in the research model. The key proposition was the positive relationship between technology use and individual learning. Next, it was proposed that a favorable working climate would have a positive effect on technology use and knowledge use. Finally, arguments were presented in support of the interactive effect of working climate and individual learning on knowledge use. The following chapter provides details of the methodology that will be used to test these relationships.

CHAPTER 4
METHODOLOGY

4.1 Introduction

The purpose of this chapter is to explain the methodology for empirically assessing the hypotheses presented in the research model. The overall research design is discussed first, including level of analysis, research context, and data collection method. Next, reliability and validity issues are addressed. Following that, the operational measures are presented. The chapter concludes with a discussion of the pre-test and subsequent pilot.

4.2 Research Design

The major components of the design strategy for this dissertation are discussed in the following subsections. These include level of analysis, research context, data collection method, and data analysis.

4.2.1 Level of Analysis

The primary goal of this study is to examine the effects of knowledge management technology use on individual learning. Secondary objectives examine contextual variables as antecedents of individual usage behavior, and knowledge utilization as a consequence of individual learning. Subsequently, the appropriate level of analysis is the individual.

4.2.2 Research Context

This dissertation empirically investigates the hypotheses using data warehouses. Data were collected at two sites. Data collected at Site 1 were used for scale validation. Data collected at Site 2 were used to test the research hypotheses. There were two main criteria for site selection. First, the technology should have been implemented for over a year, an indication that it had been incorporated into organizational routines and is no longer novel. This is in keeping with an underlying goal of this study which is to determine the extent to which organizational value can be derived from "seasoned" technologies. Second, the technology should have a wide cross-section of users throughout the organization. Selecting users from a variety of functional areas and hierarchical levels should ensure sufficient variability in individual characteristics, behaviors, and behavioral intentions and should improve the generalizability of the findings.

4.2.3 Data Collection

Two research sites were identified, both large government agencies. Potential respondents were users who had been working with the technology and the organization for at least six months because the outcomes of interest are dependent on an individual's knowledge of the particular technology and his/her work context.

The research is conducted as a cross-sectional field study using a questionnaire as the survey instrument. As suggested by Pinsonneault and Kraemar (1993), survey research is most appropriate when: 1) the central questions of interest about the phenomenon are "what is happening?" and "how and why is it happening?;" 2) control of the dependent and dependent variables is not possible or not desirable; 3) the phenomenon of interest must be studied in their natural setting; and 4) the phenomena of interest occur in current time or the recent past (p. 78). Given that the current study meets these criteria, a questionnaire was deemed an appropriate means of data collection.

The questionnaire has been constructed using validated scales to measure constructs wherever possible. Existing scales are used to measure the following constructs: support for innovation, resource availability, commitment to learning, shared vision prior related knowledge, personal innovativeness in IT, computer self-efficacy, knowledge acquisition, mental model maintenance, mental model building, decision making impacts, and intentions to innovate with an IT. In cases where previously validated measures were not found, scales have been developed by adapting related scales or have been derived from the appropriate theory. Therefore scales were developed for knowledge sharing, knowledge analysis and interpretation, and intentions to apply knowledge. Specific details on the scales are provided in the following section entitled "Scale Development."

4.2.4 Data Analysis

Structural Equation Modeling (SEM) is used to test the research model for the study. Specifically, partial least squares (PLS) has been chosen because PLS uses a component based approach to estimation. Because of this, it places minimal demands on sample size and residual distributions. Moderating effects of contextual dimensions are tested in PLS using the method suggested by Chin (1996, p. 181).

4.3 Scale Development

The following subsections describe the manner in which the constructs in the research model were operationalized. As stated previously, existing measures have been used where possible. In some instances a subset of items from the original scales is used. This has been done in the interest of parsimony and to ensure that the questionnaire is not excessively long. The approach taken has been to select those items with the highest factor loadings that capture the essence of the construct. Selection based on item loadings is often recommended in the psychometric literature (e.g., Nunnally and Bernstein 1994). This approach favors building a more homogenous scale with high internal consistency, at the possible expense of content validity since it may narrow domain coverage. Therefore, when subsets of items were selected, care was taken not to sacrifice content validity.

For variables where theory was used to guide item development, items were reviewed by colleagues and advisors with extensive research experience in the field and were reworded according to their suggestions.

All constructs, except prior related knowledge, utilize an ordinal scale to allow the respondents to indicate the extent to which they agree or disagree with statements related to the construct of interest. The Likert scale ranges from 1 = strongly disagree to 7 = strongly agree with the midpoint of 4 representing a neutral position, or in the case of mental model maintenance and mental model building, from 1 = not at all to 7 = to a great extent with the midpoint of 4 representing "somewhat". The items used to measure each construct will be discussed below. Please refer to Appendix A for a complete list of measures, organized by construct.

4.3.1 Perceived Organizational Climate for Learning and Innovation

Perceived organizational climate for learning and innovation is a multi-dimensional construct that captures the degree to which an organizational climate is supportive of learning and innovation. Conceptually and operationally, this construct combines Scott and Bruce's (1994) perceived climate for innovation, and Sinkula, et al.'s (1997) learning orientation. Perceived climate for learning and innovation has two dimensions: support for innovation and resource supply (Scott and Bruce, 1994). Learning orientation has three dimensions: commitment to learning, open-mindedness, and shared vision (Sinkula, et al., 1997). There is a conceptual overlap between support for innovation and open-mindedness, with both dimensions symbolizing an organization's willingness to change. Therefore, for the purposes of this research, the following four distinct dimensions will be considered.

4.3.1.1 Support for Innovation

Support for innovation measures the degree to which individuals view an organization as open to change, supportive of new ideas from members, and tolerant of member diversity (Scott and Bruce, 1994). Thirteen items appear in the original scale (Scott and Bruce, 1994, p. 593) and of those, the seven with the highest factor loadings (0.66 and above) were selected. These items capture the essence of the construct thus content validity has not been compromised. The selected items appear below:

1. The main function of members in this organization is to follow orders, which come down through channels.
2. Creativity is encouraged here.
3. A person cannot do things too different around here without provoking anger.

4. People around here are expected to deal with problems in the same way.
5. This place seems to be more concerned with the status quo than with change.
6. Around here, a person can get in a lot of trouble by being different.
7. The reward system here benefits mainly those who don't rock the boat.

4.3.1.2 Resource Supply

Resource supply measures the degree to which resources (personnel, funding, and time) are perceived as adequate in an organization (Scott and Bruce, 1994). Six items appear in the original scale (Scott and Bruce, 1994, p. 593), and of those the four with the highest factor loadings (0.62 and above) were selected. These items capture the essence of the construct thus content validity has not been compromised. Items used are:

1. Assistance in developing new ideas is readily available.
2. There are adequate resources devoted to innovation in this organization.
3. There is adequate time available to pursue creative ideas here.
4. This organization gives me the free time to pursue creative ideas during the workday.

4.3.1.3 Commitment to Learning

Commitment to learning, defined as the value an organization holds toward learning which influences the likelihood that the organization will promote a learning culture vision, was operationalized using the 4-item scale from Sinkula et al. (1997, p. 316). However three additional items were developed to conceptually complete the construct. While the first four items focus on an organization's value system with regards to learning, the last three reflect the extent to which an organization provides formal and informal opportunities for learning e.g. training and team activities. The items appear below:

1. Learning in this organization is seen as a key commodity necessary to guarantee organizational survival.
2. Managers agree that our organization's ability to learn is the key to our success.
3. The basic values of this organization include learning as key to improvement.
4. The sense around here is that employee learning is an investment not an expense.
5. This organization provides opportunities for professional development such as training, workshops, and seminars.
6. This organization provides opportunities for individual development other than formal training, such as team activities and experimentation.
7. In this organization, there is a commitment to sharing knowledge.

4.3.1.4 Shared Vision

Shared vision, regarded as essential for providing the focus for learning that motivates organizational members, was operationalized using the scale from Sinkula et al. (1997, p. 316). The items are:

1. There is a commonality of purpose in this organization.
2. There is agreement on our organizational vision across all levels, functions, and divisions.
3. All employees are committed to the goals of this organization.
4. Around here, employees view themselves as partners in charting the direction of the organization.

4.3.2 Extent of Use for Knowledge-Based Activities

Extent of use for knowledge based-activities consists of three dimensions, representing a range of activities supported by a KMT. This perceptual measure is designed to capture the extent to which a particular KMT is used for knowledge acquisition, knowledge sharing, and knowledge analysis and interpretation. It should be noted that the DW is the focal KMT of this study and the items are worded to reflect this. Though only Knowledge Acquisition (KA) and Knowledge Analysis and Interpretation (KAI) are applicable to a DW, for the sake of completeness, items measuring knowledge sharing are also presented below.

4.3.2.1 Knowledge Acquisition (KA)

Knowledge acquisition behaviors, focused search and scanning, were operationalized using the Vandenbosch and Higgins (1996, p. 212) scales and reworded the suit the current context. The items, listed by variable, are:

4.3.2.1.1 Focused Search

1. I regularly focus on specific information contained in the DW/KMS.
2. I use the DW to find answers to specific questions.
3. I use the DW to do routine queries.
4. I review a consistent set of reports in the DW.
5. I use the DW to look for information I need.

4.3.2.1.2 Scanning

1. I randomly browse through information contained in the DW.

2. I use the DW to see what's new.
3. I vary the information that I look in the DW.
4. My scanning of the DW is wide-ranging.

4.3.2.2 Knowledge Sharing (KS)

Knowledge sharing is designed to capture the extent to which a KMT is used to disseminate information within an individual's work context. As mentioned previously, knowledge sharing is not supported by the DW and thus these items were not measured in this study. Consequently the following items are worded generically so that a specific technology can be substituted for "the KMT" in future research.

1. I use *the KMT* to share information with colleagues.
2. I use *the KMT* to exchange my ideas with others.
3. I use *the KMT* to discuss issues with to co-workers.
4. My colleagues and I use *the KMT* to collaborate on work assignments.

4.3.2.3 Knowledge Analysis and Interpretation (KAI)

Knowledge analysis and interpretation represents an individual's reliance on the analytical and interpretive capabilities of a KMT. Previous discussions stated that such capabilities, provided by a DW, can be accessed in two modes: verification and discovery. Recall that for a given data set, in verification mode the user selects the type of analysis to be performed, and in discovery mode, the DW determines which analyses are most appropriate. With this in mind, items were developed to measure each type of activity.

4.3.2.3.1 Verification

1. I use the DW to perform a regular set of analyses.
2. When using the DW, I usually select the type of analysis to be performed.
3. I use the DW to analyze data with specific objectives in mind.
4. I use the DW to do specific calculations.

4.3.2.3.2 Discovery

1. I rely on data mining tools to reveal unexpected data patterns.
2. I rely on data mining tools to interpret what is happening with the data.
3. I use the DW to perform free-form analysis.
4. I engage in data mining activities with no clear-cut objectives in mind.

4.3.3 Individual Learning

Individual learning, conceptualized as mental model building and mental model maintenance, was operationalized using the measures developed by Vandenbosch and Higgins (1996, p. 212). Individuals will be asked to think about their work context and indicate on a seven-point Likert scale, ranging from 1 = not at all to 7 = to a great extent with a midpoint of 4 = somewhat.

4.3.3.1 Mental Model Maintenance (MMM)

To what extent has using the DW enabled you to:

1. Verify your assumptions?
2. Reinforce your perspectives?

3. Confirm you beliefs?
4. Validate your point of view?

4.3.3.2 Mental Model Building (MMB)

To what extent has using the DW enabled you to:

1. Challenge your perspectives?
2. Reorient your thinking?
3. Expand your knowledge?
4. Question your preconceptions?

An item was omitted from each category because of a theoretical overlap with the knowledge utilization construct. The omitted items are "...support your actions" (MMM) and "...foster your creativity" (MMB).

4.3.4 Knowledge Utilization

Knowledge utilization is a multidimensional construct designed to capture actual or potential changes in behavior as direct consequences of individual learning. Actual knowledge use is manifest in the application of knowledge to an individual's decision making (Menon and Varadarajan, 1992). In this context, potential knowledge use is reflected by an individual's intentions to innovate. Measures for each dimension are discussed below.

4.3.5 Decision-Making Impacts

Decision making impacts were operationalized using Sanders and Courtney's (1985) scale. The items used are:

1. Utilization of the DW has enabled me to make better decisions

2. As a result of use of the DW, I am better able to set my priorities in decision making.
3. Use of the data generated by the DW has enabled me to present my arguments more convincingly.
4. Use of the DW has improved the quality of decision I make in this organization.
5. As a result of using the DW, the speed with which I analyze decisions has increased.
6. As a result of using the DW, more relevant information has been available to me for decision making.
7. The DW has led me to greater use of analytical aids in my decision making.

4.3.5.1 Intentions to Innovate

Ongoing use of a KMT fosters learning in two domains: 1) it improves the user's understanding of the technology, and 2) it provides insights about the work context. Intentions to innovate variables are designed to capture an individual's predisposition to apply both types of knowledge. Hence, these variables represent 1) an individual's willingness and purpose to initiate IT innovation through exploration – defined by Nambisan, et al. (1999) as intentions to explore (an IT), and 2) an individual's willingness to find new ways to do his/her job.

For the purposes of this research, these two dimensions will be labeled intentions to explore an IT and intentions to explore work activities respectively. Intentions to explore an IT will be measured using Nambisan, et al.'s (1999) scale. The items are:

4.3.5.1.1 Intentions to explore an IT

1. I intend to explore the DW for potential applications to my work.

2. I intend to explore the DW for enhancing the effectiveness of my work.
3. I intend to spend considerable time and effort this year in exploring the DW for potential applications.

The following items, worded similarly to those of intentions to explore an IT, were developed to measure intention to explore work activities.

4.3.5.1.2 Intentions to explore work activities

1. I intend to explore ways in which business knowledge from the DW can be applied to my work.
2. I intend to explore ways in which business knowledge from the DW can be used to improve my job performance.
3. I intend to explore business knowledge in the DW for potential applications.

4.3.6 Individual Characteristics (Control Variables)

In the previous discussion of the research model (Chapter Three), it was noted that certain individual characteristics would influence usage behavior and subsequent outcomes. Although these variables are not of direct interest, their influence will be captured in the following way.

4.3.6.1 Personal Innovativeness in IT

In order to control for personal innovativeness in IT, the following items were adopted from Agarwal and Prasad (1998).

1. I like to experiment with new information technologies.

2. If I heard about a new information technology, I would look for ways to experiment with it.
3. Among my peers, I am usually the first to try out new information technologies.
4. In general, I am hesitant to try out new information technologies.

4.3.6.2 Computer Self-Efficacy

The following items, adapted from Taylor and Todd (1995), were used to control for computer self-efficacy.

1. I feel comfortable using the DW on my own.
2. I can easily manipulate the DW when I need to.
3. I am able to use the DW when there is no one around to show me how to use it.

4.1.1.1 Prior-Related Knowledge

The following items will be used to control for prior related knowledge.

1. How many years have you been employed with the organization?
2. How many years have you worked in your current position?
3. How many years have you been using a computer (for work, school, or home purposes)?
4. How long have you been using the DW?

4.4 Construct Validity

Construct validity is defined by Cook and Campbell (1979, p. 59) as "the degree to which the measure's true score corresponds to the conceptual variable that the measure is intended to operationalize." "Whereas reliability is concerned with the amount of random variance in an observed score, construct validity is concerned with the degree to which systematic variance in a score corresponds to the target construct" (Davis, 1986, p. 71). Bagozzi (1980) defines construct validity as the degree to which a concept achieves theoretical and empirical meaning within the overall structure of one's theory. He proposes six criteria that should be met to establish construct validity. The criteria are as follows:

1. Theoretical meaningfulness of concepts
2. Observational meaningfulness of concepts
3. Internal consistency of operationalizations (reliability)
4. Convergent validity
5. Discriminant validity
6. Nomological validity

4.4.1 Theoretical Meaningfulness of Concepts

This criterion is based on the idea that the theoretical definition of each concept should adequately describe that concept. This criterion primarily refers to the character and quality of the language used to define the concept. This essentially means that definitions should be based on theory (Karahanna, 1993). There is no empirical test that can be performed to check this criterion. In this study, constructs have been defined from previous literature whenever possible. When existing definitions did not exist, definitions were derived from the relevant theory.

4.4.2 Observational Meaningfulness of Concepts

This criterion refers to the relationship between the theoretical concepts and their measures (or operationalizations). As with the first criterion there is no empirical check that can be used to check the observational meaningfulness of concepts. It is possible to increase confidence in this criterion by paying careful attention to construct-measure correspondence as the instrument is being developed (Goodhue,1988). When using scales that have been previously validated, evidence of this criterion can be obtained by examining how these scales were derived and validated, as suggested by Karahanna (1993). A careful review of the previously validated scales revealed strong theoretical grounding and rigorous statistical testing. Newly developed items were theoretically derived and were subject to scrutiny by resident experts in the field.

4.4.3 Reliability

Reliability refers to the extent to which a measurement item (question) is free from random error (Nunnally 1978, p. 191). The following formula is frequently used to show random error in a measure (Davis, 1986):

$$X_{ij}=T_{ij} + e_{ij}$$

Where:

X_{ij} = observed score from subject i on item j

T_{ij} = true score for subject i on item j

e_{ij} = random error for subject i on item j

Reliability is generally defined as the proportion of variance in the observed score X_{ij} that is due to the true score T_{ij}, or σ^2_t/σ^2_x (Davis 1986, p. 70). As the amount of random error increases, reliability decreases. Low reliability can create problems in a statistical analysis in two ways. First, when doing some type of comparison of means low reliability will inflate the standard error and increase the likelihood of making a type II error (Davis, 1986). "A type II error occurs if the null hypothesis H_0 is not rejected when in fact it is false and should be rejected" (Levine, Berenson, and Stephan 1999, p. 484). Second, "low reliability attenuates estimates of correlation and regression coefficients relative to what their true value would be with error-free measures" (Levine, Berenson, and Stephan 1999, p. 70).

4.4.4 Convergent Validity

The fourth criterion, convergent validity, refers to the degree to which two or more attempts to measure the same concept, through maximally different methods, are in agreement. The use of different methods reduces the probability that correlations among different measures are due to method bias. Examples of this would be to measure a construct through the use of a survey and through interviews. This dissertation uses a single method of data collection so convergent validity is not relevant here.

4.4.5 Discriminant Validity

Discriminant validity refers to the degree to which measures of different concepts are distinct. This means that correlation coefficients of items of the same scale should be higher than correlation coefficients of items across different constructs. When all data are collected using a single method, differences among measures are attributable to differences in concepts rather than method. Therefore, when all data are collected using the same method, as is in this dissertation, the strongest test of discriminant validity occurs.

There are several empirical methods for testing discriminant validity. Methods include; multitrait-multimethod matrix (MTMM) (Campbell and Fiske, 1959) confirmatory factor analysis (Long, 1983), and exploratory factor analysis (Carmines, 1979; Kerlinger, 1986; Nunnally, 1978). This dissertation will use confirmatory factor analysis to determine discriminant validity.

4.4.6 Nomological Validity

Nomological validity refers to the degree to which predictions from a formal theoretical network containing the construct under scrutiny are confirmed. If the predictions are not confirmed then doubts are raised about the measures and the theory. In the context of this dissertation, nomological validity will be addressed in the discussion section.

4.5 Pre-Test Results

In the fall of 1998, a pre-test was conducted at a state university using a convenience sample of 29 users of a newly implemented data warehouse. Due to the novelty of the technology at the time, a host of issues were being resolved such as assessing end user training needs, determining what data mining tools to acquire, and integrating data from different sources.

Given that the DW was in the early stages of implementation, a scaled-down version of the research model was tested using those variables that were most pertinent to that stage of implementation. The variables measured were PIIT, focused search, scanning, MMM, MMB, and decision-making impacts.

Eighteen users agreed to participate in the study, and from these users, thirteen usable questionnaires were collected. Given the small sample size, the possibility of factor analysis was ruled out and no formal testing of hypotheses could be conducted.

However, the scales were tested for reliability and they all exhibited reasonable levels of reliability as shown in Table 4.1.

Table 4.1 Pre-Test Reliabilities

Variable	**Std. Cronbach Alpha**
PIIT	0.77
Focused Search	0.78
Scanning	0.84
Mental model maintenance	0.97
Mental model building	0.94
Decision-making impacts	0.89
n = 13	

Correlation analysis was conducted using variable scores (the mean of their corresponding item scores) and the only two relationships that proved significant at the 0.01 level were

- MMM and decision making impacts (Pearson correlation coefficient = 0.557)
- MMB and decision making impacts (Pearson correlation coefficient = 0.560)

Given that validity testing was not feasible in the pre-test, a pilot was subsequently conducted with sample of users from research site one. This necessitated two rounds of data gathering, the first round for the pilot, discussed below, and the second round for the main study, discussed in the following chapter.

4.6 Pilot Study

4.6.1 Overview of Pilot Study

This section presents the steps performed to pilot the research instrument. It begins by outlining the organization of the section. The second subsection provides an overview of the research context and data collection. Third, the steps taken to maximize data integrity are presented. The fourth subsection discusses response rate and descriptive statistics of the sample. The fifth subsection provides the results of the exploratory factor analysis done to refine the scales. Sixth, validities and reliabilities are discussed. The final subsection summarizes the steps undertaken in the pilot study.

4.6.2 Research Context and Data Collection

Site selection was based on two criteria. First, an organization had to have implemented a knowledge management technology (KMT) for at least one year. Second, there needed to be a wide cross-section of end-users who had been using the KMT for at least six months as a part of their daily work routine. Hence the KMT was not longer novel. Organizations were solicited with the help of advisors and colleagues who had contacts in the business and academic communities.

The research site chosen for the pilot was a large state university in the South that had implemented a data warehouse approximately four years prior to the pilot being conducted. The sample was comprised of a cross-section of administrative staff across the campus that used the Business Objects data mining suite of applications. Although the campus-wide data warehouse population was approximately 400 users, about one half of these were occasional users and were therefore not considered.

The pilot took the form of a field study and used a survey methodology for data collection. The survey was administered online at:

http://aissurvey.ispeednet.com

and is shown in Appendix D. A mailing list was created with 200 invitees. The invitation was issued via email by a data warehouse administrator who was known to the users. It was felt that users would be more inclined to participate when the call was made by someone known to them who endorsed the study. As a further incentive to participate, $25 gift certificates were given to three randomly selected participants. Once the survey was underway, three reminders were sent intermittently over a period of four weeks.

For the most part, data collection went smoothly. There were two users who contacted the researcher about being unable to access the survey and they were sent paper copies which they completed and promptly returned. Data were captured directly in a Microsoft Access database and therefore did not need to be re-coded or entered manually (with the exception of the two paper surveys).

4.6.3 Data Integrity

The (electronic) survey was designed to be user-friendly and to take advantage of checks and balances not available in paper-based surveys. Some items were left as text-boxes to capture free-format responses e.g. age and years of computer use. However, for other items a combination of list boxes and option buttons were used to provide a standard list of choices. For example Likert items/questions used a group of option buttons where only one choice could be made per group. Also, job title could be selected from a list box. Much of the data coding was embedded in the electronic survey. For example, option button responses were captured as 1 through 7, and if reverse-coded, as 7 through 1. Similar coding was done for list box items.

Survey data were imported into a spreadsheet to prepare the responses for analysis. The first step in the process was to create a "research model" version of the data. This was comprised of only those constructs pertinent to the research model. This was necessary because the original data capture included several items that were of interest to the participating organization but were not directly used in the research study. These items were included ensuring that the survey was mutually beneficial to the researcher as well as the organization.

Responses were not mandatory hence an inspection for missing values had to be done. Of the 73 surveys submitted, seven were discarded because the majority of the items were unanswered. Of the remaining 66 surveys, on average there were two missing responses per item. This constituted about 3% per item and the missing values were replaced with the mean values for that item as is consistent with research protocol (Tabachnick & Fidell, 1996).

4.6.4 Sample Response Rate and Descriptive Statistics

Table 4.2 provides a summary of the response rate for the pilot. Of the 200 people asked to participate 73 survey responses were submitted. Of those surveys, 66 were usable representing a response rate of 33%. Table 4.3 provides descriptive statistics for the respondents. The average age of respondents was 41.8 years with a standard deviation (SD) of 10.4 years. On average, respondents had been with the organization for 7.58 years (SD = 7.22), in their current job for 3.92 years (SD = 4.14), had been using a computer for 16.85 years (SD = 5.22), and the DW for 2.24 years (SD = 1.66). The majority of respondents were white (93%), female (61%), and had at least a Bachelor's degree (84%). Most used the warehouse on their own (68%) however 6% relied on analysts and 26% relied on both themselves and analysts. Thirty percent reported being highly proficient in using the DW meaning they were able to generate complex reports on their own whereas 58% felt they were able to generate simple reports (medium proficiency). Twelve percent of users reported being only able to refresh existing reports (low proficiency).

Table 4.2: Response Rate for Site 1

Number invited to participate	200
Number of survey submitted	73
Number of usable surveys	66
Response Rate	33%

Table 4.3: Descriptive Statistics for Site 1

(Total # of respondents = 66)

		# Respondents		Mean	StDev
Age (yrs):		62		41.8	10.4
DW Proficiency:					
(Low)	Refresh Reports	8	12%		
(Medium)	Simple Reports	38	58%		
(High)	Complex Reports	20	30%		
DW Use:					
	Self	45	68%		
	Analyst	4	6%		
	Both	17	26%		
Education Level:					
	High School	6	10%		
	Associate	4	6%		
	Bachelor's	27	41%		
	Master's	22	33%		
	Doctoral	7	10%		
Race:					
	White	61	93%		
	Black	4	6%		
	Hispanic	1	1%		
	Asian				
	Other				
Gender:					
	Female	40	61%		
	Male	26	39%		

Table 4.3 continued

				Mean	StDev
Perceived Organizational Climate for Learning and Innovation					
	Support for Innovation			4.50	1.31
	Resource Supply			3.94	1.26
	Commitment to Learning			5.33	1.07
	Shared Vision			3.93	1.38
Knowledge Acquisition:					
	Focused Search			5.58	0.95
	Scanning			3.99	1.23
Knowledge Analysis and Interpretation:					
	Verification			5.29.	1.05
	Discovery			3.49	1.28
Individual Learning:					
	Mental Model Maintenance			4.81	1.14
	Mental Model Building			4.48	1.32
Knowledge Utilization:					
	Decision-making Impacts			5.02	1.13
	Intentions to Innovate			5.22	1.25
Individual Difference Controls:					
	Personal Innovativeness in IT			5.75	1.14
	Computer Self-efficacy			5.14	1.36
	Prior Related Knowledge				
	Tenure(yrs): Organization			7.58	7.22
	Tenure(yrs): Current Position			3.92	4.14
	Years using Computers			16.85	5.22
	Years using DW			2.24	1.66

Notes:

1. All constructs, except Prior Related Knowledge, are seven-point Likert scales.
2. Mental Model Maintenance, Mental Model Building, and Compute Self-efficacy have anchors 1 = Not at all, 4 = Somewhat, 7 = To a great extent.
3. All other constructs have anchors 1 = Strongly Disagree, 4 = Neutral, 7 = Strongly Agree.

4.6.5 Measurement Model

The measurement model is assessed by loadings, internal consistency, and discriminant validity. PLS was used to validate and refine the chosen scales. It should be noted that PLS is a latent structural equation modeling (SEM) technique that uses a component based approach to estimate loadings of observed items on their expected latent variables, and test causation among a set of dependent and independent constructs, both in the same analysis (Chin, 1998b; Boudreau, Gefen, and Straub, 2001). Hence, in addition to its being used here for scale validation and refinement, it also will be used to test the research hypotheses.

The measurement model consists of first order constructs whereas the structural model consists of second order constructs. First order constructs are variables that are measured directly using their associated items. Second order constructs are comprised of multiple first order constructs, each representing a dimension of the second order constructs. For example, *Support for Innovation* and *Resource Supply* are first order constructs, whereas *Perceived Organizational Climate for Learning* is a second order construct consisting of dimensions: *Support for Innovation, Resource Supply, Commitment to Learning,* and *Shared Vision.* These dimensions are represented in the second order model by their factor scores. In general, first order constructs are used to perform confirmatory factor analysis (CFA) and second order constructs are used to test research hypotheses.

The following procedure was used for scale validation and refinement. First order constructs were modeled in PLS. The (first order) measurement model is depicted in Figure 4.1 and the associated key in Table 4.4. With the exception of *Prior Related Knowledge*, whose

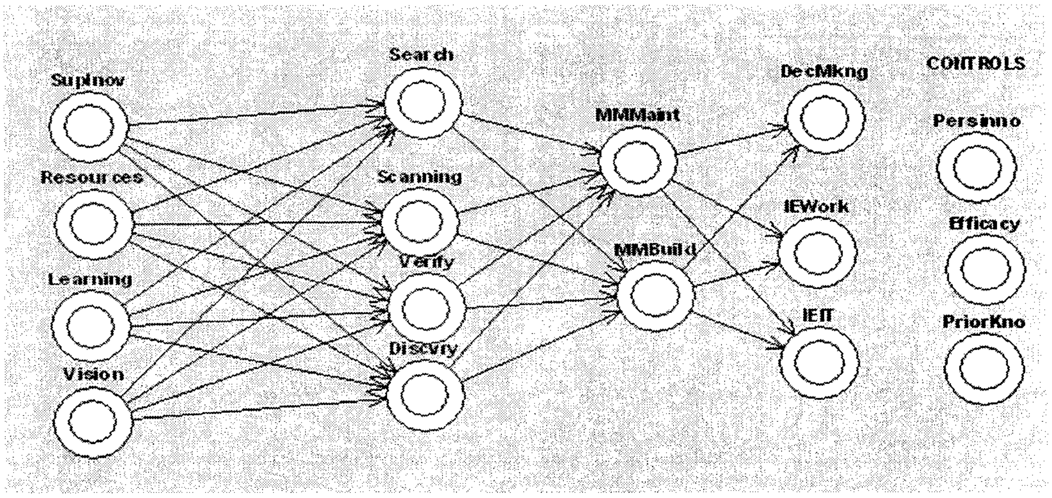


Figure 4.1: Measurement Model

Table 4.4 Measurement Model Key

Construct Symbol	Construct Name
SupInov	Support for Innovation
Resources	Resource Supply
Learning	Commitment to Learning
Vision	Shared vision
Search	Focused Search
Scanning	Scanning
MMMaint	Mental Model Maintenance
MMBuild	Mental Model Building
DecMkng	Decision Making Impacts
IEIT	Intentions to Explore IT
IEWork	Intentions to Explore Work
Persinno	Personal Innovativeness in IT (control variable)
Efficacy	Computer Self Efficacy (control variable)
PriorKno	Prior Related Knowledge (control variable)

indicators are independent and were therefore modeled using formative indicators/items, all other constructs were modeled using reflective indicators.

Formative indicators are used when the construct (or latent variable) is caused by its underlying variables, whereas reflective indicators are manifestations of the construct (Chin 1998b). In short, formative indicators precede the construct and reflective indicators are consequences of the construct.

While PLS does not directly support CFA, there is an established procedure to derive the factor scores (Karahanna, Straub, & Chervany, 2000). First, the measurement model is run and the resulting PLS weights of the indicators are used (by PLS) to create factor scores also known as the latent variable (LV) scores. Next, these LV scores are correlated with all other indicators to calculate loadings and cross loadings. PLS generates the loadings for each LV's own indicators. In order to calculate cross loadings however, a correlation analysis was run in SPSS with all LV scores and all indicators. These steps produced the results shown in Table 4.5. Indicators (or items) appear on the y-axis and latent variables (LVs) appear on the x-axis. It should be noted that interaction terms were not included in the loadings and cross loadings because they are products of other items and their inclusion would violate assumptions about the item's independence (Jonsson, 1998).

4.6.5.1 Loadings

As a rule, item loadings that are greater than .70 are generally considered acceptable (Fornell and Larker, 1981). Although a minimum of 0.70 is ideal, most loadings should be at least 0.60 (Chin, 1998a). Hence, items with loadings exceeding 0.6 were retained. Most scales met this criterion. However, there were some exceptions, and these items are shaded in Table 4.5.

Table 4.5: Initial Item Loadings (Site 1)

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMAINT	MMBUILD	DECMKNG	IEIT	IEWORK	PIIT	CSE
SI1R	**0.78**	0.36	0.43	0.45	-0.07	-0.17	-0.02	-0.05	-0.01	-0.05	0.01	0.01	0.00	-0.27	0.01
SI2	**0.82**	0.59	0.55	0.67	-0.06	-0.18	0.03	0.02	0.09	0.07	0.03	-0.07	-0.07	-0.31	-0.12
SI3R	**0.78**	0.63	0.51	0.58	0.14	-0.04	0.25	0.04	0.18	0.13	0.23	0.13	0.14	-0.11	0.07
SI4R	**0.57**	0.47	0.31	0.29	-0.03	-0.01	0.07	0.08	0.17	0.17	0.08	0.12	0.14	-0.22	-0.05
SI5R	**0.71**	0.28	0.45	0.45	-0.15	-0.13	0.04	-0.07	0.03	-0.02	-0.08	-0.14	-0.18	-0.37	-0.04
SI6R	**0.90**	0.45	0.46	0.67	0.04	-0.27	0.05	-0.17	0.05	-0.10	-0.08	-0.15	-0.11	-0.31	-0.05
SI7R	**0.80**	0.58	0.51	0.61	0.00	-0.04	0.00	-0.03	0.15	0.07	0.06	0.00	0.02	-0.32	-0.15
RS1	0.52	**0.79**	0.51	0.56	-0.07	-0.01	0.07	0.22	0.05	0.12	0.10	0.05	0.05	-0.16	-0.15
RS2	0.43	**0.61**	0.41	0.55	0.19	-0.07	0.13	-0.06	0.16	-0.01	0.12	0.07	0.07	-0.09	0.10
RS3	0.40	**0.87**	0.26	0.44	0.11	0.13	0.03	0.14	0.20	0.15	0.20	0.11	0.10	-0.09	0.12
RS4	0.46	**0.89**	0.30	0.37	0.06	0.06	0.08	0.16	0.13	0.15	0.26	0.17	0.18	-0.10	0.05
CL1	0.33	0.21	**0.85**	0.38	0.28	0.21	0.13	0.05	0.02	0.22	0.17	0.07	0.01	-0.11	0.11
CL2	0.46	0.32	**0.83**	0.41	0.19	0.03	0.16	-0.01	0.07	0.13	0.07	-0.05	-0.05	-0.25	-0.02
CL3	0.63	0.44	**0.76**	0.61	0.08	0.05	-0.01	-0.04	0.01	0.09	0.06	-0.13	-0.15	-0.26	-0.13
CL4	0.58	0.49	**0.68**	0.57	0.09	0.04	0.18	-0.04	0.02	0.10	0.18	0.08	0.11	-0.10	0.11
CL5	0.21	0.22	**0.24**	0.30	-0.03	-0.07	-0.05	-0.07	-0.09	0.04	0.15	0.03	0.06	0.02	-0.31
CL6	0.56	0.57	**0.60**	0.62	-0.03	0.05	0.01	0.14	0.14	0.17	0.00	0.01	0.01	-0.27	-0.06
CL7	0.62	0.49	**0.62**	0.72	0.07	-0.15	0.15	-0.01	0.31	0.11	0.04	-0.11	-0.10	-0.36	-0.02
SV1	0.69	0.48	0.52	**0.94**	-0.07	-0.34	-0.11	-0.24	0.13	-0.06	-0.20	-0.27	-0.23	-0.35	-0.10
SV2	0.57	0.49	0.52	**0.81**	-0.09	-0.25	-0.13	0.00	0.07	-0.07	-0.02	-0.23	-0.18	-0.34	-0.21
SV3	0.60	0.44	0.53	**0.91**	-0.06	-0.35	-0.01	-0.20	0.09	0.07	-0.04	-0.11	-0.04	-0.23	-0.08
SV4	0.65	0.53	0.52	**0.86**	-0.04	-0.19	-0.03	-0.09	0.18	0.08	-0.05	-0.22	-0.21	-0.44	-0.16

Table 4.5 continued

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMAINT	MMBUILD	DECMKNG	IEIT	IEWORK	PIIT	CSE
FS1	-0.22	-0.05	-0.09	-0.18	**0.67**	0.12	0.35	0.04	0.16	0.09	0.38	0.37	0.30	0.33	0.47
FS2	-0.13	-0.27	0.06	-0.16	**0.66**	0.24	0.50	0.04	0.20	0.05	0.33	0.29	0.26	0.37	0.55
FS3	0.10	0.16	0.29	0.06	**0.79**	0.13	0.49	0.04	0.28	0.36	0.37	0.16	0.16	0.13	0.31
FS4	-0.04	0.16	0.30	0.03	**0.60**	0.17	0.25	0.05	0.13	0.03	0.18	0.04	0.06	0.03	0.09
FS5	-0.03	-0.06	0.10	-0.16	**0.75**	0.30	0.47	-0.03	0.15	0.13	0.38	0.31	0.29	0.36	0.58
SC1	-0.11	0.16	0.15	-0.24	0.21	**0.82**	0.29	0.63	0.10	0.21	0.23	0.25	0.19	0.14	0.14
SC2	-0.29	0.00	0.02	-0.31	0.21	**0.84**	0.36	0.50	0.23	0.16	0.19	0.31	0.28	0.31	0.25
SC3	0.00	0.16	0.17	-0.17	0.15	**0.72**	0.36	0.36	0.11	0.26	0.26	0.44	0.35	0.28	0.38
SC4	-0.30	-0.08	0.04	-0.33	0.26	**0.77**	0.30	0.26	0.18	0.27	0.41	0.32	0.33	0.39	0.32
VER1	-0.08	-0.01	0.09	-0.13	0.56	0.21	**0.79**	0.33	0.38	0.33	0.36	0.07	0.11	0.20	0.45
VER2	0.21	0.20	0.17	0.11	0.38	0.35	**0.61**	0.15	0.20	0.23	0.27	0.36	0.37	0.27	0.42
VER3	-0.01	-0.08	0.13	-0.14	0.57	0.19	**0.67**	0.06	0.12	0.09	0.33	0.44	0.45	0.52	0.41
VER4	0.06	0.08	0.16	-0.05	0.22	0.42	**0.74**	0.45	0.27	0.29	0.26	0.42	0.34	0.27	0.38
DISC1	-0.17	0.05	-0.11	-0.17	-0.01	0.44	0.24	**0.74**	0.22	0.04	0.05	0.20	0.16	0.16	0.22
DISC2	-0.19	0.02	-0.12	-0.27	0.06	0.44	0.30	**0.80**	0.16	0.07	-0.02	0.10	0.07	0.05	0.19
DISC3	0.02	0.13	0.10	-0.06	0.02	0.45	0.35	**0.74**	0.00	0.16	0.08	0.10	0.08	0.09	0.20
DISC4	0.00	0.29	-0.02	-0.13	-0.07	0.30	0.13	**0.76**	0.08	0.11	0.17	0.09	0.10	-0.02	-0.02
DISC5	-0.03	0.23	0.15	-0.07	0.14	0.51	0.46	**0.80**	0.15	0.32	0.17	0.10	0.08	0.04	0.13
MMM1	0.04	0.10	0.04	0.10	0.26	0.15	0.27	0.06	**0.95**	0.54	0.37	0.10	0.16	0.05	0.26
MMM2	0.07	0.13	0.08	0.14	0.24	0.16	0.37	0.24	**0.87**	0.66	0.42	0.11	0.14	0.03	0.31
MMM3	0.03	0.13	0.07	0.09	0.26	0.19	0.27	0.04	**0.93**	0.53	0.45	0.22	0.30	0.14	0.23
MMM4	0.09	0.19	0.13	0.13	0.28	0.22	0.46	0.25	**0.95**	0.62	0.41	0.13	0.17	0.06	0.29

Table 4.5 continued

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMAINT	MMBUILD	DECMKNG	IEIT	IEWORK	PIIT	CSE
MMB1	-0.15	0.17	0.10	-0.06	0.17	0.20	0.30	0.20	0.57	**0.86**	0.37	0.12	0.18	0.08	0.26
MMB2	-0.11	0.17	0.11	-0.06	0.15	0.30	0.27	0.23	0.52	**0.94**	0.49	0.24	0.29	0.11	0.22
MMB3	0.18	0.13	0.31	0.12	0.33	0.22	0.39	0.08	0.60	**0.79**	0.54	0.26	0.26	0.05	0.22
MMB4	-0.08	0.14	0.13	-0.03	0.10	0.28	0.27	0.22	0.53	**0.93**	0.35	0.11	0.14	0.01	0.22
DM1	-0.05	0.10	0.23	-0.10	0.48	0.32	0.38	0.07	0.45	0.60	**0.85**	0.41	0.43	0.31	0.37
DM2	-0.03	0.23	0.05	-0.11	0.29	0.27	0.36	0.09	0.43	0.44	**0.87**	0.45	0.49	0.38	0.29
DM3	0.10	0.26	0.13	-0.02	0.22	0.18	0.27	0.10	0.36	0.41	**0.85**	0.38	0.43	0.35	0.18
DM4	0.00	0.17	0.07	-0.03	0.48	0.21	0.32	0.01	0.28	0.23	**0.79**	0.35	0.38	0.44	0.38
DM5	-0.10	0.17	0.14	-0.16	0.48	0.45	0.44	0.26	0.36	0.45	**0.88**	0.66	0.67	0.53	0.39
IEI1	-0.16	0.10	-0.02	-0.26	0.32	0.41	0.32	0.10	0.01	0.14	0.54	**0.90**	0.88	0.62	0.30
IEI2	-0.07	0.11	0.01	-0.23	0.23	0.36	0.38	0.11	0.18	0.21	0.53	**0.94**	0.92	0.60	0.38
IEI3	-0.02	0.14	0.04	-0.10	0.23	0.32	0.39	0.20	0.25	0.27	0.34	**0.82**	0.74	0.42	0.38
IEW1	-0.01	0.15	-0.03	-0.12	0.16	0.31	0.37	0.13	0.26	0.23	0.53	0.91	**0.93**	0.56	0.35
IEW2	-0.20	0.05	-0.06	-0.22	0.32	0.33	0.32	0.05	0.13	0.26	0.51	0.81	**0.89**	0.66	0.19
IEW3	-0.04	0.18	0.07	-0.14	0.27	0.35	0.41	0.17	0.19	0.22	0.55	0.92	**0.94**	0.56	0.35
PIIT1	-0.30	-0.07	-0.17	-0.30	0.24	0.37	0.41	0.11	0.03	0.08	0.38	0.61	0.65	**0.90**	0.42
PIIT2	-0.28	-0.15	-0.19	-0.27	0.39	0.21	0.38	0.02	0.14	0.06	0.46	0.48	0.51	**0.84**	0.33
PIIT3	-0.42	-0.11	-0.23	-0.32	0.14	0.34	0.28	0.18	0.03	0.13	0.34	0.45	0.48	**0.83**	0.29
PIIT4R	-0.29	-0.14	-0.21	-0.35	0.26	0.29	0.30	-0.06	0.06	-0.01	0.44	0.57	0.56	**0.84**	0.26
CSE1	-0.08	0.00	0.08	-0.18	0.53	0.30	0.53	0.14	0.23	0.18	0.37	0.38	0.31	0.38	**0.93**
CSE2	0.04	0.04	0.18	-0.02	0.37	0.37	0.52	0.22	0.35	0.37	0.33	0.30	0.24	0.27	**0.83**
CSE3	-0.11	-0.03	0.02	-0.16	0.49	0.25	0.51	0.10	0.23	0.18	0.31	0.37	0.29	0.38	**0.92**

Table 4.6 Final Item Loadings (Site 1)

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMAINT	MMBUILD	DECMKNG	IEWORK	PIIT	CSE
SI1R	**0.78**	0.36	0.42	0.45	-0.07	-0.17	-0.02	-0.05	-0.01	-0.05	0.01	0.01	-0.27	0.02
SI2	**0.82**	0.59	0.50	0.67	-0.05	-0.19	0.03	0.02	0.09	0.07	0.03	-0.07	-0.31	-0.12
SI3R	**0.79**	0.63	0.49	0.58	0.14	-0.04	0.25	0.04	0.18	0.13	0.23	0.14	-0.11	0.07
SI4R	**0.58**	0.47	0.27	0.29	-0.03	-0.01	0.08	0.08	0.17	0.17	0.08	0.13	-0.22	-0.05
SI5R	**0.71**	0.29	0.42	0.45	-0.15	-0.13	0.05	-0.07	0.03	-0.02	-0.08	-0.16	-0.37	-0.04
SI6R	**0.90**	0.45	0.44	0.67	0.04	-0.27	0.05	-0.17	0.05	-0.09	-0.08	-0.13	-0.31	-0.05
SI7R	**0.80**	0.57	0.49	0.61	0.01	-0.05	0.00	-0.03	0.15	0.07	0.06	0.01	-0.32	-0.14
RS1	0.52	**0.78**	0.51	0.56	-0.06	-0.01	0.07	0.22	0.05	0.13	0.11	0.05	-0.16	-0.15
RS2	0.43	**0.65**	0.39	0.55	0.19	-0.07	0.13	-0.06	0.16	-0.01	0.12	0.07	-0.09	0.10
RS3	0.40	**0.88**	0.24	0.44	0.12	0.13	0.03	0.14	0.20	0.15	0.20	0.11	-0.09	0.12
RS4	0.47	**0.89**	0.27	0.37	0.07	0.06	0.08	0.16	0.13	0.15	0.26	0.18	-0.10	0.05
CL1	0.33	0.21	**0.87**	0.38	0.28	0.21	0.13	0.05	0.02	0.22	0.17	0.04	-0.11	0.12
CL2	0.46	0.32	**0.82**	0.41	0.19	0.03	0.15	-0.02	0.07	0.13	0.07	-0.05	-0.25	-0.02
CL3	0.63	0.44	**0.77**	0.61	0.09	0.04	0.00	-0.04	0.01	0.09	0.06	-0.14	-0.26	-0.13
CL4	0.58	0.50	**0.69**	0.57	0.10	0.04	0.19	-0.04	0.02	0.10	0.18	0.10	-0.10	0.11
SV1	0.69	0.49	0.48	**0.94**	-0.07	-0.34	-0.11	-0.25	0.13	-0.06	-0.20	-0.25	-0.35	-0.10
SV2	0.57	0.50	0.51	**0.81**	-0.09	-0.25	-0.13	0.00	0.07	-0.07	-0.02	-0.21	-0.34	-0.21
SV3	0.60	0.44	0.51	**0.91**	-0.06	-0.35	-0.01	-0.20	0.09	0.07	-0.04	-0.07	-0.23	-0.08
SV4	0.65	0.53	0.47	**0.86**	-0.03	-0.19	-0.03	-0.09	0.18	0.08	-0.05	-0.21	-0.44	-0.15
FS1	-0.22	-0.04	-0.10	-0.18	**0.67**	0.12	0.35	0.04	0.16	0.09	0.38	0.34	0.33	0.47
FS2	-0.13	-0.25	0.04	-0.16	**0.64**	0.24	0.50	0.04	0.20	0.05	0.33	0.28	0.37	0.55
FS3	0.10	0.16	0.29	0.06	**0.80**	0.13	0.49	0.04	0.28	0.36	0.37	0.16	0.13	0.31
FS4	-0.04	0.17	0.30	0.03	**0.61**	0.17	0.25	0.05	0.13	0.03	0.18	0.05	0.04	0.09
FS5	-0.03	-0.04	0.11	-0.16	**0.74**	0.31	0.47	-0.03	0.15	0.13	0.38	0.30	0.36	0.58

Table 4.6 continued

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMAINT	MMBUILD	DECMKNG	IEWORK	PIIT	CSE
SC1	-0.11	0.15	0.16	-0.24	0.21	**0.82**	0.29	0.63	0.10	0.21	0.23	0.22	0.14	0.14
SC2	-0.29	0.00	0.03	-0.31	0.21	**0.84**	0.36	0.50	0.23	0.16	0.19	0.29	0.31	0.26
SC3	0.00	0.16	0.17	-0.17	0.15	**0.72**	0.36	0.35	0.11	0.26	0.26	0.40	0.28	0.38
SC4	-0.29	-0.08	0.07	-0.33	0.26	**0.78**	0.30	0.26	0.18	0.27	0.41	0.33	0.39	0.32
VER1	-0.07	-0.01	0.07	-0.13	0.57	0.21	**0.79**	0.33	0.39	0.33	0.36	0.09	0.20	0.45
VER2	0.21	0.22	0.16	0.11	0.38	0.35	**0.62**	0.15	0.20	0.23	0.27	0.37	0.27	0.43
VER3	-0.01	-0.07	0.13	-0.14	0.56	0.20	**0.66**	0.06	0.12	0.09	0.33	0.45	0.52	0.41
VER4	0.06	0.08	0.15	-0.05	0.21	0.42	**0.74**	0.44	0.27	0.29	0.26	0.38	0.27	0.38
DISC1	-0.17	0.04	-0.12	-0.17	-0.01	0.44	0.24	**0.74**	0.22	0.04	0.05	0.18	0.15	0.22
DISC2	-0.19	0.02	-0.13	-0.27	0.05	0.44	0.30	**0.80**	0.17	0.07	-0.02	0.09	0.05	0.19
DISC3	0.03	0.11	0.10	-0.06	0.01	0.45	0.35	**0.74**	0.00	0.16	0.08	0.09	0.09	0.20
DISC4	0.00	0.28	-0.02	-0.13	-0.07	0.30	0.13	**0.77**	0.08	0.10	0.17	0.09	-0.02	-0.02
DISC5	-0.02	0.22	0.15	-0.07	0.14	0.51	0.46	**0.79**	0.15	0.32	0.17	0.09	0.04	0.13
MMM1	0.04	0.11	-0.01	0.10	0.25	0.15	0.27	0.06	**0.95**	0.54	0.37	0.14	0.05	0.27
MMM2	0.07	0.14	0.05	0.14	0.24	0.16	0.37	0.25	**0.87**	0.66	0.42	0.13	0.03	0.31
MMM3	0.03	0.13	0.04	0.09	0.25	0.19	0.28	0.04	**0.93**	0.53	0.45	0.27	0.14	0.23
MMM4	0.09	0.20	0.07	0.13	0.28	0.22	0.46	0.25	**0.95**	0.62	0.41	0.15	0.06	0.29
MMB1	-0.15	0.16	0.09	-0.06	0.17	0.20	0.29	0.19	0.57	**0.86**	0.37	0.15	0.08	0.26
MMB2	-0.11	0.16	0.12	-0.06	0.15	0.30	0.27	0.23	0.52	**0.93**	0.49	0.27	0.10	0.22
MMB3	0.18	0.13	0.30	0.12	0.34	0.22	0.39	0.08	0.60	**0.80**	0.54	0.26	0.05	0.23
MMB4	-0.08	0.14	0.13	-0.03	0.11	0.28	0.27	0.22	0.53	**0.93**	0.35	0.13	0.01	0.22

Table 4.6 continued

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMAINT	MMBUILD	DECMKNG	IEWORK	PIIT	CSE
DM1	-0.05	0.11	0.24	-0.10	0.48	0.32	0.38	0.07	0.45	0.60	**0.85**	0.43	0.31	0.37
DM2	-0.03	0.23	0.05	-0.11	0.29	0.27	0.36	0.09	0.43	0.44	**0.87**	0.47	0.38	0.29
DM3	0.11	0.26	0.13	-0.02	0.22	0.18	0.27	0.10	0.36	0.41	**0.86**	0.41	0.35	0.18
DM4	0.01	0.18	0.10	-0.03	0.48	0.21	0.32	0.01	0.28	0.23	**0.79**	0.37	0.44	0.38
DM5	-0.10	0.17	0.17	-0.16	0.48	0.45	0.44	0.26	0.36	0.45	**0.88**	0.68	0.53	0.39
IEI1	-0.15	0.10	0.01	-0.26	0.32	0.41	0.32	0.10	0.01	0.14	0.54	**0.89**	0.62	0.30
IEI2	-0.07	0.11	0.03	-0.23	0.23	0.36	0.38	0.11	0.18	0.21	0.53	**0.94**	0.60	0.38
IEI3	-0.02	0.15	0.03	-0.10	0.22	0.32	0.39	0.20	0.25	0.27	0.34	**0.79**	0.42	0.38
IEW1	0.00	0.16	-0.04	-0.12	0.16	0.31	0.37	0.13	0.26	0.23	0.53	**0.93**	0.56	0.35
IEW2	-0.20	0.04	-0.03	-0.22	0.32	0.33	0.32	0.05	0.13	0.26	0.51	**0.86**	0.66	0.19
IEW3	-0.04	0.18	0.08	-0.14	0.27	0.35	0.41	0.17	0.19	0.22	0.55	**0.94**	0.56	0.35
PIIT1	-0.30	-0.07	-0.14	-0.30	0.24	0.37	0.41	0.11	0.03	0.08	0.38	0.64	**0.90**	0.43
PIIT2	-0.27	-0.15	-0.17	-0.27	0.38	0.21	0.37	0.02	0.14	0.06	0.46	0.50	**0.84**	0.33
PIIT3	-0.42	-0.12	-0.20	-0.32	0.13	0.34	0.27	0.18	0.03	0.13	0.34	0.47	**0.83**	0.29
PIIT4R	-0.29	-0.14	-0.17	-0.35	0.26	0.29	0.30	-0.06	0.06	-0.01	0.44	0.57	**0.84**	0.26
CSE1	-0.08	0.02	0.05	-0.18	0.52	0.30	0.53	0.14	0.23	0.18	0.37	0.35	0.38	**0.93**
CSE2	0.04	0.04	0.15	-0.02	0.37	0.37	0.52	0.22	0.35	0.37	0.33	0.28	0.27	**0.83**
CSE3	-0.10	-0.02	-0.01	-0.16	0.48	0.25	0.51	0.10	0.23	0.18	0.31	0.34	0.38	**0.92**

First, *Commitment to Learning* had three items (CL5, CL6, and CL7) that loaded poorly and/or cross-loaded.

CL5: This organization provides opportunities for professional development such as training, workshops, and seminars.

CL6: This organization provides opportunities for individual development other than formal training, such as team activities and experimentation.

CL7: In this organization, there is a commitment to sharing knowledge.

Having reviewed the wording for these items, one can understand their ambiguity within the context of an educational institution. Follow up interviews with end-users further revealed that they did not clearly make the distinction between the academic mission of the (educational) organization which is learning, and managerial support for employee learning. The feedback suggested that the spurious results from this scale could possibly be due to the site and not necessarily the scale but this potential explanation remained to be validated in the next round of data collection. These three items were subsequently dropped. Next, the items for *Intentions to Explore Work* and *Intentions to Explore IT* had their highest loadings on their respective LVs. However they cross loaded on each other, thereby leading to the decision to combine them as a single LV named *Intentions to Explore Work.*

After making these adjustments, the measurement model was re-run and the final loadings are shown in Table 4.6. All items loaded on their hypothesized constructs. Table 4.7 lists item loadings and weights. The majority were significant with the exception of three *Prior Related Knowledge* variables: years with organization (YrsEmp), years in current job (YrsWork) and years of computer use (YrsComp).

Table 4.7 Item Loadings and Weights (Site 1)

	Loadings	Weights	T-Statistic	p-value	Significance
SupInov :					
SI1R	0.7789		4.3572	0.00	***
SI2	0.8239		5.3151	0.00	***
SI3R	0.7867		3.2325	0.00	***
SI4R	0.5751		2.2519	0.01	***
SI5R	0.7067		3.6676	0.00	***
SI6R	0.9037		6.0796	0.00	***
SI7R	0.8020		5.0854	0.00	***
Resource:					
RS1	0.7813		4.9046	0.00	***
RS2	0.6496		3.0893	0.00	***
RS3	0.8777		8.4739	0.00	***
RS4	0.8907		8.5027	0.00	***
Learning:					
CL1	0.8725		10.4923	0.00	***
CL2	0.8209		7.6407	0.00	***
CL3	0.7698		4.2930	0.00	***
CL4	0.6875		3.5476	0.00	***
Vision :					
SV1	0.9422		51.4055	0.00	***
SV2	0.8144		13.7385	0.00	***
SV3	0.9087		21.7261	0.00	***
SV4	0.8587		20.3371	0.00	***
Search :					
FS1	0.6673		3.6725	0.00	***
FS2	0.6423		2.4320	0.01	***
FS3	0.8034		3.3647	0.00	***
FS4	0.6104		2.1763	0.02	**
FS5	0.7385		3.6208	0.00	***
Scanning:					
SC4	0.7773		13.0385	0.00	***
SC2	0.8390		18.5907	0.00	***
SC1	0.8159		12.5243	0.00	***
SC3	0.7189		9.0986	0.00	***
Verify :					
VER3	0.6631		3.0824	0.00	***
VER2	0.6155		2.1768	0.02	**
VER1	0.7902		4.5022	0.00	***
VER4	0.7412		5.2294	0.00	***

Table 4.7 continued

	Loadings	Weights	T-Statistic	p-value	Significance
Discvry :					
DISC1	0.7450		5.9044	0.00	***
DISC3	0.7385		2.9463	0.00	***
DISC5	0.7917		2.8024	0.00	***
DISC2	0.8048		6.8685	0.00	***
DISC4	0.7653		4.5338	0.00	***
MMMaint :					
MMM2	0.8725		19.4644	0.00	***
MMM4	0.9454		48.9594	0.00	***
MMM1	0.9543		58.2391	0.00	***
MMM3	0.9275		37.6084	0.00	***
MMBuild :					
MMB3	0.7973		10.3337	0.00	***
MMB4	0.9341		35.7003	0.00	***
MMB2	0.9345		31.4676	0.00	***
MMB1	0.8572		13.9696	0.00	***
DecMkng :					
DM4	0.7855		8.2758	0.00	***
DM1	0.8465		18.4214	0.00	***
DM2	0.8699		18.7976	0.00	***
DM5	0.8822		17.0576	0.00	***
DM3	0.8555		12.5403	0.00	***
IEWork :					
IEI1	0.8946		32.7543	0.00	***
IEI2	0.9388		36.2589	0.00	***
IEI3	0.7922		13.3010	0.00	***
IEW1	0.9334		41.4337	0.00	***
IEW2	0.8589		17.8768	0.00	***
IEW3	0.9396		38.7704	0.00	***
PIIT :					
PIIT1	0.9021		49.7481	0.00	***
PIIT2	0.8433		7.4017	0.00	***
PIIT3	0.8305		20.1579	0.00	***
PIIT4R	0.8396		13.9626	0.00	***
CSE :					
CSE1	0.9260		41.1384	0.00	***
CSE2	0.8288		15.7914	0.00	***
CSE3	0.9224		34.2937	0.00	***

Table 4.7 continued

	Loadings	Weights	T-Statistic	p-value	Significance
PriorKno:					
YrsWork		-0.2707	-0.5533	0.29	NS
YrsEmp		0.5251	0.9567	0.17	NS
YrsComp		0.2055	0.4557	0.33	NS
YrsDW		-0.9584	-3.3108	0.00	***

*** significant at 0.01
** significant at 0.05
* significant at 0.10

4.6.5.2 Internal Consistency

The next step was to assess internal consistency using composite reliabilities. Again the rule specifies .70 as the acceptable minimum (Fornell and Larker, 1981). All constructs met this criterion as shown in Table 4.8. Composite reliabilities are not applicable to LVs with formative indicators, (Chin, 1998b) therefore *Prior Related Knowledge* was not included in the reliability analysis.

4.6.5.3 Discriminant Validity

The final step in the scale validation process is to assess discriminant validity. According to Chin (1998b), discriminant validity is satisfied when the following requirements are met. First, indicators should load more strongly on their corresponding construct that on other constructs. Second, the square root of the average variance extracted (AVE) should be larger than the inter-construct correlations. As can be seen from Tables 4.6 and 4.8 both criteria for discriminant validity were satisfied for all constructs.

4.6.6 Pilot Study Summation

The preceding discussion described the steps taken to pilot the survey instrument. With the exception of three deviant *Commitment to Learning* items that loaded poorly and/or cross loaded, most items exhibited high loadings (>=.70) on their respective constructs/LVs. All constructs produced good composite reliability scores and exhibited discriminant validity.

Table 4.8 Correlation of Constructs (Site 1)

CONSTRUCTS		Composite Reliability	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SupInov	(1)	**0.91**	0.77													
Resource	(2)	**0.88**	0.55	0.81												
CommitLrn	(3)	**0.87**	0.55	0.40	0.79											
Vision	(4)	**0.93**	0.71	0.54	0.55	0.88										
Search	(5)	**0.82**	-0.04	0.06	0.25	-0.07	0.70									
Scanning	(6)	**0.87**	-0.22	0.07	0.13	-0.34	0.27	0.79								
Verify	(7)	**0.80**	0.05	0.07	0.17	-0.08	0.59	0.41	0.71							
Discvry	(8)	**0.88**	-0.09	0.20	0.00	-0.18	0.04	0.55	0.39	0.77						
MMMaint	(9)	**0.96**	0.07	0.16	0.04	0.13	0.28	0.20	0.38	0.17	0.93					
MMBuild	(10)	**0.96**	-0.03	0.17	0.20	0.00	0.23	0.28	0.36	0.20	0.64	0.93				
DecMkng	(11)	**0.93**	-0.02	0.22	0.17	-0.10	0.46	0.35	0.42	0.13	0.45	0.51	0.85			
IEWork	(12)	**0.96**	-0.09	0.14	0.01	-0.20	0.28	0.39	0.41	0.14	0.19	0.24	0.56	0.89		
PIIT	(13)	**0.92**	-0.37	-0.14	-0.20	-0.36	0.30	0.36	0.40	0.06	0.08	0.07	0.48	0.64	0.85	
CSE	(14)	**0.92**	-0.06	0.01	0.07	-0.14	0.52	0.34	0.58	0.17	0.30	0.26	0.38	0.36	0.39	0.89

Note:

Composite Reliability = $\rho_c = (\Sigma\lambda_i)^2/[(\Sigma\lambda_i)^2+\Sigma_i var(\varepsilon_i)]$, where λ_i is the component loading to an indicator and $var(\varepsilon_i) = 1- \Sigma\lambda_i^2$

Diagonal elements in the 'correlation of constructs' matrix are the square root of the average variance extracted. For adequate discriminant validity, diagonal elements should be greater than corresponding off-diagonal elements.

4.7 Chapter Summary

This chapter has outlined the methodology that was used to test the research model and hypotheses developed in Chapter Three. The results of the pre-test and pilot were also presented. The discussion began with descriptions of the research design, methods of data collection and analysis, as well as scale development. Next, issues relating to construct validity were addressed. Following that, preliminary results from the pre-test were discussed, and the chapter concluded with details and results of the pilot. The following chapter presents data analysis of the structural model and the subsequent testing of the research hypotheses.

CHAPTER 5

DATA ANALYSIS

5.1 Introduction

The purpose of this chapter is to report on the data collection and analysis used to test the research hypotheses presented in Chapter Three. The second section provides an overview of the research context and data collection. The third section discusses response rate and descriptive statistics of the sample. The fourth section replicates the measurement model validation undertaken in the pilot and provides the results of the confirmatory factor analysis, as well as discriminant validity and reliability statistics of the new sample. In the fifth and final section, the research hypotheses are tested through a PLS structural model and results are summarized.

5.2 Research Context and Data Collection

Selection for the second site was based on the same two criteria as the first but with an additional constraint – Site 2 had to have the same KMT as Site 1 so that there would be consistency. Once again, advisors and colleagues were instrumental is securing participation.

Site 2 was a large state organization in the Midwest U.S. that had implemented a data warehouse approximately four years prior to the study being conducted. Like site 1, the site 2 sample was comprised of a cross-section of administrative staff that used the COGNOS suite of applications, including Powerplay and Visualizer, to extract, analyze, and present information generated form the data warehouse. An IT manager at the organization was instrumental in selecting appropriate participants for the study resulting in 200 employees being selected to participate.

As was the case with Site 1, the study at Site 2 was endorsed by the senior managers in the organization and the call was issued by an IT manager known to the user population. The survey was administered online in a similar fashion at:

http://www.kelley.iupui.edu/kargraha/fssasurvey

Appendix E[1] contains the actual HTML version of the survey.

Once the survey was underway, three reminders were sent intermittently over a period of four weeks. As was done for site 1, responses were inspected for missing values. Of the 50 surveys submitted, three were discarded because the majority of the items were unanswered. Of the remaining 47 surveys, missing values were replaced with the mean values for that item as is consistent with research protocol (Tabachnick and Fidell, 1996).

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[1] The Web-based surveys for Site 1 and Site 2 (Appendices D and E respectively) used the same items per construct. However, reference to the technology was based on the term that end-users were most familiar with. The Site 1 survey made reference to the data warehouse (DW) and the Site 2 survey made reference to COGNOS. Each survey also contained additional measures that were of interest to each organization e.g., perceptions of data quality, business value, and ease of use. These additional measures were not included in the research model.

5.3 Sample Statistics and Response Rate

Table 5.1 provides a summary of the response rate for site 2. Of the 200 people asked to participate 50 survey responses were submitted.

Table 5.1: Response Rate for Site 2

Number invited to participate	200
Number of survey submitted	50
Number of usable surveys	47
Response Rate	23.5%

Of those surveys submitted, 47 were usable representing a response rate of 23.5%. Sample statistics are shown in Table 5.2. The average age of respondents was 48.1 years with a standard deviation (SD) of 9.4 years. On average, respondents had been with the organization for 16.8 years (SD = 10.1), in their current job for 6.1 years (SD = 5.9), had been using a computer for 21.0 years (SD = 5.8), and the DW for 0.83 years (SD = 0.72). The majority of those who reported race, gender, and education were white (85%), female (49%), and had at least a Bachelor's degree (67%). Most used the warehouse on their own (68%) however 2% relied on analysts and 21% relied on both themselves and analysts. Eight percent reported being highly proficient in using the DW, meaning they were able to generate complex reports on their own, whereas 28% felt they were able to generate simple reports (medium proficiency). Twenty eight percent reported being only able to refresh existing reports (low proficiency).

Table 5.2: Descriptive Statistics for Site 2

(Total # of respondents = 47)

		# Respondents		Mean	StDev
Age (yrs):		41		48.1	9.4
DW Proficiency:					
(Low)	Refresh Reports	13	28%		
(Medium)	Simple Reports	13	28%		
(High)	Complex Reports	4	8%		
	Not reported	17	36%		
DW Use:					
	Self	32	68%		
	Analyst	1	2%		
	Both	10	21%		
	Not reported	4	9%		
Education Level:					
	High School	3	6%		
	Associate	4	8%		
	Bachelor's	24	52%		
	Master's	7	15%		
	Doctoral				
	Not reported	9	19%		
Race:					
	White	40	85%		
	Black	1	2%		
	Hispanic				
	Asian				
	Other	2	4%		
	Not reported	4	9%		
Gender:					
	Female	23	49%		
	Male	19	40%		
	Not reported	5	11%		

Table 5.2 continued

			Mean	StDev
Perceived Organizational Climate for Learning and Innovation				
	Support for Innovation		4.08	1.22
	Resource Supply		3.36	1.12
	Commitment to Learning		4.02	1.43
	Shared Vision		3.39	1.29
Knowledge Acquisition:				
	Focused Search		4.91	1.59
	Scanning		3.70	1.38
Knowledge Analysis and Interpretation:				
	Verification		4.07	1.47
	Discovery		3.18	1.34
Individual Learning:				
	Mental Model Maintenance		4.14	1.45
	Mental Model Building		4.08	1.44
Knowledge Utilization:				
	Decision-making Impacts		4.10	1.31
	Intentions to Innovate		4.54	1.09
Individual Difference Controls:				
	Personal Innovativeness in IT		4.98	1.32
	Computer Self-efficacy		4.45	1.40
	Prior Related Knowledge			
	Tenure(yrs): Organization		16.83	10.13
	Tenure(yrs): Current Position		6.13	5.87
	Years using Computers		14.02	5.84
	Years using DW		0.83	0.72

Notes:

4. All constructs, except Prior Related Knowledge, are seven-point Likert scales.
5. Mental Model Maintenance, Mental Model Building, and Compute Self-efficacy have anchors 1 = Not at all, 4 = Somewhat, 7 = To a great extent.
6. All other constructs have anchors 1 = Strongly Disagree, 4 = Neutral, 7 = Strongly Agree.

In order to assess non-response bias, T-tests were done on latent variable scores comparing surveys that were submitted before reminders were sent with those that were submitted afterwards. Eight of the 47 usable surveys were submitted post-reminder. There were no statistically significant differences between pre and post reminder scores. All p-values exceeded 0.06.

5.4 Measurement Model

5.4.1 Measurement Model – Site 2

Data for site 2 was modeled in PLS using the revised measurement model from study 1. A confirmatory factor analysis (CFA) was undertaken following the same steps as outlined in the pilot. Results are reported below.

5.4.1.1 Loadings

Initial item loadings for site 2 are shown in Table 5.3. In general, loadings were consistent with those of Site 1. However, there were some notable differences. First, an item in the *Support for Innovation* scale loaded poorly at 0.42 (SI1R) and two others cross-loaded (SI2 and SI3R). These items were dropped from subsequent analyses.

Second, *Mental Model Maintenance* and *Mental Model Building* items cross loaded on each other, thereby leading to the decision to combine them as one construct for hypothesis testing.

Table 5.3 Initial Item Loadings (Site 2)

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMAINT	MMBUILD	DECMKNG	IEWORK	PIIT	CSE
SI1R	**0.42**	0.13	0.36	0.27	-0.14	0.10	-0.17	-0.08	0.01	-0.08	0.17	0.24	0.20	0.01
SI2	**0.49**	0.40	**0.52**	0.42	0.13	0.28	-0.06	-0.07	0.11	0.06	0.06	0.35	0.21	0.02
SI3R	**0.62**	0.56	**0.63**	0.51	0.00	0.08	-0.12	-0.09	-0.15	-0.16	-0.10	0.23	0.03	-0.01
SI4R	**0.58**	0.38	0.43	0.40	-0.04	0.10	-0.18	-0.06	0.00	0.05	-0.11	0.19	-0.02	-0.21
SI5R	**0.91**	0.55	0.64	0.48	-0.12	-0.16	-0.42	-0.53	-0.05	-0.06	-0.10	-0.01	-0.17	-0.17
SI6R	**0.61**	0.40	0.38	0.37	0.20	0.07	0.04	-0.15	0.00	-0.07	-0.05	0.10	-0.04	0.01
SI7R	**0.79**	0.32	0.56	0.45	-0.02	-0.04	-0.22	-0.17	-0.17	-0.15	-0.17	-0.01	-0.21	-0.06
RS1	0.45	**0.85**	0.67	0.51	-0.19	0.15	-0.35	-0.19	0.03	-0.04	-0.01	0.21	0.02	-0.17
RS2	0.62	**0.79**	0.60	0.61	-0.14	-0.01	-0.28	-0.17	-0.05	-0.04	-0.07	0.01	-0.14	-0.03
RS3	0.34	**0.71**	0.46	0.48	-0.06	0.12	-0.04	-0.06	0.06	0.11	0.08	0.15	0.11	0.11
RS4	0.38	**0.83**	0.54	0.33	0.02	0.23	-0.06	-0.19	0.22	0.20	0.26	0.29	0.15	0.05
CL1	0.61	0.46	**0.84**	0.44	-0.06	-0.02	-0.30	-0.25	-0.03	0.00	0.04	0.15	0.01	-0.20
CL2	0.71	0.63	**0.88**	0.61	-0.03	0.01	-0.29	-0.28	-0.06	-0.04	-0.05	0.13	-0.01	-0.14
CL3	0.68	0.74	**0.89**	0.57	-0.13	0.02	-0.30	-0.23	-0.10	-0.16	-0.07	0.23	-0.04	-0.15
CL4	0.74	0.71	**0.92**	0.54	-0.06	0.12	-0.34	-0.21	-0.05	-0.01	0.02	0.19	-0.04	-0.03
CL5	0.44	0.48	**0.73**	0.35	0.02	0.18	-0.23	-0.08	0.11	0.16	0.08	0.24	0.06	0.12
CL6	0.55	0.69	**0.80**	0.63	-0.10	0.25	-0.27	-0.13	0.18	0.16	0.17	0.34	0.15	-0.02
CL7	0.53	0.54	**0.63**	**0.75**	0.11	0.19	-0.04	0.05	0.06	0.04	0.05	0.13	-0.04	-0.08
SV1	0.51	0.58	0.59	**0.94**	0.01	0.06	-0.15	-0.09	-0.03	-0.05	-0.08	-0.01	0.01	-0.08
SV2	0.46	0.44	0.46	**0.62**	-0.03	0.26	-0.03	0.03	0.01	-0.01	0.22	0.26	0.05	-0.06
SV3	0.54	0.40	0.49	**0.87**	0.06	-0.03	-0.15	-0.12	-0.06	-0.13	-0.01	-0.10	-0.02	-0.11
SV4	0.52	0.63	0.61	**0.93**	-0.14	0.04	-0.20	-0.11	-0.01	0.01	-0.04	0.07	0.04	-0.13
FS1	-0.16	-0.27	-0.20	-0.17	**0.87**	0.44	0.69	0.39	0.36	0.31	0.28	0.04	0.20	0.54
FS2	-0.12	-0.17	-0.13	-0.06	**0.96**	0.42	0.71	0.39	0.57	0.51	0.42	0.05	0.03	0.56
FS3	0.17	0.04	0.21	-0.01	**0.71**	0.61	0.49	0.43	0.42	0.38	0.33	0.36	0.07	0.58
FS4	-0.05	-0.10	-0.04	-0.02	**0.96**	0.48	0.71	0.35	0.54	0.48	0.45	0.13	0.10	0.51
FS5	-0.22	-0.17	-0.13	0.01	**0.94**	0.50	0.74	0.39	0.57	0.52	0.52	0.07	0.11	0.57

Table 5.3 continued

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMAINT	MMBUILD	DECMKNG	IEWORK	PIIT	CSE
SC1	0.09	0.30	0.23	0.06	0.31	**0.84**	0.30	0.46	0.53	0.52	0.40	0.58	0.29	0.47
SC2	0.03	0.10	0.18	0.13	0.48	**0.85**	0.52	0.56	0.51	0.48	0.52	0.59	0.42	0.51
SC3	-0.17	0.02	0.00	-0.08	0.35	**0.79**	0.35	0.47	0.48	0.43	0.27	0.54	0.39	0.32
SC4	-0.13	0.03	-0.05	0.13	0.66	**0.88**	0.66	0.59	0.59	0.52	0.48	0.47	0.39	0.60
VER1	-0.32	-0.27	-0.30	-0.07	0.61	0.39	**0.88**	0.57	0.48	0.45	0.36	0.14	0.06	0.62
VER2	-0.45	-0.31	-0.44	-0.19	0.51	0.36	**0.85**	0.65	0.40	0.36	0.33	0.19	0.17	0.50
VER3	-0.19	-0.17	-0.21	-0.14	0.82	0.54	**0.75**	0.42	0.60	0.54	0.54	0.25	0.29	0.51
VER4	-0.29	-0.25	-0.19	-0.16	0.51	0.51	**0.82**	0.64	0.44	0.50	0.40	0.25	0.05	0.51
DISC1	-0.36	-0.19	-0.28	-0.18	0.29	0.47	0.52	**0.83**	0.26	0.23	0.17	0.36	0.35	0.36
DISC2	-0.19	-0.08	-0.22	-0.09	0.15	0.36	0.41	**0.78**	0.19	0.13	-0.01	0.25	0.23	0.36
DISC3	-0.48	-0.36	-0.30	-0.28	0.40	0.54	0.66	**0.91**	0.38	0.37	0.23	0.32	0.17	0.51
DISC4	-0.16	0.05	0.00	0.09	0.02	0.40	0.18	**0.62**	0.26	0.27	-0.03	0.24	0.07	0.25
DISC5	-0.30	-0.14	-0.13	0.05	0.56	0.58	0.71	**0.82**	0.58	0.60	0.49	0.32	0.21	0.44
MMM1	-0.16	-0.03	-0.09	-0.11	0.53	0.55	0.61	0.47	**0.96**	0.90	0.66	0.43	0.21	0.65
MMM2	0.16	0.27	0.20	0.18	0.47	0.71	0.40	0.43	**0.84**	0.82	0.57	0.51	0.36	0.56
MMM3	-0.07	0.01	-0.02	-0.09	0.53	0.53	0.57	0.46	**0.96**	0.92	0.64	0.38	0.15	0.61
MMM4	-0.21	-0.04	-0.07	-0.07	0.56	0.54	0.61	0.43	**0.95**	0.86	0.76	0.38	0.21	0.64
MMB1	-0.04	0.01	0.03	-0.06	0.40	0.46	0.44	0.34	0.86	**0.91**	0.47	0.38	0.19	0.51
MMB2	-0.13	-0.05	-0.11	-0.11	0.46	0.60	0.54	0.48	0.90	**0.92**	0.57	0.40	0.31	0.61
MMB3	-0.10	0.08	0.08	-0.05	0.50	0.56	0.52	0.39	0.86	**0.91**	0.77	0.46	0.19	0.61
MMB4	-0.08	0.04	0.04	0.04	0.49	0.50	0.55	0.50	0.84	**0.91**	0.56	0.35	0.09	0.49
DM1	-0.03	-0.01	0.08	-0.04	0.38	0.36	0.39	0.16	0.59	0.58	**0.90**	0.42	0.28	0.46
DM2	-0.10	0.05	0.08	-0.01	0.39	0.38	0.44	0.19	0.70	0.65	**0.93**	0.51	0.39	0.43
DM3	-0.14	-0.01	-0.03	-0.10	0.46	0.46	0.48	0.27	0.66	0.60	**0.94**	0.53	0.42	0.40
DM4	-0.08	0.06	-0.04	0.09	0.44	0.42	0.47	0.21	0.51	0.47	**0.85**	0.35	0.47	0.44
DM5	-0.08	0.06	0.05	0.04	0.40	0.60	0.46	0.48	0.71	0.65	**0.88**	0.71	0.45	0.50

Table 5.3 continued

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMAINT	MMBUILD	DECMKNG	IEWORK	PIIT	CSE
IEW1	0.21	0.23	0.30	0.15	0.13	0.59	0.21	0.28	0.38	0.35	0.44	**0.86**	0.60	0.28
IEW2	0.12	0.20	0.13	0.08	-0.10	0.45	-0.02	0.12	0.17	0.13	0.24	**0.77**	0.42	0.04
IEW3	0.18	0.23	0.30	0.13	0.22	0.64	0.27	0.40	0.40	0.33	0.49	**0.90**	0.63	0.28
IEI1	-0.21	-0.06	-0.04	-0.24	0.08	0.41	0.22	0.32	0.39	0.43	0.54	**0.68**	0.32	0.20
IEI2	-0.05	-0.03	0.09	-0.12	0.19	0.48	0.31	0.43	0.49	0.49	0.60	**0.87**	0.48	0.23
IEI3	0.18	0.38	0.39	0.19	0.06	0.57	0.21	0.29	0.40	0.40	0.49	**0.84**	0.48	0.33
PIIT1	0.06	0.07	0.06	0.20	0.10	0.45	0.14	0.22	0.28	0.25	0.44	0.56	**0.87**	0.31
PIIT2	-0.15	-0.04	0.09	0.00	0.19	0.38	0.28	0.28	0.33	0.34	0.55	0.56	**0.89**	0.29
PIIT3	-0.17	0.00	-0.04	-0.05	0.12	0.41	0.17	0.23	0.14	0.07	0.31	0.56	**0.90**	0.22
PIIT4R	-0.22	-0.04	-0.14	-0.15	-0.17	0.23	-0.08	0.08	-0.01	-0.05	0.11	0.36	**0.79**	-0.03
CSE1	-0.09	0.07	0.01	-0.06	0.58	0.52	0.54	0.36	0.66	0.64	0.54	0.27	0.21	**0.92**
CSE2	-0.20	-0.25	-0.20	-0.20	0.40	0.57	0.58	0.69	0.50	0.44	0.34	0.35	0.34	**0.81**
CSE3	-0.08	-0.04	-0.09	-0.05	0.63	0.38	0.60	0.27	0.56	0.50	0.38	0.10	0.12	**0.88**

Table 5.4 Revised Item Loadings (Site 2)

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMB	DECMKNG	IEWORK	PIIT	CSE
SI4R	**0.56**	0.38	0.42	0.40	-0.05	0.10	-0.18	-0.06	0.02	-0.11	0.19	-0.02	-0.21
SI5R	**0.95**	0.55	0.66	0.48	-0.13	-0.16	-0.43	-0.53	-0.05	-0.10	-0.01	-0.17	-0.17
SI6R	**0.62**	0.40	0.43	0.37	0.20	0.07	0.04	-0.15	-0.04	-0.05	0.10	-0.04	0.01
SI7R	**0.79**	0.32	0.58	0.45	-0.02	-0.04	-0.23	-0.17	-0.16	-0.17	-0.01	-0.21	-0.06
RS1	0.42	**0.85**	0.64	0.51	-0.19	0.15	-0.35	-0.19	0.00	-0.01	0.21	0.02	-0.17
RS2	0.61	**0.79**	0.59	0.61	-0.14	-0.01	-0.28	-0.17	-0.05	-0.07	0.01	-0.14	-0.03
RS3	0.31	**0.71**	0.43	0.48	-0.06	0.12	-0.04	-0.06	0.08	0.08	0.15	0.11	0.11
RS4	0.35	**0.83**	0.51	0.33	0.02	0.23	-0.06	-0.19	0.22	0.26	0.29	0.15	0.05
CL1	0.56	0.46	**0.87**	0.44	-0.06	-0.02	-0.30	-0.26	-0.01	0.04	0.15	0.01	-0.20
CL2	0.68	0.63	**0.92**	0.61	-0.03	0.01	-0.29	-0.28	-0.05	-0.05	0.12	-0.01	-0.14
CL3	0.63	0.74	**0.89**	0.57	-0.13	0.01	-0.30	-0.23	-0.13	-0.07	0.23	-0.04	-0.15
CL4	0.68	0.71	**0.91**	0.54	-0.06	0.12	-0.34	-0.21	-0.03	0.02	0.19	-0.04	-0.03
SV1	0.48	0.58	0.56	**0.94**	0.01	0.06	-0.15	-0.10	-0.04	-0.08	-0.02	0.01	-0.08
SV2	0.39	0.44	0.42	**0.62**	-0.03	0.26	-0.03	0.02	0.00	0.22	0.26	0.05	-0.06
SV3	0.50	0.40	0.48	**0.87**	0.06	-0.03	-0.15	-0.12	-0.10	-0.01	-0.10	-0.02	-0.11
SV4	0.48	0.63	0.58	**0.93**	-0.15	0.04	-0.20	-0.11	0.00	-0.04	0.07	0.04	-0.13
FS1	-0.14	-0.27	-0.19	-0.17	**0.87**	0.44	0.68	0.38	0.34	0.28	0.04	0.20	0.54
FS2	-0.09	-0.17	-0.13	-0.06	**0.96**	0.42	0.70	0.37	0.55	0.42	0.05	0.03	0.56
FS3	0.13	0.04	0.20	0.00	**0.70**	0.61	0.49	0.42	0.41	0.33	0.35	0.07	0.58
FS4	-0.05	-0.10	-0.04	-0.02	**0.96**	0.48	0.70	0.34	0.52	0.45	0.13	0.10	0.51
FS5	-0.21	-0.17	-0.15	0.01	**0.94**	0.50	0.73	0.37	0.56	0.52	0.07	0.11	0.57

Table 5.4 continued

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMB	DECMKNG	IEWORK	PIIT	CSE
SC1	0.04	0.30	0.16	0.06	0.31	**0.84**	0.30	0.45	0.53	0.40	0.58	0.29	0.47
SC2	-0.04	0.10	0.14	0.13	0.48	**0.85**	0.52	0.55	0.50	0.52	0.59	0.42	0.51
SC3	-0.19	0.02	-0.07	-0.08	0.35	**0.79**	0.35	0.47	0.47	0.27	0.54	0.39	0.32
SC4	-0.16	0.03	-0.11	0.13	0.66	**0.88**	0.65	0.59	0.57	0.47	0.47	0.39	0.60
VER1	-0.34	-0.27	-0.28	-0.07	0.61	0.39	**0.89**	0.56	0.48	0.36	0.14	0.06	0.62
VER2	-0.46	-0.31	-0.42	-0.19	0.51	0.36	**0.86**	0.65	0.39	0.33	0.19	0.17	0.50
VER3	-0.18	-0.17	-0.25	-0.14	0.82	0.54	**0.73**	0.41	0.58	0.54	0.25	0.29	0.51
VER4	-0.31	-0.25	-0.18	-0.16	0.51	0.51	**0.82**	0.62	0.48	0.40	0.26	0.05	0.51
DISC1	-0.37	-0.19	-0.31	-0.18	0.29	0.47	0.52	**0.84**	0.25	0.17	0.36	0.35	0.36
DISC2	-0.24	-0.08	-0.24	-0.09	0.15	0.36	0.42	**0.79**	0.16	-0.01	0.24	0.23	0.36
DISC3	-0.51	-0.36	-0.33	-0.28	0.40	0.54	0.66	**0.92**	0.38	0.23	0.32	0.17	0.51
DISC4	-0.21	0.05	-0.03	0.09	0.01	0.40	0.19	**0.63**	0.27	-0.03	0.24	0.07	0.25
DISC5	-0.33	-0.14	-0.17	0.05	0.56	0.58	0.71	**0.80**	0.60	0.49	0.32	0.21	0.44
MMM1	-0.15	-0.03	-0.16	-0.11	0.53	0.55	0.60	0.46	**0.95**	0.66	0.43	0.21	0.65
MMM2	0.15	0.27	0.15	0.18	0.47	0.71	0.39	0.42	**0.84**	0.57	0.51	0.36	0.56
MMM3	-0.06	0.01	-0.09	-0.09	0.53	0.53	0.56	0.44	**0.96**	0.64	0.38	0.15	0.61
MMM4	-0.22	-0.04	-0.14	-0.07	0.56	0.54	0.60	0.41	**0.92**	0.76	0.38	0.21	0.64
MMB1	-0.01	0.01	-0.04	-0.06	0.40	0.46	0.43	0.33	**0.89**	0.47	0.38	0.19	0.51
MMB2	-0.11	-0.05	-0.17	-0.11	0.46	0.60	0.54	0.47	**0.92**	0.57	0.40	0.31	0.61
MMB3	-0.11	0.08	0.01	-0.05	0.49	0.56	0.51	0.37	**0.90**	0.77	0.46	0.19	0.61
MMB4	-0.05	0.04	-0.01	0.04	0.49	0.50	0.55	0.48	**0.89**	0.56	0.35	0.09	0.49

Table 5.4 continued

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMB	DECMKNG	IEWORK	PIIT	CSE
DM1	-0.07	-0.01	0.04	-0.04	0.38	0.36	0.38	0.14	0.59	**0.90**	0.42	0.28	0.46
DM2	-0.12	0.06	0.03	0.00	0.39	0.38	0.44	0.17	0.69	**0.93**	0.51	0.39	0.43
DM3	-0.17	-0.01	-0.06	-0.10	0.46	0.46	0.47	0.26	0.64	**0.93**	0.53	0.42	0.40
DM4	-0.12	0.06	-0.06	0.09	0.45	0.42	0.47	0.19	0.50	**0.85**	0.35	0.47	0.44
DM5	-0.12	0.06	-0.02	0.04	0.40	0.60	0.45	0.47	0.69	**0.88**	0.71	0.45	0.50
IEI1	-0.22	-0.06	-0.12	-0.24	0.08	0.41	0.22	0.31	0.41	0.54	**0.68**	0.32	0.20
IEI2	-0.11	-0.03	0.05	-0.12	0.19	0.47	0.31	0.42	0.50	0.60	**0.87**	0.48	0.23
IEI3	0.10	0.38	0.36	0.20	0.06	0.57	0.21	0.29	0.40	0.49	**0.84**	0.48	0.33
IEW1	0.13	0.23	0.25	0.15	0.12	0.59	0.21	0.29	0.37	0.44	**0.86**	0.60	0.28
IEW2	0.07	0.20	0.07	0.09	-0.10	0.45	-0.03	0.12	0.15	0.24	**0.77**	0.42	0.04
IEW3	0.09	0.23	0.27	0.13	0.22	0.64	0.27	0.41	0.37	0.49	**0.90**	0.63	0.28
PIIT1	-0.02	0.07	0.02	0.20	0.10	0.45	0.13	0.22	0.27	0.44	0.56	**0.87**	0.31
PIIT2	-0.21	-0.04	0.04	0.00	0.19	0.38	0.27	0.27	0.34	0.55	0.56	**0.89**	0.29
PIIT3	-0.22	0.00	-0.05	-0.05	0.12	0.41	0.16	0.24	0.11	0.31	0.56	**0.90**	0.22
PIIT4R	-0.24	-0.03	-0.17	-0.15	-0.17	0.23	-0.08	0.09	-0.03	0.11	0.36	**0.79**	-0.03
CSE1	-0.09	0.07	-0.06	-0.06	0.58	0.52	0.53	0.35	0.66	0.54	0.27	0.21	**0.92**
CSE2	-0.26	-0.25	-0.23	-0.20	0.40	0.57	0.59	0.69	0.48	0.34	0.35	0.34	**0.81**
CSE3	-0.10	-0.04	-0.12	-0.05	0.63	0.38	0.60	0.26	0.54	0.38	0.10	0.12	**0.88**

Third, one *Commitment to Learning* item (CL7) cross-loaded and was also discarded. As you may recall, CL5, CL6, and CL7 all loaded poorly for Site 1 data and were subsequently discarded. It was suspected that these poor loadings were primarily due to a confound between the type of organization (i.e. educational) and the wording of the items (that all related to learning). In the current (non-educational) context, CL5 and Cl6 loaded well thereby confirming these suspicions but CL7 did poorly once again. In future studies, CL5 and CL6 could therefore be included in the *Commitment to Learning* scale. However they were discarded for Site 2 in order to keep items consistent with those of Site 1 and thus make the models for the two sites directly comparable. This was necessary because, as stated above, *Mental Model Building* and *Mental Model Maintenance* did not emerge as distinct factors in Site 2. Thus, Hypotheses H2a through H2d could not be tested using Site 2 data. On order to test these hypotheses, the structural model was also run using Site 1 data. Keeping the items consistent across sites facilitates comparison of results.

These adjustments were made and the measurement model re-run. The revised CFA results are shown in Table 5.4.With the exception of one *Support for Innovation* item (SI4R), all loadings exceeded 0.60. Final item loadings and weights for the Site 2 measurement model are all significant as shown in Table 5.6.

5.4.1.2 Internal Consistency

The next step was to assess internal consistency using composite reliabilities. All constructs satisfied the .70 criterion as shown in Table 5.5.

Table 5.5 Correlation of Constructs (Site 2)

CONSTRUCTS		Composite Reliability	1	2	3	4	5	6	7	8	9	10	11	12	13
SupInov	(1)	**0.83**	**0.74**												
Resource	(2)	**0.87**	0.56	**0.80**											
CommitLrn	(3)	**0.94**	0.71	0.71	**0.90**										
Vision	(4)	**0.91**	0.54	0.62	0.61	**0.85**									
Search	(5)	**0.95**	-0.10	-0.15	-0.08	-0.05	**0.89**								
Scanning	(6)	**0.91**	-0.10	0.14	0.04	0.08	0.54	**0.84**							
Verify	(7)	**0.90**	-0.39	-0.30	-0.35	-0.17	0.74	0.54	**0.83**						
Discvry	(8)	**0.90**	-0.44	-0.21	-0.27	-0.10	0.41	0.61	0.68	**0.80**					
MMMB	(9)	**0.97**	-0.08	0.04	-0.06	-0.04	0.54	0.62	0.58	0.47	**0.91**				
DecMkng	(10)	**0.95**	-0.14	0.04	-0.02	0.00	0.46	0.50	0.49	0.28	0.70	**0.90**			
IEWork	(11)	**0.93**	0.02	0.19	0.19	0.05	0.13	0.64	0.25	0.38	0.46	0.57	**0.82**		
PIIT	(12)	**0.92**	-0.19	0.01	-0.02	0.03	0.11	0.44	0.18	0.25	0.24	0.45	0.60	**0.87**	
CSE	(13)	**0.91**	-0.17	-0.07	-0.15	-0.12	0.61	0.57	0.65	0.50	0.65	0.50	0.29	0.27	**0.87**

Note:

Composite Reliability = $\rho_c = (\Sigma\lambda_i)^2/[(\Sigma\lambda_i)^2+\Sigma_i var(\varepsilon_i)]$, where λ_i is the component loading to an indicator and $var(\varepsilon_i) = 1 - \Sigma\lambda_i^2$

Diagonal elements in the 'correlation of constructs' matrix are the square root of the average variance extracted. For adequate discriminant validity, diagonal elements should be greater than corresponding off-diagonal elements.

5.4.1.3 Discriminant Validity

Recall that there are two criteria for discriminant validity. First, indicators should load more strongly on their corresponding construct that on other constructs. Second, the square root of the average variance extracted (AVE) should be larger than the inter-construct correlations. As shown by Tables 5.4 and 5.5 all constructs exhibited adequate discriminant validity.

5.5 Structural Model and Hypothesis Testing

5.5.1 Structural Model

PLS was used to test the hypotheses developed in Chapter Three. Recall that PLS is a latent SEM technique that uses a component-based approach to estimation and subsequently places minimal demands on sample size and residual distributions (Chin, 1998b). However, the rule of thumb regarding sample size is to have seven times the number of predictors from 1) the indicators of the most complex formative construct or 2) the largest number of predictors for a dependent variable, whichever is greater (Chin, 1998b). A review of the measurement model indicated that since the maximum number of formative indicators as well as the maximum number of predictors for any given construct is six, a minimum sample size of 42 is needed for hypothesis testing and Site 2 data satisfies this criterion.

Table 5.6: Measurement Model Weights and Loadings (Site 2)

	Loadings	Weights	T-Statistic	p-value	Significance
SupInov :					
SI4R	0.5613		2.1122	0.02	**
SI5R	0.9452		7.8099	0.00	***
SI6R	0.6189		2.1218	0.02	**
SI7R	0.7885		3.6847	0.00	***
Resource:					
RS1	0.8520		2.6884	0.00	***
RS2	0.7921		2.7360	0.00	***
RS3	0.7087		2.6127	0.01	**
RS4	0.8301		2.8638	0.00	***
Learning:					
CL1	0.8704		15.0419	0.00	***
CL2	0.9181		24.9083	0.00	***
CL3	0.8851		17.3464	0.00	***
CL4	0.9127		23.2387	0.00	***
Vision :					
SV1	0.9369		6.8153	0.00	***
SV2	0.6229		1.7452	0.04	**
SV3	0.8747		5.1308	0.00	***
SV4	0.9298		6.0766	0.00	***
Search :					
FS1	0.8705		13.3376	0.00	***
FS2	0.9648		83.2766	0.00	***
FS3	0.7044		5.1300	0.00	***
FS4	0.9629		61.4830	0.00	***
FS5	0.9417		38.6394	0.00	***
Scanning:					
SC4	0.8835		22.0403	0.00	***
SC2	0.8503		19.4078	0.00	***
SC1	0.8383		14.7704	0.00	***
SC3	0.7916		8.9825	0.00	***
Verify :					
VER3	0.7337		11.2946	0.00	***
VER2	0.8581		21.9448	0.00	***
VER1	0.8884		22.6845	0.00	***
VER4	0.8233		14.0603	0.00	***

Table 5.6 continued

	Loadings	Weights	T-Statistic	p-value	Significance
Discvry :					
DISC1	0.8446		14.6811	0.00	***
DISC3	0.9151		27.6314	0.00	***
DISC5	0.7988		19.5079	0.00	***
DISC2	0.7930		8.2952	0.00	***
DISC4	0.6265		3.8381	0.00	***
MMMaint :					
MMM2	0.8403		8.2115	0.00	***
MMM4	0.9206		41.5365	0.00	***
MMM1	0.9481		62.4493	0.00	***
MMM3	0.9562		66.5192	0.00	***
MMB1	0.8917		16.2644	0.00	***
MMB2	0.9229		21.0334	0.00	***
MMB3	0.8959		21.3915	0.00	***
MMB4	0.8851		14.3224	0.00	***
DecMkng :					
DM4	0.8481		11.1967	0.00	***
DM1	0.8987		18.8981	0.00	***
DM2	0.9302		37.0055	0.00	***
DM5	0.8811		19.7886	0.00	***
DM3	0.9350		24.3343	0.00	***
IEWork :					
IEW1	0.8592		20.9330	0.00	***
IEW2	0.7675		5.1957	0.00	***
IEW3	0.8961		37.5642	0.00	***
IEI1	0.6836		4.4344	0.00	***
IEI2	0.8703		12.9718	0.00	***
IEI3	0.8385		16.7064	0.00	***
PIIT :					
PIIT1	0.8744		12.7015	0.00	***
PIIT2	0.8909		19.1389	0.00	***
PIIT3	0.9009		21.6400	0.00	***
PIIT4R	0.7931		6.2501	0.00	***
CSE :					
CSE1	0.9203		7.6953	0.00	***
CSE2	0.8140		12.3834	0.00	***
CSE3	0.8836		5.5953	0.00	***

Table 5.6 continued

	Loadings	Weights	T-Statistic	p-value	Significance
PriorKno:					
YrsWork		0.6001	2.3315	0.01	***
YrsEmp		-0.4896	-1.5672	0.06	*
YrsComp		-0.6901	-2.1407	0.02	**
YrsDW		-0.5121	-1.5999	0.06	*

*** significant at 0.01
** significant at 0.05
* significant at 0.10
NS non-significant

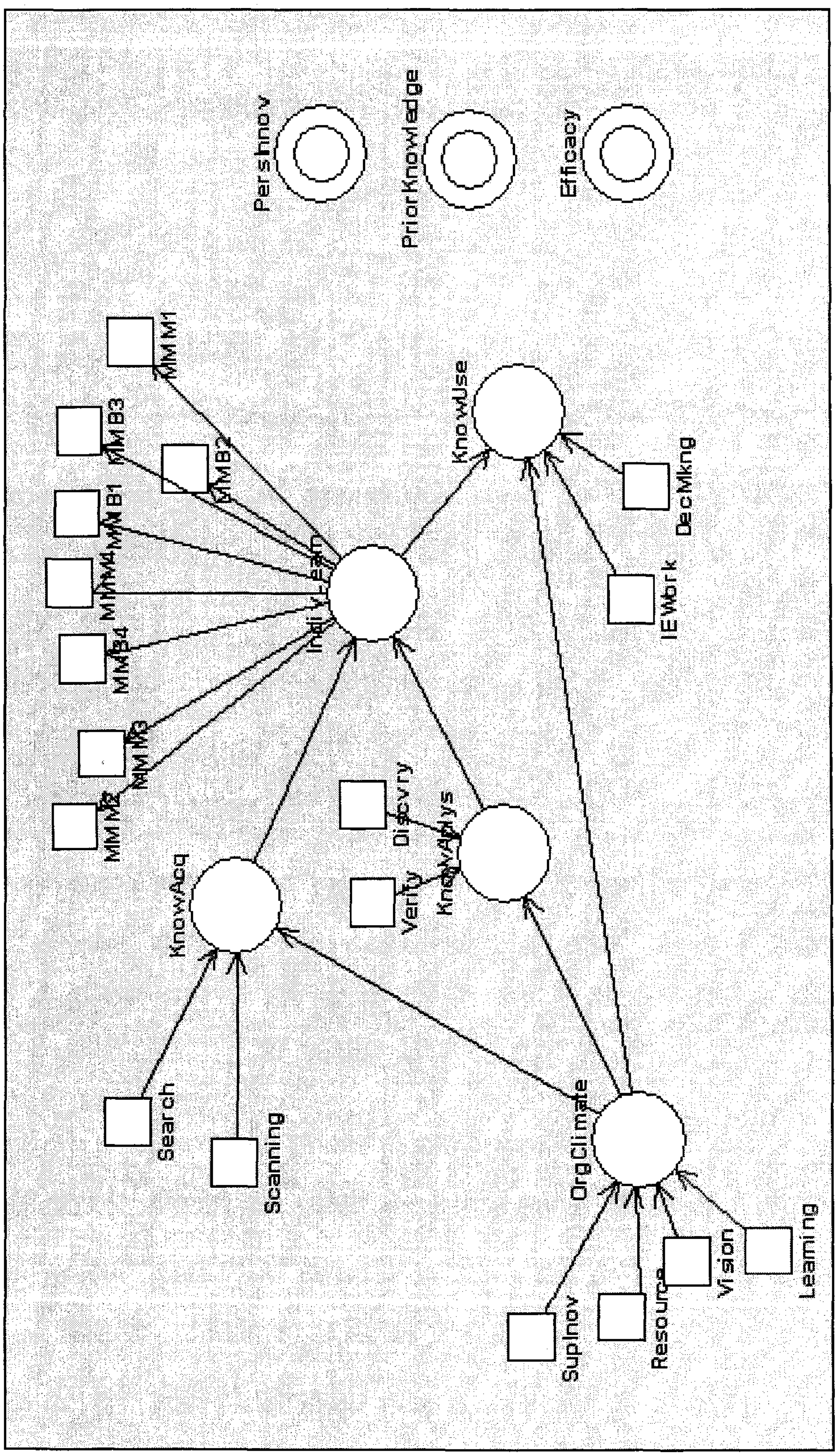

Figure 5.1: Structural Model

Table 5.7 Structural Model Key

Construct Symbol	Construct Name	Items/Constructs (LVs)	Nature of Indicators
OrgClimate	Perceived Organizational Climate for Learning and Innovation.	Support for Innovation Resource Supply Commitment to Learning Shared Vision	Formative
KnowAcq	Knowledge Acquisition	Focused Search Scanning	Formative
KnowAnlys	Knowledge Analysis	Verification Discovery	Formative
IndivLearn**	Individual Learning	MMM1- MMM4 MMB1 - MMB4	Reflective
KnowUse	Knowledge Utilization	Intentions to Explore Work Decision Making Impacts	Formative
PersInno	Personal Innovativeness in IT	PIIT1, PIIT2, PIIT3, PIIT4R	Reflective
Efficacy	Computer Self Efficacy	CSE1, CSE2, CSE3	Reflective
PriorKno	Prior Related Knowledge	Yrs Work, Yrs Employed Yrs Computer, Yrs DW	Formative

**** Note:** When one-dimensional, Individual Learning has eight (8) reflective indicators. When comprised of two dimensions, Individual Learning has two formative indicators: Mental Model Maintenance (MMMaint) and Mental Model Building (MMBuild).

The structural model is depicted in Figure 5.1 and the corresponding key in Table 5.7. Since PLS does not directly support second order factors, the Latent Variable (or factor) scores of the items for each dimension are used as the score for that dimension and used as the items for these second order constructs: *Perceived Organizational Climate for Learning and Innovation*, *Knowledge Acquisition, Knowledge Analysis and Interpretation,* and *Knowledge Utilization. Knowledge Acquisition* (KnowAcq) is an example of a second order construct with dimensions (and first order constructs) *Focused Search* (Search) and *Scanning* (Scanning). The Latent Variable scores obtained from PLS for *Search* and *Scanning* become the item values for *Knowledge Acquisition.*

As can be seen in Figure 5.1, *Perceived Organization Climate for Learning and Innovation* (OrgClimate) is formed by *Support for Innovation* (SupInov), *Resource Supply* (Resource), *Shared Vision* (Vision) and *Commitment to Learning* (Learning). *Knowledge Analysis and Interpretation* (KnowAnlys) is formed by *Verification* (Verify) and *Discovery* (Discvry). *Knowledge Utilization* (KnowUse) is formed by *Decision-Making Impacts* (DecMkng) and *Intentions to Explore Work* (IE Work). *Individual Learning* is a reflective construct because *Mental Model Maintenance* and *Mental Model Building* items all loaded onto one dimension. All control variables retain their items from the measurement model.

In PLS, loadings of measures of each construct can be interpreted as loadings in a principal component factor analysis. Paths (the numbers on the lines) are interpreted as standardized weights in a regression analysis. The path coefficients and explained variances (the numbers under the circles) for the model are shown in Figure 5.2c. The significance of the path coefficients was determined using the T-statistic calculated with the bootstrap technique since this is the approach that provides the best estimation of the model (Chin, 1998b).

The structural model was run in three stages run. The first was run without controls or interaction terms and is depicted in Figure 5.2a. In this model, *Perceived Organizational Climate for Learning and Innovation* explains 1.7% and 2.16% of the variance in *Knowledge Acquisition* and *Knowledge Analysis and Interpretation* respectively. In addition, *Knowledge Acquisition* and *Knowledge Analysis and Interpretation* combined explain 46.3% of the variance in *Individual Learning*. Similarly, *Individual Learning* and *Perceived Organizational Climate for Learning and Innovation* explain 49.9% of the variance in *Knowledge Utilization*.

The second run (Figure 5.2b) included the interaction term *OrgClimate * Learning* (OrgClim*Learn) used to represent the moderating effect of *Perceived Organizational Climate for Learning and Innovation* (OrgClimate) on the relationship between *Individual Learning* (IndivLearn) and *Knowledge Utilization* (KnowUse). The interaction term was calculated by taking the product of the factor/construct scores for *Perceived Organizational Climate for Learning and Innovation* and *Individual Learning*. The explained variance in *Knowledge Utilization* changed to 50.1%, thereby showing only a slight increase of 0.2%, and the path from *OrgClimate*Learn* to *Knowledge Utilization* was non-significant. The effect size $\boldsymbol{f}^2$ of the interaction term was also calculated as follows:

$$\boldsymbol{f}^2 = (R^2_{\text{included}} - R^2_{\text{excluded}}) \,/\, (1 - R^2_{\text{included}})$$

According to Cohen (1988), $\boldsymbol{f}^2$ values of 0.02, 0.15, and 0.35 correspond to small, medium and large effect sizes respectively. The interaction effect size was 0.004 thus confirming the negligible effect of *OrgClimate*Learn* on *Knowledge Utilization*.

All control variables were included in the final run (Figure 5.2c) and corresponding weights and loadings are displayed in Table 5.8. *Support for Innovation* proved to be the only significant dimension of *Perceived Organizational Climate for Learning and Innovation* and *Individual Learning*. Otherwise all other weights and loadings were significant.

In the conceptual framework (Figure 2.2), it was theorized that the control variables would influence both usage behaviors: KMT use and knowledge use. Subsequently, a path between each control and *Knowledge Acquisition*, *Knowledge Analysis and Interpretation*, and *Knowledge Utilization* respectively was included in the final version of the model. Note the change in *Knowledge Utilization's* R^2 from one model to the next and the corresponding effect sizes (as shown in Table 5.9a).

All three controls, *Personal Innovativeness in IT, Prior Related Knowledge*, and *Computer Self Efficacy*, had a combined large effect on *Knowledge Utilization* (Figure 5.2c), changing the R^2 from 50.1% to 64.5%. As is evident from Figure 5.3c, *Perceived Climate for Learning and Innovation*, *Individual Learning*, the *OrgClimate * Learning Interaction,* and all three controls together explained 64.5% of the variance in *Knowledge Utilization*. The controls had a similar effect on *Knowledge Acquisition* and *Knowledge Analysis and Interpretation*, changing their respective R^2 from 1.7% to 54.8%, and from 2.16% to 59.3%. The corresponding effect sizes were 1.2 and 0.93 thus the controls had a large effect on KMT usage behaviors (Table 5.9b).

5.5.2 Support for Hypotheses

Hypotheses were tested by determining the size and level of the significance of path coefficients. This entailed mapping the T-statistic for each path coefficient to its respective p-value. When assessing model fit, standardized paths should be at least 0.20 (ideally > 0.30)

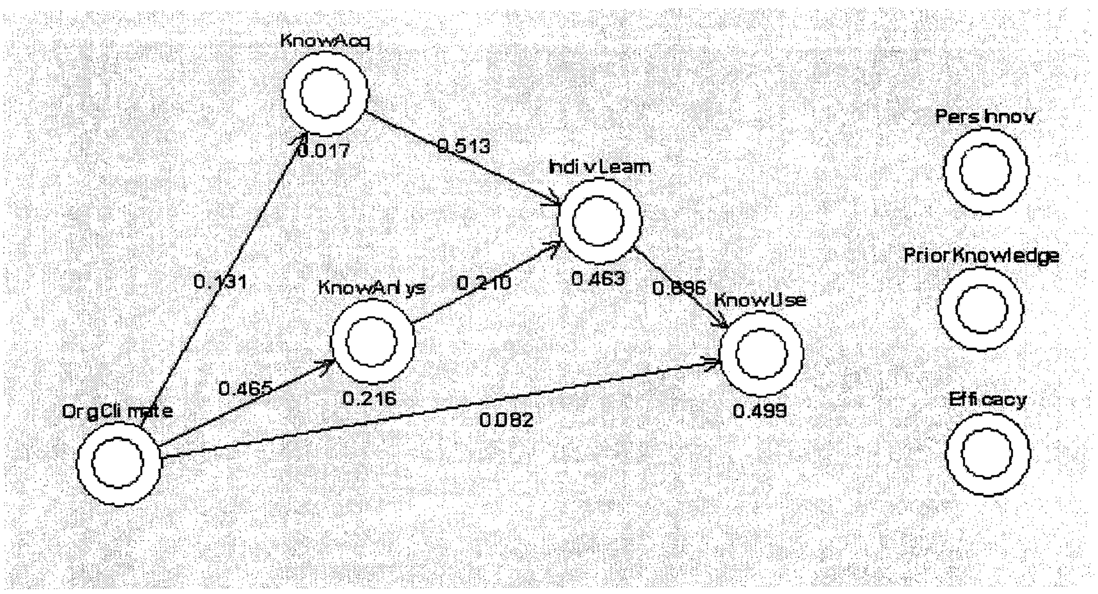

Figure 5.2a: Structural model – no interaction or controls (Site2)

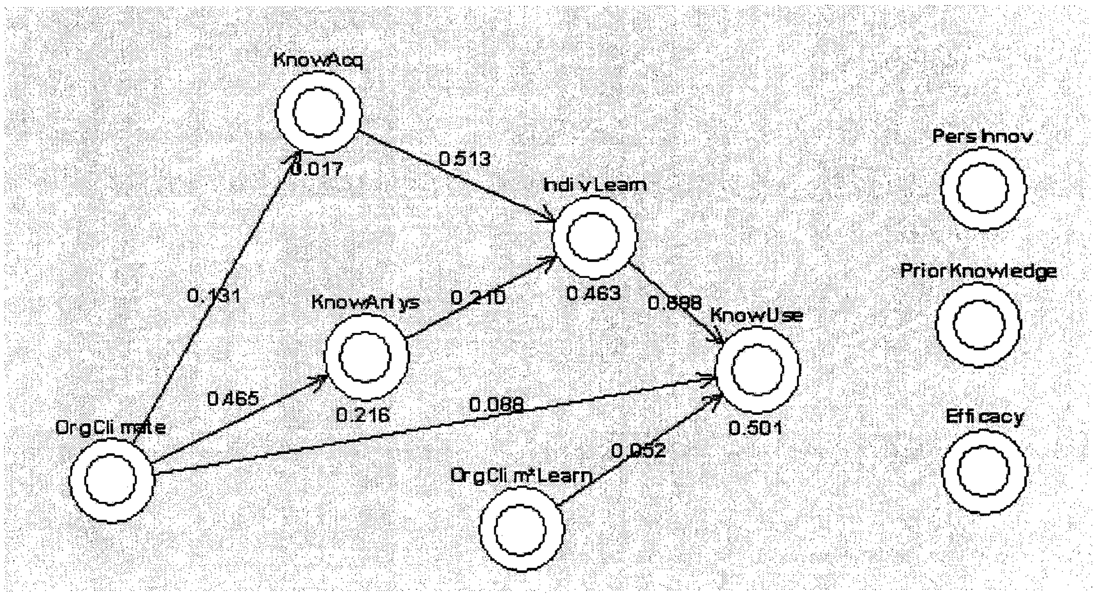

Figure 5.2b: Structural model with interaction, no controls (Site2)

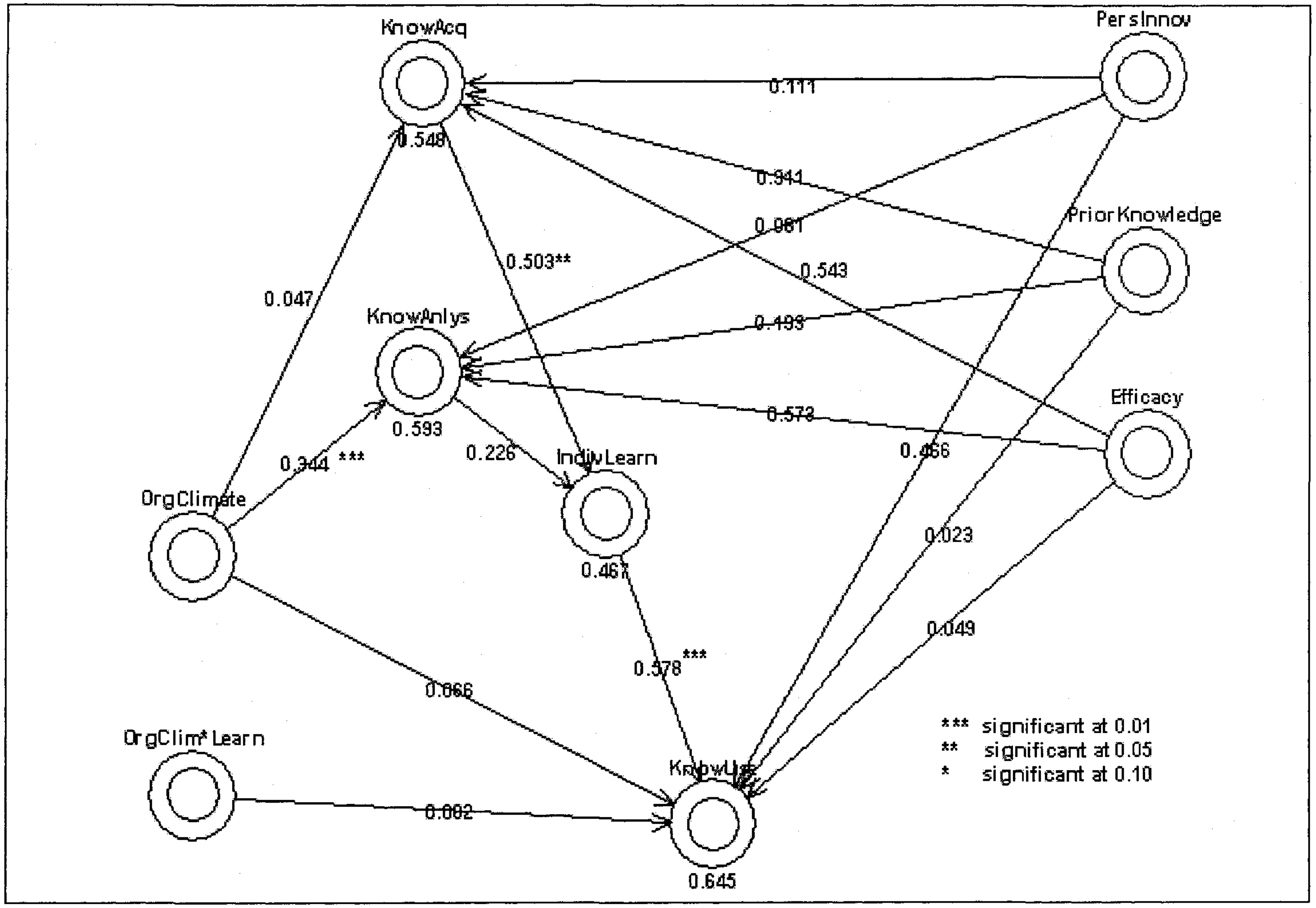

Figure 5.2c: Structural model with interaction and controls (Site 2)

Table 5.8: Structural Model Weights and Loadings (Site 2)

	Weights	Loadings	T-Statistic	p-value	Significance
OrgClima:					
SupInov	1.0307		2.0198	0.02	**
Resource	0.1667		0.3508	0.36	NS
Learning	0.0752		0.1294	0.45	NS
Vision	-0.4131		-0.9899	0.16	NS
KnowAcq :					
Search	-0.3948		-1.6504	0.05	**
Scanning	-0.7306		-3.1169	0.00	***
KnowAnlys:					
Verify	-0.7572		-4.3898	0.00	***
Discvry	-0.3178		-1.5829	0.06	*
IndivLearn:					
MMM1		0.9477	70.6719	0.00	***
MMM2		0.8412	5.9758	0.00	***
MMM3		0.9562	82.8538	0.00	***
MMM4		0.9198	36.4875	0.00	***
MMB1		0.8922	19.5628	0.00	***
MMB2		0.9234	21.2528	0.00	***
MMB3		0.895	21.5098	0.00	***
MMB4		0.8855	16.5254	0.00	***
KnowUse :					
DecMkng	0.6414		1.4268	0.08	*
IEWork	0.4838		1.2724	0.10	*
PersInno:					
PIIT1		0.8778	10.5708	0.00	***
PIIT2		0.8997	15.6509	0.00	***
PIIT3		0.8961	7.3045	0.00	***
PIIT4R		0.772	3.6672	0.00	***
Efficacy:					
CSE1		0.8986	30.8239	0.00	***
CSE2		0.8333	17.857	0.00	***
CSE3		0.8894	16.5195	0.00	***

Table 5.8 continued

	Weights	Loadings	T-Statistic	p-value	Significance
PriorKno:					
YrsWork	0.4046		1.3264	0.10	*
YrsEmp	-0.4117		-1.4798	0.07	*
YrsComp	-0.636		-2.4221	0.01	***
YrsDW	-0.6558		-2.0248	0.02	**

*** significant at 0.01
** significant at 0.05
* significant at 0.10
NS non-significant

Table 5.9a: Effect Size of Interaction and Controls on Knowledge Use

Model Characteristics	$R^2_{included}$	$R^2_{excluded}$	f^2	**Effect Size**
Site 2				
No interaction or controls (Figure 5.2a)	0.499			
Interaction, no controls (Figure 5.2b)	0.501	0.499	0.004	Negligible
Interaction, all controls (Figure 5.2c)	0.645	0.501	**0.401**	Large
Site 1				
No interaction or controls (Figure 5.3a)	0.384			
Interaction, no controls (Figure 5.3b)	0.384	0.384	0	Zero
Interaction, all controls (Figure 5.3c)	0.606	0.384	**0.564**	Large

Table 5.9b: Effect Size of Controls on Knowledge-based Activities

Model Characteristics	**Site 2**		**Site 1**	
	KnowAcq	**KnowAnlys**	**KnowAcq**	**KnowAnlys**
$R^2_{\text{no controls}}$	0.017	0.216	0.353	0.124
R^2_{controls}	0.548	0.593	0.527	0.391
f^2	**1.2**	**0.926**	**0.369**	**0.438**
Effect Size	Large	Large	Large	Large

in order to be considered meaningful (Chin, 1998a). In PLS, null hypotheses posit no effect and alternate hypotheses posit an effect (that may be one-or two tailed) (Chin, 1998b).In this study, one tailed hypothesis testing was undertaken. It should be noted that H1b and H3b relate to knowledge sharing and were not tested as they are not applicable in the context of a data warehouse. In other words, the technology is not used to share information; rather it is used primarily for analytical purposes.

5.5.2.1 Site 2 Hypothesis Testing

The structural model was used to test Hypotheses H1, H3, H4, H5, and H6. At Site 2 support was found for H1a, H3c, and H5. The path from Knowledge *Acquisition* to *Individual Learning* was significant (path coefficient = 0.503, p = 0.03) thereby supporting H1a. Also significant was the path between *Perceived Organizational Climate for Learning and Innovation* and *Knowledge Analysis and Interpretation* (path coefficient = 0.344, p = 0.01) thereby supporting H3c. *Individual Learning* was a significant predictor of *Knowledge Use* (path coefficient = 0.578, p = 0.01) providing support for H5. There was no support for the relationship between *Perceived Organizational Climate for Learning and Innovation* and *Knowledge Utilization* (H4), nor was there support for the moderating effect of *Perceived Organizational Climate for Learning and Innovation* on the relationship between *Individual Learning and Knowledge Utilization.* (H6). All individual paths from controls (*Personal Innovativeness in IT, Prior Related Knowledge*, and *Computer Self-efficacy)* to usage behaviors (*Knowledge Acquisition, Knowledge Analysis and Interpretation,* and *Knowledge Utilization*) were non-significant however, as mentioned previously, the combined effect of controls on each usage behavior was large. Significant paths are depicted in Figure 5.2c and summarized results for hypothesis tests are shown in the column labeled *Site 2* in Table 5.10.

H2a, H2b, H2c, and H2d were not tested at Site 2. These hypotheses posit the relative effects of *Focused Search*, *Scanning*, *Verification*, and *Discovery* on *Mental Model Maintenance* and *Mental Model Building*. As you may recall *Mental Model Maintenance* and *Mental Model Building* did not prove to be distinct dimensions of *Individual Learning* for the Site 2 data set.

5.5.2.2 Site 1 Hypothesis Testing

In order to improve the external validity of the study and test H2a through 2d, the hypotheses were tested again using Site 1 data. However, the Site 1 measurement model was first modified to have the same items for each construct as the Site 2 measurement model. This entailed dropping the first three items (SI1R, SI2, and SI3R) from the *Support for Innovation* scale. CFA was repeated and yielded the revised item loadings in Table 5.11. With the exception of FS4 (loading = 0.59) and SI4R (loading = 0.53), all other item loadings exceeded 0.60 (Chin 1998a). As shown in Table 5.12, composite reliabilities of all constructs exceeded 0.70, and both criteria for discriminant validity were satisfied (indicators loaded more strongly on their corresponding construct that on other constructs and the square root of the AVE was larger than the inter-construct correlations). Thus all constructs exhibited adequate internal consistency and discriminant validity. Revised weights and loadings for the measurement model are depicted in Table 5.13. Year of DW use (YrsDW) was the only significant *Prior Related Knowledge* variable. Otherwise, loadings for all constructs were significant.

Table 5.10: Support for Research Hypotheses

Hypothesis	Site 2	Site 1
H1a: KnowAcq → IndivLearn	**Supported, p = 0.03 (**)**	Not supported
H1c: KnowAnlys → IndivLearn	Not supported	**Supported, p = 0.02 (**)**
H2a: Search→ MMMaint > Search →MMBuild	Not tested	Not supported
H2b: Scanning →MMBuild and MMMaint	Not tested	Not supported
H2c: Verify → MMMaint > Verify →MMBuild	Not tested	Not supported
H2d: Discvry → MMBuild and MMMaint	Not tested	Not supported
H3a: OrgClimate → KnowAcq	Not supported	**Supported, p < 0.001 (***)**
H3c: OrgClimate → KnowAnlys	**Supported, p = 0.01 (***)**	Not supported
H4: OrgClimate → KnowUse	Not supported	**Supported, p = 0.03 (**)**
H5: IndivLearn → KnowUse	**Supported, p =0.01 (***)**	**Supported, p < 0.001 (***)**
H6: OrgClimate*IndivLearn→ KnowUse	Not supported	Not supported

Table 5.11: Revised Item Loadings (Site 1)

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMAINT	MMBUILD	DECMKNG	IEWORK	PIIT	CSE
SI4R	**0.53**	0.47	0.27	0.29	-0.03	-0.01	0.08	0.08	0.17	0.17	0.08	0.13	-0.22	-0.05
SI5R	**0.75**	0.29	0.42	0.45	-0.14	-0.13	0.05	-0.07	0.03	-0.02	-0.08	-0.16	-0.37	-0.04
SI6R	**0.95**	0.45	0.44	0.67	0.04	-0.26	0.05	-0.17	0.05	-0.09	-0.08	-0.13	-0.31	-0.05
SI7R	**0.78**	0.57	0.49	0.61	0.01	-0.04	0.01	-0.03	0.15	0.07	0.06	0.01	-0.32	-0.14
RS1	0.47	**0.79**	0.51	0.56	-0.07	0.00	0.07	0.22	0.05	0.13	0.11	0.05	-0.16	-0.15
RS2	0.38	**0.64**	0.38	0.55	0.19	-0.07	0.13	-0.06	0.16	-0.01	0.12	0.07	-0.09	0.10
RS3	0.35	**0.87**	0.24	0.44	0.12	0.14	0.03	0.14	0.20	0.15	0.20	0.11	-0.09	0.12
RS4	0.37	**0.89**	0.27	0.37	0.06	0.06	0.08	0.16	0.13	0.15	0.26	0.18	-0.10	0.05
CL1	0.29	0.21	**0.87**	0.38	0.29	0.21	0.14	0.05	0.02	0.22	0.17	0.04	-0.11	0.12
CL2	0.42	0.32	**0.82**	0.41	0.19	0.03	0.15	-0.02	0.07	0.13	0.07	-0.05	-0.25	-0.02
CL3	0.62	0.45	**0.77**	0.61	0.09	0.05	0.00	-0.04	0.01	0.09	0.06	-0.14	-0.26	-0.13
CL4	0.54	0.50	**0.69**	0.57	0.10	0.04	0.19	-0.04	0.02	0.10	0.18	0.10	-0.10	0.11
SV1	0.69	0.49	0.48	**0.94**	-0.07	-0.34	-0.11	-0.25	0.13	-0.06	-0.20	-0.25	-0.35	-0.10
SV2	0.52	0.50	0.51	**0.81**	-0.09	-0.25	-0.13	0.00	0.07	-0.07	-0.02	-0.21	-0.34	-0.21
SV3	0.59	0.44	0.51	**0.91**	-0.06	-0.35	-0.01	-0.20	0.09	0.07	-0.04	-0.07	-0.23	-0.08
SV4	0.63	0.53	0.47	**0.86**	-0.03	-0.19	-0.03	-0.09	0.18	0.08	-0.05	-0.21	-0.44	-0.15
FS1	-0.21	-0.05	-0.10	-0.18	**0.66**	0.12	0.35	0.04	0.16	0.09	0.38	0.34	0.33	0.47
FS2	-0.13	-0.25	0.04	-0.16	**0.65**	0.24	0.50	0.04	0.20	0.05	0.33	0.28	0.37	0.55
FS3	0.10	0.16	0.29	0.06	**0.81**	0.13	0.49	0.04	0.28	0.36	0.37	0.16	0.13	0.31
FS4	-0.02	0.17	0.30	0.03	**0.59**	0.17	0.24	0.05	0.13	0.03	0.18	0.05	0.04	0.09
FS5	0.00	-0.05	0.11	-0.16	**0.75**	0.31	0.47	-0.03	0.15	0.13	0.38	0.30	0.36	0.58
SC1	-0.14	0.15	0.16	-0.24	0.21	**0.82**	0.29	0.63	0.10	0.21	0.23	0.22	0.14	0.14
SC2	-0.27	0.00	0.03	-0.31	0.21	**0.84**	0.36	0.50	0.23	0.16	0.19	0.29	0.31	0.26
SC3	-0.04	0.16	0.17	-0.17	0.15	**0.72**	0.36	0.36	0.11	0.26	0.26	0.40	0.28	0.38
SC4	-0.28	-0.08	0.08	-0.33	0.27	**0.77**	0.30	0.26	0.18	0.27	0.41	0.33	0.39	0.32

Table 5.11 continued

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMAINT	MMBUILD	DECMKNG	IEWORK	PIIT	CSE
VER1	-0.06	-0.01	0.07	-0.13	0.56	0.21	**0.79**	0.33	0.39	0.33	0.36	0.09	0.20	0.45
VER2	0.23	0.21	0.16	0.11	0.38	0.35	**0.62**	0.15	0.20	0.23	0.27	0.37	0.27	0.43
VER3	-0.05	-0.08	0.13	-0.14	0.57	0.20	**0.66**	0.06	0.12	0.09	0.33	0.45	0.52	0.41
VER4	0.05	0.08	0.15	-0.05	0.22	0.42	**0.74**	0.45	0.27	0.29	0.26	0.38	0.27	0.38
DISC1	-0.23	0.04	-0.12	-0.17	-0.01	0.44	0.24	**0.75**	0.22	0.04	0.05	0.18	0.15	0.22
DISC2	-0.20	0.02	-0.14	-0.28	0.05	0.44	0.30	**0.80**	0.17	0.07	-0.02	0.09	0.05	0.19
DISC3	-0.03	0.12	0.10	-0.06	0.02	0.45	0.35	**0.74**	0.00	0.16	0.08	0.09	0.09	0.20
DISC4	-0.06	0.28	-0.02	-0.13	-0.07	0.30	0.13	**0.76**	0.08	0.10	0.17	0.09	-0.02	-0.02
DISC5	-0.07	0.22	0.15	-0.07	0.14	0.51	0.46	**0.79**	0.15	0.32	0.17	0.09	0.04	0.13
MMM1	0.05	0.10	-0.01	0.10	0.26	0.15	0.27	0.06	**0.95**	0.54	0.37	0.14	0.05	0.27
MMM2	0.06	0.13	0.05	0.14	0.24	0.16	0.37	0.25	**0.87**	0.66	0.42	0.13	0.03	0.31
MMM3	0.03	0.13	0.04	0.09	0.26	0.19	0.28	0.04	**0.93**	0.53	0.45	0.27	0.14	0.23
MMM4	0.06	0.20	0.07	0.13	0.28	0.22	0.46	0.25	**0.95**	0.62	0.41	0.15	0.06	0.29
MMB1	-0.18	0.16	0.09	-0.06	0.17	0.20	0.29	0.19	0.57	**0.86**	0.37	0.15	0.08	0.26
MMB2	-0.16	0.16	0.12	-0.06	0.16	0.30	0.27	0.23	0.52	**0.93**	0.49	0.27	0.10	0.22
MMB3	0.14	0.13	0.30	0.12	0.34	0.22	0.39	0.08	0.60	**0.80**	0.54	0.26	0.05	0.23
MMB4	-0.11	0.14	0.13	-0.03	0.11	0.28	0.27	0.22	0.53	**0.93**	0.35	0.13	0.01	0.22
DM1	-0.09	0.11	0.24	-0.10	0.48	0.32	0.38	0.06	0.45	0.60	**0.85**	0.43	0.31	0.37
DM2	-0.08	0.23	0.05	-0.11	0.29	0.27	0.36	0.09	0.43	0.44	**0.87**	0.47	0.38	0.29
DM3	0.04	0.26	0.13	-0.02	0.22	0.18	0.27	0.09	0.36	0.41	**0.86**	0.41	0.35	0.18
DM4	-0.04	0.18	0.10	-0.03	0.48	0.21	0.32	0.01	0.28	0.23	**0.79**	0.37	0.44	0.38
DM5	-0.15	0.17	0.17	-0.16	0.47	0.45	0.44	0.26	0.36	0.45	**0.88**	0.68	0.53	0.39

Table 5.11 continued

	SUPINOV	RESOURCE	LEARNING	VISION	SEARCH	SCANNING	VERIFY	DISCVRY	MMMAINT	MMBUILD	DECMKNG	IEWORK	PIIT	CSE
IEI1	-0.18	0.10	0.01	-0.26	0.32	0.41	0.32	0.10	0.01	0.14	0.54	**0.89**	0.62	0.30
IEI2	-0.13	0.11	0.03	-0.23	0.23	0.36	0.38	0.11	0.18	0.21	0.53	**0.94**	0.60	0.38
IEI3	-0.09	0.15	0.03	-0.10	0.22	0.32	0.39	0.20	0.25	0.27	0.34	**0.79**	0.42	0.38
IEW1	-0.07	0.15	-0.04	-0.12	0.16	0.31	0.37	0.13	0.26	0.23	0.53	**0.93**	0.56	0.35
IEW2	-0.21	0.04	-0.03	-0.22	0.32	0.33	0.32	0.05	0.13	0.26	0.51	**0.86**	0.66	0.19
IEW3	-0.10	0.18	0.08	-0.14	0.27	0.35	0.41	0.17	0.19	0.22	0.55	**0.94**	0.56	0.35
PIIT1	-0.29	-0.07	-0.14	-0.30	0.24	0.37	0.41	0.11	0.03	0.08	0.38	0.64	**0.90**	0.43
PIIT2	-0.28	-0.15	-0.17	-0.27	0.39	0.21	0.37	0.02	0.14	0.06	0.46	0.50	**0.84**	0.33
PIIT3	-0.41	-0.12	-0.20	-0.32	0.14	0.34	0.27	0.18	0.03	0.13	0.34	0.47	**0.83**	0.29
PIIT4R	-0.32	-0.14	-0.17	-0.35	0.26	0.29	0.30	-0.06	0.06	-0.01	0.44	0.57	**0.84**	0.26
CSE1	-0.08	0.01	0.05	-0.18	0.53	0.30	0.53	0.14	0.23	0.18	0.37	0.35	0.38	**0.93**
CSE2	0.04	0.04	0.15	-0.02	0.37	0.37	0.53	0.22	0.35	0.37	0.33	0.28	0.27	**0.83**
CSE3	-0.12	-0.03	-0.01	-0.16	0.49	0.25	0.51	0.10	0.23	0.18	0.31	0.34	0.38	**0.92**

Table 5.12: Revised Correlation of Constructs (Site 1)

CONSTRUCTS		Composite Reliability	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SupInov	(1)	**0.87**	0.83													
Resource	(2)	**0.88**	0.47	0.80												
CommitLrn	(3)	**0.87**	0.51	0.40	0.79											
Vision	(4)	**0.93**	0.69	0.54	0.55	0.88										
Search	(5)	**0.82**	-0.02	0.05	0.25	-0.07	0.70									
Scanning	(6)	**0.87**	-0.23	0.07	0.14	-0.34	0.27	0.79								
Verify	(7)	**0.80**	0.05	0.08	0.17	-0.08	0.59	0.42	0.71							
Discvry	(8)	**0.88**	-0.15	0.20	0.00	-0.18	0.04	0.55	0.39	0.77						
MMMaint	(9)	**0.96**	0.05	0.16	0.04	0.13	0.28	0.20	0.38	0.17	0.93					
MMBuild	(10)	**0.96**	-0.07	0.17	0.20	0.00	0.24	0.29	0.36	0.20	0.64	0.93				
DecMkng	(11)	**0.93**	-0.08	0.22	0.17	-0.10	0.46	0.35	0.42	0.13	0.45	0.51	0.85			
IEWork	(12)	**0.96**	-0.15	0.13	0.01	-0.20	0.29	0.39	0.41	0.14	0.19	0.24	0.56	0.89		
PIIT	(13)	**0.92**	-0.37	-0.14	-0.20	-0.36	0.30	0.35	0.40	0.07	0.08	0.07	0.48	0.64	0.85	
CSE	(14)	**0.92**	-0.06	0.01	0.07	-0.14	0.52	0.34	0.58	0.17	0.30	0.26	0.38	0.36	0.39	0.89

Note:

Composite Reliability = $\rho_c = (\Sigma\lambda_i)^2/[(\Sigma\lambda_i)^2+\Sigma_i var(\varepsilon_i)]$, where λ_i is the component loading to an indicator and $var(\varepsilon_i) = 1 - \Sigma\lambda_i^2$

Diagonal elements in the 'correlation of constructs' matrix are the square root of the average variance extracted. For adequate discriminant validity, diagonal elements should be greater than corresponding off-diagonal elements.

As you may recall, *Mental Model Building* and *Mental Model Maintenance* emerged as distinct constructs in Site 1, thus allowing us to test the hypotheses pertaining to the differential effects of knowledge-based activities on *Mental Model Building* and *Mental Model Maintenance*. (H2a through H2d) using the model shown in Figure 5.3d. . In this model, 16.7% and 16.1% of the variance in *Mental Model Building* and *Mental Model Maintenance* respectively was explained by *Knowledge Acquisition* and *Knowledge Analysis and Interpretation*. All corresponding loadings were significant as shown in Table 5.14b.

The paths to *Mental Model Building* and *Mental Model Maintenance* from 1) *Focused Search*, 2) *Scanning*, and 3) *Discovery* were non-significant. Thus H2a, H2b, and H2d were not supported. The paths from *Verification* to *Mental Model Building* and *Mental Model Maintenance* were both significant (path coefficients = 0.256, p = 0.04 and path coefficient = 0.327, p = 0.09 respectively). To assess whether the difference was statistically significant and thus that H2c was supported, Chow's test[2] was run. Results indicated that both path coefficients were not statistically different (p = 0.97) hence H2c was not supported.

The structural model was used to test all other hypotheses. As was previously done, the model was first run with no controls or interaction (Figure 5.3a), then with the interaction term (Figure 5.3b), and finally with the controls (Figure 5.3c). Corresponding weights and loadings are displayed in Table 5.14a. For the most part, weights and loadings were significant except for *Support for Innovation*, *Discovery*, *YrsWork* (years in current job), *YrsEmp* (years in organization), and *YrsComp* (years of computer use) which were non-significant. *Perceived Organizational Climate for Learning and Innovation* and all controls explained

[2] The Chow Test is used to test for break points or structural changes in a model. In other words, it is used to determine if regression parameter estimates, in this case path coefficients, differ significantly.

52.7%, 39.1%, and 60.6% of the variance in *Knowledge Acquisition, Knowledge Analysis and Interpretation,* and *Knowledge Utilization* respectively.

Note that Site 1 provided more significant results, possibly due to the higher sample size and thus higher statistical power. Specifically the following three hypotheses, not supported at Site 2, were supported at Site 1: 1) H4, which posited that *Perceived Organizational Climate for Learning and Innovation* would have a positive effect on *Knowledge Utilization* (path coefficient = 0.241, p = 0.03), 2) H3a which posited *Perceived Organizational Climate for Learning and Innovation* as a significant predictor of *Knowledge Acquisition* (path coefficient = 0.457, p < 0.001), and 3) H1c which posited that *Knowledge Analysis and Interpretation* would have a positive effect on *Individual Learning* (path coefficient = 0.304, p = 0.02). In contrast, two hypotheses that were supported at Site 2 were not supported at Site 1: 1) H3c which posited *Perceived Organizational Climate for Learning and Innovation* as a significant predictor of *Knowledge Analysis and Interpretation* and 2) H1a which posited *Knowledge Acquisition* as a significant predictor of *Individual Learning.* Consistent with Site 2, there was strong support for H5, which posited *Individual Learning* as a significant predictor of *Knowledge Utilization.* Significant paths are depicted in Figure 5.3c and summarized results for hypothesis tests are shown in the column labeled *Site 1* in Table 5.10.

5.5.2.3 Exploring a Combined Sample

Since the resulting sample sizes for the study were relatively small, and may have been a contributing factor in some hypotheses not supported we explored combining the pilot data with the main study data as a potential way to increase statistical power

Table 5.13: Revised Measurement Model Weights and Loadings (Site 1)

	Loadings	Weights	T-Statistic	p-value	Significance
SupInov :					
SI4R	0.5318		1.8928	0.03	**
SI5R	0.7493		3.5968	0.00	***
SI6R	0.9482		2.873	0.00	***
SI7R	0.7779		3.5652	0.00	***
Resource:					
RS1	0.7866		2.9353	0.00	***
RS2	0.6404		2.242	0.01	***
RS3	0.8749		3.7331	0.00	***
RS4	0.889		5.4218	0.00	***
Learning:					
CL1	0.8748		12.1481	0.00	***
CL2	0.8177		11.1774	0.00	***
CL3	0.771		6.0843	0.00	***
CL4	0.6863		5.4528	0.00	***
Vision :					
SV1	0.9422		9.5776	0.00	***
SV2	0.8144		4.9207	0.00	***
SV3	0.9087		13.0344	0.00	***
SV4	0.8586		10.5381	0.00	***
Search :					
FS1	0.6624		2.8257	0.00	***
FS2	0.6526		2.4367	0.01	***
FS3	0.8072		5.4244	0.00	***
FS4	0.5926		2.7334	0.00	***
FS5	0.7466		3.6227	0.00	***
Scanning:					
SC4	0.7742		13.175	0.00	***
SC2	0.8362		14.7655	0.00	***
SC1	0.8171		16.4477	0.00	***
SC3	0.7241		9.0204	0.00	***
Verify :					
VER3	0.6578		4.7442	0.00	***
VER2	0.6216		2.1836	0.02	**
VER1	0.788		7.5396	0.00	***
VER4	0.7421		4.5019	0.00	***

Table 5.13 continued

	Loadings	Weights	T-Statistic	p-value	Significance
Discvry :					
DISC1	0.7494		3.0436	0.00	***
DISC3	0.7412		4.3595	0.00	***
DISC5	0.7926		3.4876	0.00	***
DISC2	0.803		2.9585	0.00	***
DISC4	0.7612		3.4606	0.00	***
MMMaint :					
MMM2	0.8726		22.1607	0.00	***
MMM4	0.9454		48.0622	0.00	***
MMM1	0.9543		60.7145	0.00	***
MMM3	0.9274		30.671	0.00	***
MMBuild :					
MMB3	0.7975		10.3886	0.00	***
MMB4	0.934		34.857	0.00	***
MMB2	0.9344		32.2874	0.00	***
MMB1	0.857		18.3903	0.00	***
DecMkng :					
DM4	0.7855		9.5802	0.00	***
DM1	0.8465		13.4833	0.00	***
DM2	0.8699		18.6739	0.00	***
DM5	0.8822		19.4109	0.00	***
DM3	0.8555		14.0539	0.00	***
IEWork :					
IEI1	0.8946		22.6573	0.00	***
IEI2	0.9388		39.3369	0.00	***
IEI3	0.7922		14.6683	0.00	***
IEW1	0.9334		33.6698	0.00	***
IEW2	0.8589		16.7714	0.00	***
IEW3	0.9396		40.7304	0.00	***
PIIT :					
PIIT1	0.9021		55.6453	0.00	***
PIIT2	0.8433		6.4296	0.00	***
PIIT3	0.8305		18.515	0.00	***
PIIT4R	0.8396		10.874	0.00	***

Table 5.13 continued

	Loadings	Weights	T-Statistic	p-value	Significance
CSE :					
CSE1	0.926		43.7711	0.00	***
CSE2	0.8288		19.9276	0.00	***
CSE3	0.9224		40.6439	0.00	***
PriorKno:					
YrsWork		-0.2707	-0.4939	0.31	NS
YrsEmp		0.5251	0.9529	0.17	NS
YrsComp		0.2055	0.5045	0.31	NS
YrsDW		-0.9584	-4.2612	0.00	***

*** significant at 0.01
** significant at 0.05
* significant at 0.10
NS non-significant

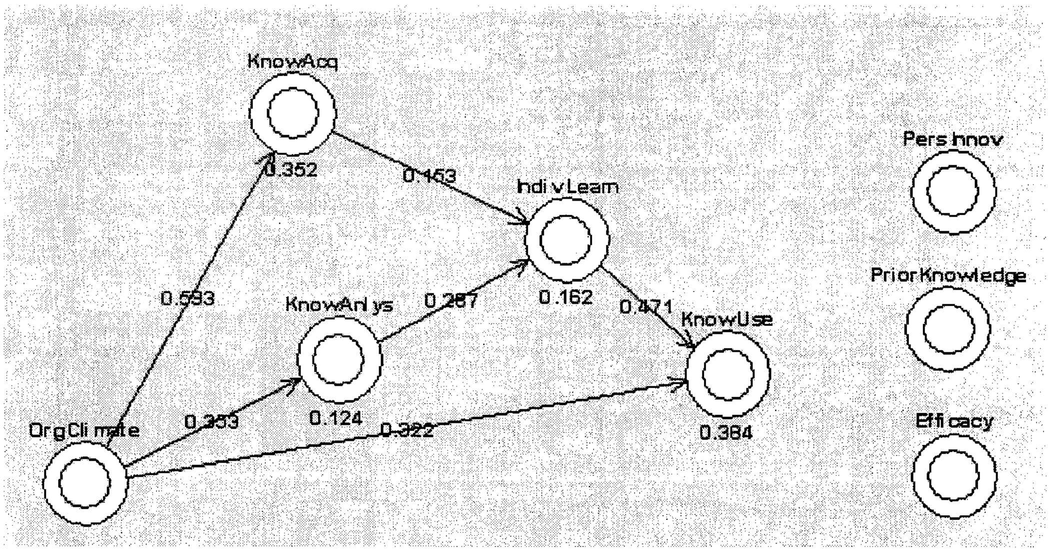

Figure 5.3a: Structural model – no interaction or controls (Site1)

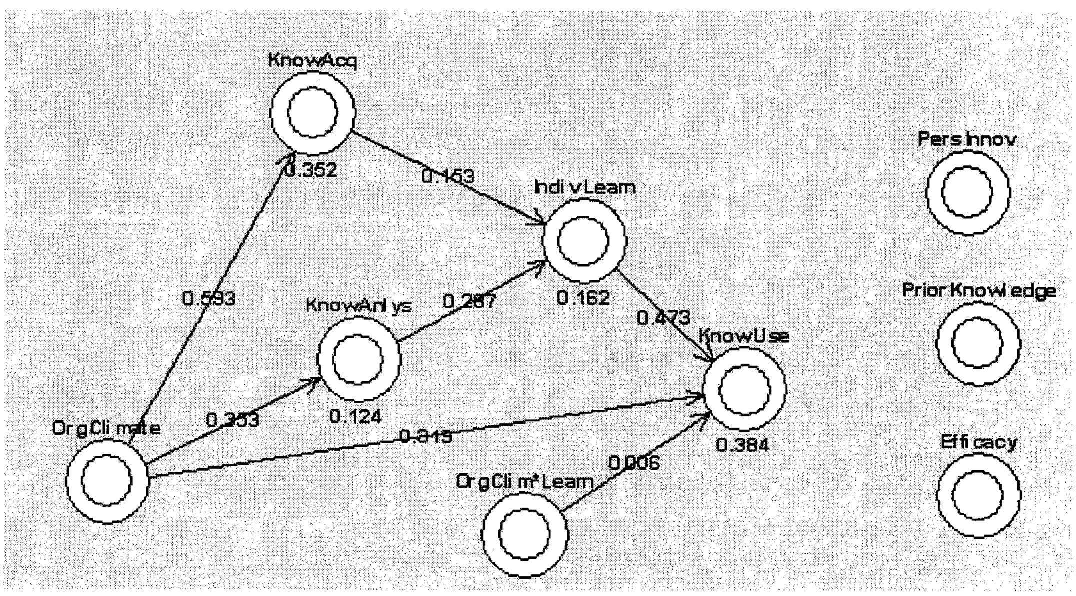

Figure 5.3b: Structural model with interaction, no controls (Site1)

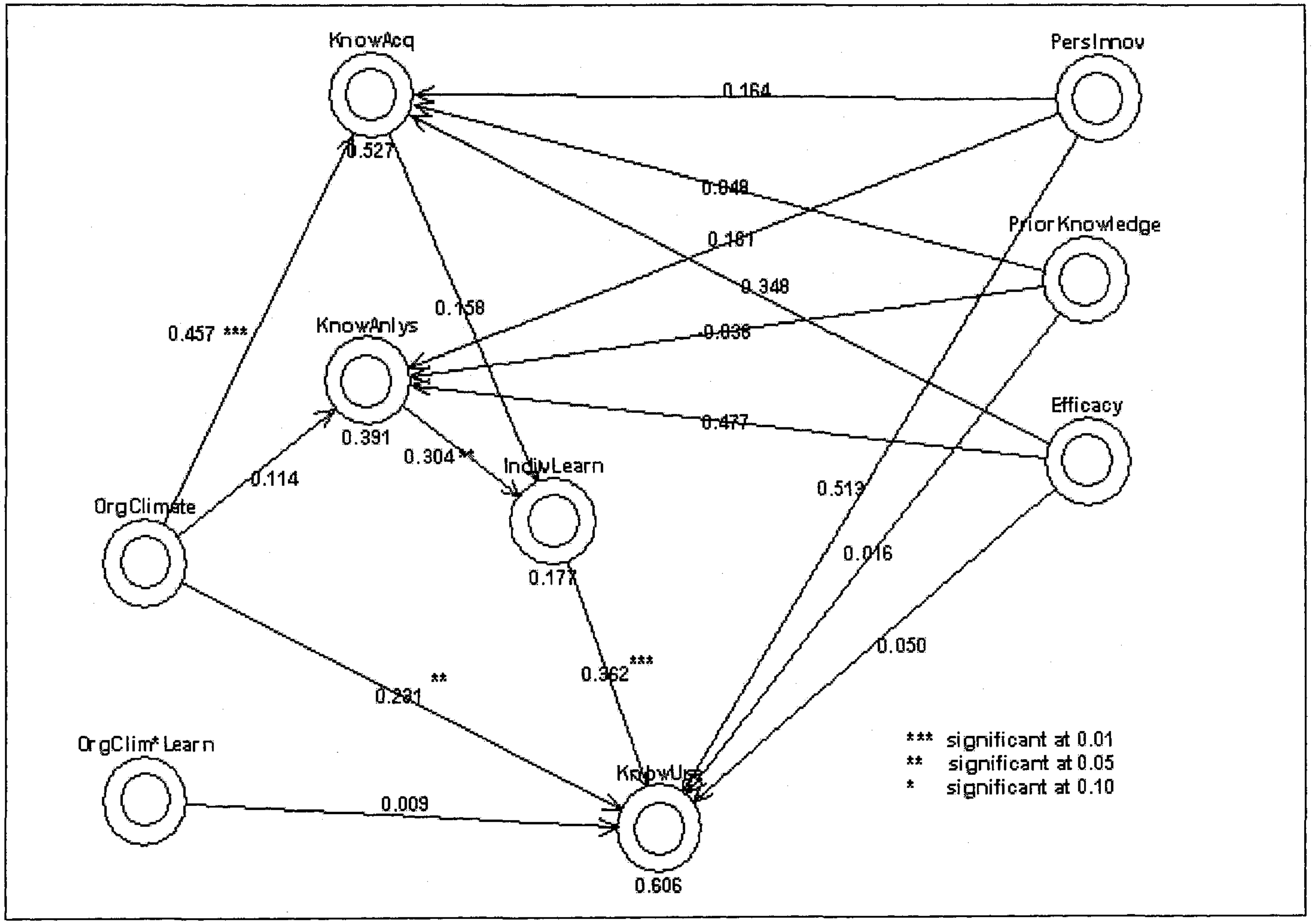

Figure 5.3c: Structural model with interaction and controls (Site 1)

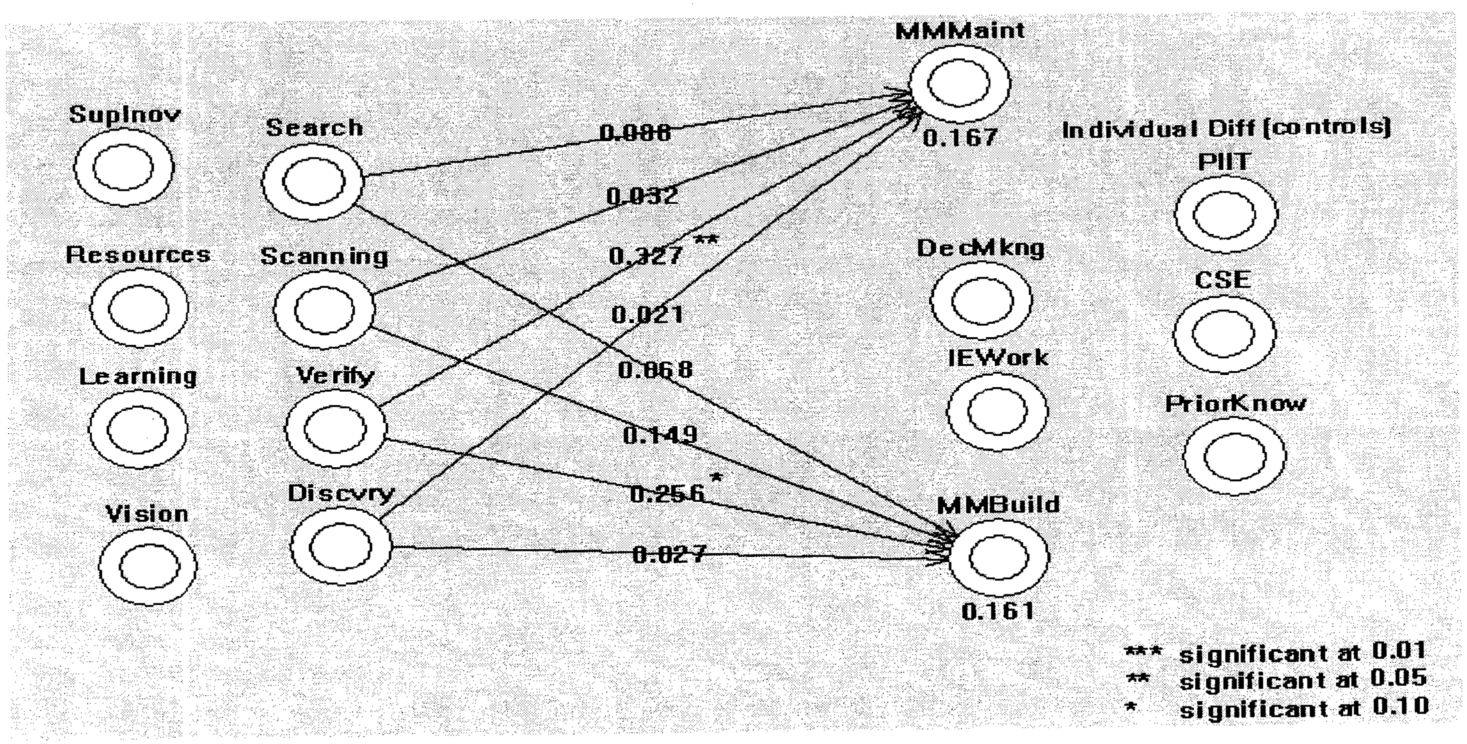

Figure 5.3d: Hypothesis 2 Model (Site 1)

Table 5.14a: Structural Model Weights and Loadings (Site 1)

	Weights	Loadings	T-Statistic	p-value	Significance
OrgClima:					
SupInov	0.2134		0.6312	0.27	NS
Resource	-0.6001		-2.2269	0.01	***
Learning	-0.8582		-2.62	0.01	***
Vision	1.0751		3.5956	0.00	***
KnowAcq :					
Search	-0.574		-2.7213	0.00	***
Scanning	-0.68		-3.2812	0.00	***
KnowAnlys:					
Verify	1.0004		3.9603	0.00	***
Discvry	-0.0011		-0.0041	0.50	NS
IndivLea:					
MMMaint	-0.4338		-1.2743	0.10	*
MMBuild	-0.6663		-1.8384	0.04	**
KnowUse :					
DecMkng	-0.6339		-2.6267	0.01	***
IEWork	-0.495		-2.2399	0.01	***
PersInno:					
PIIT1	0.9039		44.3713	0.00	***
PIIT2	0.8492		8.7926	0.00	***
PIIT3	0.8301		19.8418	0.00	***
PIIT4R	0.8323		12.6346	0.00	***
Efficacy:					
CSE1	0.9206		52.29	0.00	***
CSE2	0.8383		17.6429	0.00	***
CSE3	0.919		40.0833	0.00	***
PriorKno:					
YrsWork	-0.5243		-0.7683	0.22	NS
YrsEmp	0.7785		1.2526	0.11	NS
YrsComp	-0.1263		-0.2556	0.40	NS
YrsDW	-0.9015		-3.2637	0.00	***

*** significant at 0.01   * significant at 0.10
** significant at 0.05   NS non-significant

Table5.14b: Hypothesis 2 Model Loadings (Site 1)

	Loadings:	T-Statistic	p-value	Significance
Search :				
FS1	0.6913	3.3165	0.00	***
FS2	0.6736	2.8111	0.00	***
FS3	0.8401	2.4836	0.01	***
FS4	0.4816	1.616	0.06	*
FS5	0.7366	3.7081	0.00	***
Scanning:				
SC4	0.7978	4.1017	0.00	***
SC2	0.8275	4.4956	0.00	***
SC1	0.7857	4.1239	0.00	***
SC3	0.7367	4.1312	0.00	***
Verify :				
VER3	0.614	3.874	0.00	***
VER2	0.6168	3.225	0.00	***
VER1	0.8097	4.9553	0.00	***
VER4	0.7393	4.8358	0.00	***
Discvry :				
DISC1	0.7533	2.7679	0.00	***
DISC3	0.7606	2.8139	0.00	***
DISC5	0.8543	3.3101	0.00	***
DISC2	0.7619	2.8025	0.00	***
DISC4	0.6801	3.8559	0.00	***
MMMaint :				
MMM2	0.8818	15.1314	0.00	***
MMM4	0.9524	52.2867	0.00	***
MMM1	0.9479	56.404	0.00	***
MMM3	0.9138	27.6117	0.00	***
MMBuild :				
MMB1	0.8667	15.2046	0.00	***
MMB2	0.9327	48.4354	0.00	***
MMB3	0.7871	10.7326	0.00	***
MMB4	0.9404	48.7445	0.00	***

*** significant at 0.01
** significant at 0.05
* significant at 0.10

In order to do so, T-tests were performed on the key dependent and independent variables to ensure that there were no statistically significant differences between the two samples. This was done in Microsoft Excel using construct scores from both samples and the TTEST function. Construct scores were calculated by averaging associated item scores. The resulting p-values indicated a high likelihood that both samples did not come from populations with the same mean. With the exception of *Support for Innovation* ($p = 0.12$), *Scanning* ($p = 0.24$), *Discovery* ($p = 0.21$), and *Mental Model Building* ($p = 0.13$), all other p-values were below 0.05 indicating that there were statistically significant differences between both sets of construct scores. Subsequently, data from both samples were not pooled.

5.5.3 Hypothesis Testing Summation

In summary, this section provided a detailed discussion of procedure used to test the research hypotheses. Initially, Site 2 data was used for hypothesis testing resulting in moderate support for the research model. In order to improve external validity and to test hypotheses H2a through H2d, hypothesis testing was repeated using Site 1 (pilot) data yielding more significant results than before, possibly due to the larger sample size. Finally, after T-tests revealed significant differences in construct scores from both samples, there was no justification for pooling the data to increase statistical power.

5.6 Chapter Summary

This chapter provided a two step approach to the hypothesis testing performed in this research study. The first section provided details regarding data collection at second research site and testing of research hypotheses. In order to improve external validity, hypothesis testing was repeated using the pilot data after ensuring that the Site 1 measurement model was structurally equivalent to that of Site 2. In other words, each construct had the same items for Site 1 and Site 2 data. Both samples yielded moderate support for the research model. Much of the analysis involved using PLS to perform structural equation modeling; however SPSS and Microsoft Excel were also valuable analytical tools. The final chapter contains a more in depth discussion and interpretation of the results, as well as implications for future research.

CHAPTER 6

DISCUSSION OF RESULTS

6.1 Introduction

The purpose of this chapter is to provide an in-depth discussion of the data analysis and results presented previously in Chapter Five. First, the research findings are discussed and implications for practice are offered. Next, the limitations of this study are addressed. Finally, the chapter concludes with directions for future research.

6.2 Research Findings

The main objective of this study was to examine how use of knowledge management technologies (KMTs) such as groupware, data warehouses, and portals, has contributed to learning within organizations. The study was grounded in organizational learning and IT implementation theories. These two streams of literature were used to derive a conceptual framework that identified paths through which such learning can take place at the individual and ultimately the organizational level. The central argument of this research was that use of a KMT promotes individual learning, and this knowledge, when applied in an organizational setting, results in organizational learning. It was also hypothesized that certain individual and organizational characteristics would influence two categories of usage behaviors: technology use and knowledge use. The conceptual framework was used to develop the research model (Figure 3.1) and six associated (sets of) hypotheses (Table 3.1).

6.2.1 Overview of Findings

The model was empirically evaluated in the context of data warehousing technologies, and therefore only applicable variables were operationalized. Hypotheses were tested separately using two independent samples: Site 1 (n = 66) and Site 2 (n = 47). Significance in findings varied by sample but for any given data set, there was partial support for the research model. The small sample sizes for the study may have contributed to some non-significant findings. The results of hypothesis testing, shown in Table 6.1, and subsequent interpretations and conclusions are based on the results from both samples. The remainder of this section reports the details of research findings.

6.2.2 Antecedents of Individual Learning

At the very heart of the research model is the relationship between knowledge-based activities (usage behavior) and learning. Knowledge-based activities included *Knowledge Acquisition* (KA), *Knowledge Sharing* (KS) and *Knowledge Analysis and Interpretation* (KAI). KS is not applicable in a data warehouse context and therefore any related hypotheses were not tested, specifically H1b and H3b that relate to antecedents and consequences of KS. The relationship between KA and *Individual Learning*, as proposed in H1a, was significant for Site 2. Similarly, the relationship between KAI and *Individual Learning*, as posited in H1c, was significant for Site 1. The difference in results across the two samples may be attributed to the fact that Site 2 has only been using the DW for (on average) less than a year while the average length of DW use in Site 1 was 2.24 years. It is possible that initial use of a DW focuses mostly on the more routine KA activities whereas later use involves more sophisticated uses such as KAI. Even though descriptive statistics from the two sites support this interpretation, future research should investigate how the relationship between knowledge based activities and learning evolves over time. Taken together, these findings indicate that KMT use is a significant predictor of mental model maintenance and mental model building.

The research model further proposed relationships between knowledge-based activity dimensions and *Individual Learning* dimensions. Specifically H2a though H2d posited the relative and positive effects of *Focused Search*, *Scanning*, *Verification*, and *Discovery* on *Mental Model Maintenance* and *Mental Model Building*. These relationships were not tested at Site 2 because the data did not distinguish *Mental Model Maintenance* and *Mental Model Building* as distinct dimensions of *Individual Learning*. However, H2a through H2d were tested for Site 1. *Focused Search* was not more likely to result in *Mental Model Maintenance* than in *Mental Model Building* (H2a) as both paths were non-significant. Similarly, *Verification* was not more likely to result in *Mental Model Maintenance* than in *Mental Model Building* (H2c). However both path coefficients were significant indicating that *Verification* was a significant predictor of both *Individual Learning* dimensions. Contrary to hypothesis H2d, *Discovery* was not a significant predictor of *Mental Model Maintenance* or *Mental Model Building*.

Descriptive statistics were examined to explain these findings. Specifically, with respect to *Discovery*, upon further examination of the Site 1 descriptive statistics in Table 4.3, it was evident that users engaged in *Discovery* (mean = 3.49, SD = 1.28) to a lesser extent than *Focused Search* (mean = 5.58, SD = 0.95), *Scanning* (mean = 3.99, SD = 1.23), and *Verification* (mean = 5.29, SD = 1.05). Similar results were obtained at Site 2 (see descriptive statistics in Table 5.2) where *Discovery* had the lowest mean of all the knowledge-based activities. One possible explanation for the limited use of data mining applications is inadequate training. Site 2 survey comments such as "I have not really been trained to use COGNOS...", "the survey gave indications that COGNOS could perform experimental functions....I thought COGNOS was just a record keeper of reports" and from Site 1, "It was very challenging to learn which (BO) universe to use and which objects to achieve results needed for reports" validate this line of reasoning and further explains why *Verification* was the preferred behavior. At both organizations standard reports, easily refreshed as needed, were provided through the respective data warehouses. Reported sample statistics for Sites 1 and 2 in Tables 4.3 and 5.2 respectively also indicate that 30% of Site 1 users and 8% of Site 2 users considered themselves highly proficient (defined as the ability to create complex reports). Hence the majority of users refreshed existing reports or generated simple ones.

In addition, perceptions of poor data quality may have had an impact on the results. According to a Site 1 user, "The quality of referential integrity between tables/views appears to be very poor....data are not trustworthy..." Another Site 1 user was frustrated with response time and Web access problems. Training aside, a Site 2 user cited dissatisfaction with the way in which the technology was deployed. These comments indicate that both organizations may be grappling with implementation issues that inhibit more effective use of their respective DWs.

Table 6.1: Summary of Research Hypotheses

Use of an IT for knowledge-based activities and Individual Learning.	**Supported**
H1: Use of an IT for knowledge -based activities will have a positive effect on Individual Learning.	
H1a: Use of an IT for Knowledge Acquisition will have a positive effect on Individual Learning.	**Partially***
H1b: Use of an IT for Knowledge Sharing will have a positive effect on Individual Learning.	N/A
H1c: Use of an IT for Knowledge Analysis and Interpretation will have a positive effect on Individual Learning.	**Partially**
H2a: Focused Search is more likely to result in MMM than in MMB.	No
H2b: Scanning is likely to result in MMB and MMM.	**No**
H2c: Verification is more likely to result in MMM than in MMB.	No
H2d: Discovery is likely to result in MMB and MMM.	No
Perceived Organizational Climate for Learning and Innovation and use of an IT for knowledge-based activities.	
H3: Perceived Organizational Climate for Learning and Innovation will have a positive effect on the extent to which a KMT is used for knowledge-based activities.	
H3a: Perceived Organizational Climate for Learning and Innovation will have a positive effect on the extent to which a KMT is used for Knowledge Acquisition.	**Partially**
H3b: Perceived Organizational Climate for Learning and Innovation will have a positive effect on the extent to which a KMT is used for Knowledge Sharing.	N/A
H3c: Perceived Organizational Climate for Learning and Innovation will have a positive effect on the extent to which a KMT is used for Knowledge Analysis and Interpretation.	**Partially**
Perceived Organizational Climate for Learning and Innovation and Knowledge Utilization.	
H4: Perceived Organizational Climate for Learning and Innovation will have a positive effect on Knowledge Utilization.	**Partially**
Individual Learning and Knowledge Utilization	
H5: Individual Learning will have a positive effect on Knowledge Utilization	**Yes**
Moderating effect of Perceived Organizational Climate for Learning and Innovation on the relationship between Individual Learning and Knowledge Utilization	
H6: Perceived Organizational Climate for Learning and Innovation will moderate the relationship between individual learning and knowledge utilization such that high Individual Learning will be more likely to result in Knowledge Utilization in the presence of, rather than in the absence of, a pro-innovative working climate.	No

Note: *Partially indicates that the hypothesis was supported at one of two research sites.

6.2.3 Individual Learning and Knowledge Utilization

The true value of learning lies in the actual or potential application of knowledge. Individuals can actively include new knowledge in their decision-making processes or have the intent to do so. In this study both dimensions were incorporated into *Knowledge Utilization*. Actual use was operationalized as *Decision-making Impacts*. Intention was a proximal measure of potential use and was operationalized as *Intentions to Explore Work*. Both dimensions were highly significant for Site 1 and were marginally significant at Site 2.

The hypothesized direct relationship between *Individual Learning* and *Knowledge Utilization*, as proposed in H5, was supported at both sites. This implies that as individuals gain insights from the data warehouse, they actually apply or are likely to apply this knowledge within their work context thus providing organizational benefit. This supports Huber's (1990) definition of organizational learning which focuses on the context in which knowledge is applied (in this case the organization) by individuals and/or groups.

Construct scores for Site 1 and Site (Table 4.3 and Table 5.2 respectively) indicate low levels of Scanning and Discovery, moderate levels of Focused Search and Verification, and moderate levels of Mental Model Maintenance and Mental Model Building. The strong relationship between *Individual Learning* and *Knowledge Utilization* implies that higher levels of learning will lead to higher levels of knowledge use.

6.2.4 Perceived Organizational Climate for Learning and Innovation

In this study *Perceived Organizational Climate for Learning and Innovation* is comprised of four dimensions: *Support for Innovation* (SupInov), *Resource Supply* (Resource), *Shared Vision*

(Vision) and *Commitment to Learning* (Learning). Structural model weights and loadings (Tables 5.8 and 5.14a) revealed that *Support for Innovation* was the only significant dimension at Site 2 (mean = 4.08, SD = 1.22), and the only non-significant dimension at Site 1 (mean = 4.48, SD = 1.37).

The research model proposed a direct positive path from *Perceived Organizational Climate for Learning and Innovation* to each of the following: KA (H3a), KAI (H3c), and *Knowledge Utilization* (H4). In addition to these direct effects, it was posited in H6 that *Perceived Organizational Climate for Learning and Innovation* would moderate the relationship between *Individual Learning* and *Knowledge Utilization*. The significance of each of these paths is discussed below.

6.2.4.1 Knowledge-Based Activities

Perceived Organizational Climate for Learning and Innovation was a significant predictor of KA for the Site 1 as hypothesized in H3a. In addition, there was a significant positive relationship between *Perceived Organizational Climate for Learning and Innovation* and KAI for the Site 2, thereby supporting H3c. When taken together these results indicate that the learning and innovation orientation of working climate is an important determinant of the extent to which individuals engage in knowledge acquisition and analysis behaviors. This is consistent with the theory of planned behavior (TPB; Ajzen 1991) which posits that subjective norms as well as requisite resources and opportunities, are important predictors of intention, a crucial antecedent of behavior.

6.2.4.2 Knowledge Utilization

Perceived Organizational Climate for Learning and Innovation was a significant predictor of *Knowledge Utilization* for Site 1. This finding suggests that even though an individual may be receptive to new ideas and thereby inclined to learn, acting on this inclination may depend on organizational cues that encourage or discourage the application of this new knowledge.

6.2.4.3 The Moderating Effects of Perceived Climate

No support was found for the hypothesized moderating effect of *Perceived Organizational Climate for Learning and Innovation* on the relationship between I*ndividual Learning* and *Knowledge Utilization* (H6). This is not unexpected since interaction effects are often difficult to measure and require greater power to detect than do main effects. Thus, it is possible that the given samples may have been too small for this effect to be detected. Future studies, with larger sample sizes, can provide more definitive evidence on this relationship.

6.2.4.4 Individual Difference Controls

Three individual difference controls were incorporated in this study: *Personal Innovativeness in IT, Computer Self-efficacy*, and *Prior Related Knowledge.* As predicted, controls had a large combined effect on both usage behaviors: KMT use and knowledge use. However, despite the large increase in explained variance, no significant individual paths between controls and usage behaviors were found in either data set. This may suggest possible interaction effects. Nonetheless, these individual differences seem to be playing an important role in KMT-related behaviors and thus warrant further investigation in future research.

The structural model weights and loadings for both samples (Tables 5.8 and 5.14a) indicate that at Site 1, years of computer use (YrsComp) and years of data warehouse use (YrsDW) were significant indicators of *Prior Related Knowledge* yet at Site 2, years of data warehouse use was significant. Organizational tenure (YrsEmp) and years in current position (YrsWork) were not significant in either sample. These results indicate that *Prior Related Knowledge,* especially computer/data warehouse experience, is a significant predictor of KAI behaviors. According to one user, "... the folks who set it (the DW) up did a good job but forgot that it might not be intuitive to the rest of us." Another stated, "...DBs (databases) are powerful tools but a lot of people who need to access the data aren't sufficiently knowledgeable about models or the data to create good queries." Once again these comments underscore the importance of adequate training.

6.2.4.5 Practical Implications

When taken together these results indicate moderate support for the research model and help us to understand the processes through which KMT use fosters learning. There was a strong relationship between knowledge-based activities and learning. Furthermore learning was primarily the result of verification. Working climate was also found to have a significant effect on knowledge acquisition and analysis behaviors as well as knowledge use. Individual characteristics also appear to be important in usage behaviors. These findings have a number of implications for practice.

One major implication of this study is that KMTs contribute to organizational learning. These results demonstrate that within an organizational context, IT-enabled learning can produce organizational benefits. Furthermore, contextual factors and individual characteristics also determine the extent to which individuals will engage in the kind of usage activities that are likely to foster mental model maintenance and building. In the context of a data warehouse, these findings suggest that on-going use of query, OLAP, and data mining capabilities is likely to result in improved decision-making and may even enhance users' ability to find innovative uses for the technology on the job, thereby enabling them to "work smarter."

Second, the extent to which an individual perceives working climate as being supportive of learning and innovation is crucial in determining the extent and the nature of that individual's usage behaviors. Managerial support should be manifest in encouragement, rewards, as well as resources. As one user commented "the *reality* does not always match the *talk* around here...some things only get lip service only – it's cheaper." Hence, a shared vision and verbal commitments to learning and innovation are steps in the right direction, but the provision of adequate resources is also necessary.

Third, certain individual characteristics were found to have a significant impact on usage behaviors, particularly computer experience in general and technology-specific experience. Lack of adequate training may explain why certain usage behaviors, namely search and discovery, were not prevalent or were not likely to result in mental model building or maintenance. Training is particularly critical in a data warehouse context. Because this integrated data store is designed to provide informational resources to an entire organization, it is vast and the associated tools are complex and not necessarily intuitive. Customized training, therefore, enables users to select the right tools and data that best suit their information needs.

Based on the above, it is evident that working climate can facilitate or enhance the extent to which KMTs are used to acquire and apply knowledge in an organization. Furthermore, expectations and behavioral norms can be shaped by deliberate managerial action. Therefore, an organization is more likely to realize the intended benefits from KMT deployment (knowledge creation, sharing, and integration) if it creates a climate that facilitates learning and innovation.

These findings should provide those who deploy KMTs with a better understanding of how these technologies can provide value to individuals and how to encourage the effective use of such systems. In addition, the survey instrument provides a means of evaluating 1) the extent to which individuals are engaging in knowledge-based activities and 2) perceptions of the organizational support for creativity in general. This feedback could be used either to focus attention on areas in which organizational support is lacking or to provide justification for more widespread deployment.

Finally, the research suggests some issues related to KMT design as well as deployment. As modeled in this research, knowledge is regarded as an individual attribute and learning is an individual process. However, much knowledge is created through shared sensemaking and is held collectively in communities of practice such as organizations (Brown and Duguid, 1998). Both the knowledge and its value are socially constructed and situated (Lave and Wenger, 1991), and it is the collective that decides/influences what knowledge is meaningful, useful, and actionable (Brown and Duguid, 1998).

There are two implications for KMTs, one for deployment and one for design. In deployment, organizations should sanction the use of such technologies as being mission-critical or otherwise valuable to business processes. For designers of KMTs, it is useful to recognize that any knowledge derived from KMT use is subject to interpretation and application in a given organizational context. Hence, even though some KMTs such as a DW may be used individually, there still needs to be a shared understanding of the meaning of outputs such as graphs, visualizations, patterns, and relationships as they relate/apply to the organization. A variety of processes may help develop this shared understanding. These may include boundary objects (Star and Greisemer, 1989), and KMT designers may need to build into their systems specific types of boundary objects (Carlile, 2002) that facilitate the development of these shared understandings.

6.3 Limitations

As with any other, this study has a number of limitations. The first relates to source bias. This study relied solely on self-reported end user-perceptions. Future efforts at examining these relationships should attempt to utilize alternative methodologies for the purposes of triangulation, in essence validating subjective measures with objective ones. For example, since some empirical evidence suggests that self-reported measures of usage do not correspond with objective measures of usage (Straub, Limayen, and Karahanna-Evaristo, 1995), actual usage statistics could be gathered from system logs and compared to the self-reported use.

The second limitation relates to the nature of the study. Learning evolves over time and as such, a cross-sectional study does not capture the complexity of this evolution. Longitudinal studies would provide more rigorous tests of the relationship between KMT use and learning, as well the relationship between learning and knowledge use. Such studies would also provide the means to validate the hypothesized causality in the research model.

A third limitation relates to sample size and composition. The number of respondents within each organization was small and may have limited the ability to detect significant relationships or may have accounted for the differences in significance across samples. This research needs to be replicated across a wider range of organizations and KMTs in order to improve its external validity. It should be noted that attempts made to include other organizations in the study were not successful. For most, the data warehouse had not been implemented long enough for users to become proficient or there were too few users to provide an ample sample size. Other organizations, however, were uncomfortable with the questions related to organizational climate. This proved to be a real dilemma when soliciting participation.

Finally, both research sites were non-profit organizations thereby limiting the generalizability of the results. Therefore the study needs to be replicated in for-profit organizations in order to determine if results differ in alternate settings.

Despite these limitations, however, the study has the advantage of being conducted in two separate organizational settings which improves its generalizability to similar organizations using similar technologies. Furthermore, this research provides evidence that the use of KMTs contribute to learning within organizations, and that controllable contextual characteristics determine ways in which this learning can be beneficial to an organization.

6.4 Contributions and Future Directions

This research study was conducted in direct response to the call made by Vandenbosch and Higgins (1996) to extend their study of the relationship between executive support system (ESS) knowledge acquisition behaviors (focused search and scanning) and individual learning (mental model maintenance and mental model building). They proposed that future studies examine the effects of individual characteristics and organizational context on knowledge acquisition behaviors. In addition to heeding these suggestions, this study extended their work by developing and testing a more comprehensive research model of knowledge-based activities and learning outcomes. The extended model incorporates: 1) a broader conceptualization of knowledge-based activities (acquisition, sharing, and analysis and interpretation) facilitated by technologies designed to support knowledge work, 2) consequences of post-adoptive behavior in the form of specific organizational learning outcomes (decision-making impacts and intentions to innovate with an IT), 3) the effect of certain perceived working climate characteristics (that reflect learning and innovation orientation) on usage behaviors (KMT use and knowledge use), and 4) the effect of specific individual characteristics (personal innovativeness in IT, computer self-efficacy, and prior related knowledge) on both of the aforementioned usage behaviors.

While the focus of this research was on KMTs and not ESSs, the relationships between KMT usage behaviors and learning generally are consistent with those found by Vandenbosch and Higgins (1996). Specifically, knowledge-based activities are significant predictors of mental model maintenance and building. Results from this study also validate most of the additional relationships depicted in the extended research model. There is a significant relationship between perceived organizational climate for learning and innovation and both usage behaviors (KMT use and knowledge use). In addition, specific user-situational and personality differences have a combined significant effect on both usage behaviors.

These findings have a number of implications for future research. First, this study warrants further investigation and some interesting possibilities exist. A complementary follow-up qualitative study of end-users at both research sites could provide some insight into the extent to which they use of the DW has enabled them to be more creative in the way they work. This may further help to explain quantitative results by providing a richer interpretation of them.

Second, further research is needed to understand the relative effects of organizational, KMT, and individual characteristics and their interaction. As you may recall, individual difference controls had a combined large effect on all usage behaviors but none were individually significant suggesting that there may have been interactive effects. The relatively small samples in the current study precluded examining these interaction effects.

Third, empirical research is needed to determine the extent to which individual learning results in higher order learning outcomes such as individual and/or organizational performance (Vandenbosch and Higgins, 1996) and IT infusion, namely extended use, integrative use, and emergent use. Along these same lines Nambisan et al. (1999) cite the need for future IT research to shift focus from IT acceptance and further examine factors that influence users' ability to find new uses for an IT.

Another avenue of research relates to the temporal nature of the phenomenon of interest – learning. Because learning evolves over time, the research model should be tested longitudinally. This would provide a way to examine the relative effects of various dimensions of perceived climate and individual characteristics on learning and learning outcomes over time. In addition, it can examine how knowledge-based activities evolve over time as users gain experience with the technology. Subsequently, it could also be determined whether or not intentions in Time 1 result in specific behaviors in Time 2, and why they do or do not. One could further investigate how the manipulation of certain perceived climate dimensions affects learning and subsequent learning outcomes.

Finally, the research model should also be empirically tested in the context of other KMTs and organizations to determine its predictive validity in alternate settings. The model includes a comprehensive set of knowledge-based activities that can be tailored to a specific KMT. As you may recall, KS was not tested in this study because it was not applicable in a data warehouse setting. It would, however, be applicable in a context where groupware is deployed.

Overall, these research findings are very encouraging. Based on feedback from end-users at participating organizations, it seems that the DW is not yet truly "seasoned:" or entrenched in organizational routines despite being deployed for a few years. This is understandable considering that a DW often takes, on average, two to five years to implement. Yet users have begun to reap benefits within a relatively short time [DW experience ranged from 0.83 years (Site 2, SD = 0.72) to 2.24 years (Site 1, SD = 1.66)] thereby verifying that KMTs such as DWs have the potential to contribute significantly to the gathering and use of organizational intelligence. Study results also underscore the need to provide a supportive working environment in order to encourage knowledge-based activities and knowledge use. Finally, user-situational differences (such as experience) and personality differences, both significant predictors of usage behavior, can be honed and channeled respectively for the creative good of the organization.

6.5 Chapter Summary

This research was driven by the need to understand the processes through which the use of knowledge management technologies contributes to learning within organizations. Chapter One provided justification for the study and outlined the broad research objectives. Chapter Two reviewed the organization learning and IT implementation theories that were used to develop the conceptual framework that guided the study. The research model and related hypotheses were presented and explained in Chapter Three. Chapter Four gave details of the research methodology and included results of the pre-test and the pilot. Chapter Five presented the results of the data analysis and hypothesis testing. Finally, Chapter Six included a discussion of results, implications for practice, limitations, and directions for future research.

APPENDIX A

Scale Items Organized by Construct

Perceived Organizational Climate for Learning And Innovation

Support for Innovation (Scott & Bruce, 1994) [SI]

1. The main function of members in this organization is to follow orders, which come down through channels.
2. Creativity is encouraged here.
3. A person cannot do things too different around here without provoking anger.
4. People around here are expected to deal with problems in the same way.
5. This place seems to be more concerned with the status quo than with change
6. Around here, a person can get in a lot of trouble by being different
7. The reward system here benefits mainly those who don't rock the boat.

Resource Supply (Scott & Bruce, 1994) [RS]

1. Assistance in developing new ideas is readily available
2. There are adequate resources devoted to innovation in this organization
3. There is adequate time available to pursue creative ideas here
4. This organization gives me the free time to pursue creative ideas during the workday

Commitment to Learning *(Sinkula, Baker, and Noordewier, 1997)* [CL]

1. Learning in this organization is seen as a key commodity necessary to guarantee organizational survival.
2. Managers agree that our organization's ability to learn is the key to our success.
3. The basic values of this organization include learning as key to improvement
4. The sense around here is that employee learning is an investment not an expense.
5. This organization provides opportunities for professional development such as training, workshops, and seminars.
6. This organization provides opportunities for individual development other than formal training, such as team activities and experimentation.
7. In this organization, there is a commitment to sharing knowledge.

Shared Vision *(Sinkula, Baker, and Noordewier, 1997)* [SV]

1. There is a commonality of purpose in this organization.
2. There is agreement on our organizational vision across all levels, functions, and divisions.
3. All employees are committed to the goals of this organization.
4. Around here, employees view themselves as partners in charting the direction of the organization.

Extent of Use of Knowledge-Based Activities

Knowledge Acquisition

Focused Search (Vandenbosch and Higgins, 1996) [FS]

1. I regularly focus on specific information contained in the DW.
2. I use the DW to find answers to specific questions.
3. I use the DW to do routine queries.
4. I review a consistent set of reports in the DW.
5. I use the DW to look for information I need.

Scanning (Vandenbosch and Higgins, 1996) [SC]

1. I randomly browse through information contained in the DW.
2. I use the DW to see what's new.
3. I vary the information that I look in the DW.
4. My scanning of the DW is wide-ranging

Knowledge Sharing [KS]

5. I use the <*substitute technology*> to share information with colleagues.
6. I use the <*substitute technology*> to exchange my ideas with others.
7. I use the <*substitute technology*> to discuss issues with to co-workers.
8. My colleagues and I use the <*substitute technology*> to collaborate on work assignments.

Knowledge Analysis and Interpretation

Verification [VER]

1. I use the DW to perform a regular set of analyses.
2. When using the DW, I select usually the type of analysis to be performed.
3. I use the DW to analyze data with specific objectives in mind.
4. I use the DW to do specific calculations.

Discovery [DISC]

1. I rely on data mining tools to reveal unexpected data patterns.
2. I rely on data mining tools to interpret what is happening with the data.
3. I use the DW to perform free-form analysis.
4. I engage in data mining activities with no clear-cut objectives in mind.

Individual Learning

Mental Model Maintenance *(Vandenbosch and Higgins, 1996)* [MMM]

To what extent has using the DW enabled you to:

1. Verify your assumptions.
2. Reinforce your perspectives.
3. Confirm you beliefs.
4. Validate your point of view

Mental Model Building *(Vandenbosch and Higgins, 1996)* [MMB]

To what extent has using the DW enabled you to:

1. Challenge your perspectives.
2. Reorient your thinking.
3. Expand your knowledge.
4. Question your preconceptions.

Knowledge Utilization

Decision-Making Impacts *(Sanders and Courtney, 1985)* [DM]

1. As a result of use of the DW, I am better able to set my priorities in decision making.
2. Use of the data generated by the DW has enabled me to present my arguments more convincingly.
3. Use of the DW has improved the quality of decision I make in this organization.
4. As a result of using the DW, the speed with which I analyze decisions has increased.
5. The DW has led me to greater use of analytical aids in my decision making.

Intentions to innovate

Intentions to explore an IT (Nambisan, Agarwal and Tanniru, 1999) [IEI]

1. I intend to explore the DW for potential applications to my work.
2. I intend to explore the DW for enhancing the effectiveness of my work.
3. I intend to spend considerable time and effort this year in exploring the DW for potential applications.

Intentions to explore work activities [IEW]

1. I intend to explore ways in which business knowledge from the DW can be applied to my work.
2. I intend to explore ways in which business knowledge from the DW can be used to improve my job performance.
3. I intend to explore business knowledge in the DW for potential applications.

Individual Characteristics

Personal Innovativeness in IT *(Agarwal and Prasad, 1998)* [PIIT]

1. I like to experiment with new information technologies.
2. If I heard about a new information technology, I would look for ways to experiment with it.
3. Among my peers, I am usually the first to try out new information technologies.
4. In general, I am hesitant to try out new information technologies.

Computer Self-efficacy *(Taylor and Todd, 1995)* [CSE]

1. I feel comfortable using the DW on my own.
2. I can easily manipulate the DW when I need to.
3. I am able to use the DW when there is no one around to show me how to use it.

Prior Related Knowledge

The following items will be used to control for prior related knowledge.

1. How many years have you been employed with the organization? [YRSEMP]
2. How many years have you worked in your current position? [YRSWORK]
3. How many years have you been using a computer (for work, school, or home purposes)? [YRSCOMP]
4. How long have you been using the DW? [YRSDW]

APPENDIX B

Human Subjects Approval Memorandum

Florida State
UNIVERSITY

Office of the Vice President
for Research
Tallahassee, Florida 32306-2763
(850) 644-8633 • FAX (850) 644-4392

REAPPROVAL MEMORANDUM
from the Human Subjects Committee

Date: May 8, 2002

From: David Quadagno, Chairperson

To: Karen Graham
1886 Mary Ellen Drive
Tallahassee, FL 32303

Dept: Information & Management Sciences

Re: Reapproval of Use of Human subjects in Research
Project entitled: The Data Warehouse: A Knowledge-Creating Resource?

Your request to continue the research project listed above involving human subjects has been approved by the Human Subjects Committee. If your project has not been completed by April 13, 2003, please request renewed approval.

You are reminded that a change in protocol in this project must be approved by resubmission of the project to the Committee for approval. Also, the principal investigator must report to the Chair promptly, and in writing, any unanticipated problems involving risks to subjects or others.

By copy of this memorandum, the Chairman of your department and/or your major professor are reminded of their responsibility for being informed concerning research projects involving human subjects in their department. They are advised to review the protocols of such investigations as often as necessary to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

:hh
cc: Dr. Robert Mason
human/renewal.hs
APPLICATION NO.02.231 -R

APPENDIX C

Informed Consent Form

I freely and voluntarily and without element of force or coercion, consent to be a participant in the research project entitled ***"The Impact of Knowledge Management Technologies on Learning within Organizations"***.

This research is being conducted by Karen Graham, a doctoral candidate under the advisement of Dr. Robert Mason, Professor of and Management Sciences, both of Florida State University. I understand the purpose of her research project is to better understand how data warehousing technologies are being used. In addition, the study seeks to determine how data warehousing technologies facilitate individual learning and improved decision-making. I understand that if I participate in the project I will be asked questions about my usage of information technologies as well as general information about my organization and myself.

I understand I will be asked to fill out a web-based survey. I may also be asked to participate in an interview with the researchers named above. The total time commitment would be about 30 minutes for the survey and no more than 30 minutes for the interview. I will not receive any compensation for my time. The researchers will answer my questions or they will refer me to a knowledgeable source.

I understand my participation is totally voluntary and I may stop participation at anytime. All my answers to the questions will be kept confidential to the extent allowed by law. My name will not appear on any of the results. Results will be reported in aggregate, not individually.

I understand there is a possibility of a minimal level of risk involved if I agree to participate in this study. I might experience anxiety when thinking about information technologies. The researchers will be available to talk with me about any emotional discomfort I may experience while participating. I am also able to stop my participation at any time I wish.

I understand there are benefits for participating in this research project. First, my own awareness about the capabilities of data warehousing technologies will change. Also, I will be providing information technology professionals with valuable insight into users' feelings and behaviors regarding the advantages and shortcomings of these technologies. This knowledge can assist them in providing user-friendly tools that improve decision-making in organizations. I understand that this consent may be withdrawn at any time without prejudice, penalty or loss of benefits to which I am otherwise entitled. I have been given the right to ask and have answered any inquiry concerning the study. Questions, if any, have been answered to my satisfaction.

I understand that I may contact Karen Graham, Florida State University, Department of Information and Management Science, at (850)-644-3869 or kag8836@garnet.acns.fsu.edu, for answers to questions about this research or my rights. Group results will be sent to me upon my request.

I have read and understood this consent form.

I AGREE to participate in this

I DO NOT wish to participate in this study

APPENDIX D

Web-Based Survey #1

SITE 1 DATA WAREHOUSE USER SURVEY

SURVEY OBJECTIVE: Your organization has adopted data warehousing (DW) technology to support your decision-making activities and to improve business intelligence throughout the organization. The purpose of this questionnaire is to understand how useful this technology has been to you and what, if any, concerns you might have. We greatly appreciate your time and effort in completing this survey and ask that you be complete in your responses. A summary of the results will be provided on request. All responses will be kept completely confidential.

Select your work location: Other

A. EXPERIENCE	
1. How many years have you worked in your current position?	Years
2. How many years have you been employed with this organization?	Years
3. How many years have you been using a computer (for work/school/home)?	Years
4. How long have you been using the Data Warehouse and associated applications?	Years
Data Warehouse Access	
5. Do you use the DW yourself or through an intermediary/analyst?	Self Analyst Both
6. Do you use the DW to generate reports for others?	Yes No

7. Is adequate equipment available for you to access the DW?	○ Yes ○ No
8. Which best characterizes your highest level of proficiency with the DW?	○ I refresh existing reports. ○ I generate simple reports with basic formatting. ○ I generate highly customized reports e.g., with special formatting and/or using sub-queries.

9. To what extent do you use the following applications to access the DW?	*Not at all*		*Somewhat*		*To a great extent*
Access	○	○	○	○	○
Excel	○	○	○	○	○
SPSS	○	○	○	○	○
Business Objects	○	○	○	○	○

B. SUPPORT FOR LEARNING: The following statements are intended to capture information about **the extent to which your organization supports learning and creativity**. Please indicate the extent to which you disagree (left-hand side of scale) or agree (right-hand side of scale) with each statement.

	Strongly Disagree			**Neutral**			**Strongly Agree**
1. The main function of members in this organization is to follow orders, which come down through channels.	○	○	○	○	○	○	○
2. Creativity is encouraged here.	○	○	○	○	○	○	○
3. Around here, a person can get into a lot of trouble by being different.	○	○	○	○	○	○	○
4. This place seems to be more concerned with the status quo than with change.	○	○	○	○	○	○	○
5. Learning in this organization is seen as a key commodity necessary to guarantee organizational survival.	○	○	○	○	○	○	○
6. People around here are expected to deal with problems in the same way.	○	○	○	○	○	○	○

7. Managers agree that organization's ability to learn is the key to our success.	○	○	○	○	○	○	○
8. The reward system here mainly benefits those who don't rock the boat.	○	○	○	○	○	○	○
9. Assistance in developing new ideas is readily available.	○	○	○	○	○	○	○
10. There are adequate resources devoted to innovation in this organization.	○	○	○	○	○	○	○
11. There is adequate time available to pursue creative ideas here.	○	○	○	○	○	○	○
12. This organization gives me the free time to pursue creative ideas during the workday.	○	○	○	○	○	○	○
13. A person cannot do things too different around here without provoking anger.	○	○	○	○	○	○	○
14. The basic values of this organization include learning as key to improvement.	○	○	○	○	○	○	○
15. This organization provides opportunities for professional development such as training, workshops, and seminars.	○	○	○	○	○	○	○
16. There is agreement on our organizational vision across all levels, functions, and divisions.	○	○	○	○	○	○	○
17. The sense around here is that employee learning is an investment not an expense.	○	○	○	○	○	○	○
18. This organization provides opportunities for individual development other than formal training, such as team activities and experimentation.	○	○	○	○	○	○	○
19. All employees are committed to the goals of this organization.	○	○	○	○	○	○	○
20. Around here, employees view themselves as partners in charting the direction of the organization.	○	○	○	○	○	○	○
21. There is a commonality of purpose in this organization.	○	○	○	○	○	○	○
22. In this organization, there is a commitment to sharing knowledge.	○	○	○	○	○	○	○

C. DATA QUALITY: To what extent do the following characteristics reflect data that is available in the warehouse?

1. ACCURACY:

Very inaccurate			Somewhat accurate			Highly accurate
○	○	○	○	○	○	○

2. CURRENCY:

Very outdated			Somewhat up-to-date			Very current
○	○	○	○	○	○	○

3. PRESENTATION:

Format not useful			Format somewhat useful			Format very useful
○	○	○	○	○	○	○

4. COMPATIBILITY:

Difficult to compare/integrate data across multiple sources			Somewhat able to compare/integrate data across multiple sources			Easy to compare/ integrate data across multiple sources
○	○	○	○	○	○	○

5. MEANING:

Exact meaning of data elements obvious or easy to find out			Somewhat able to discern meaning of data elements			Meaning of data elements not obvious or hard to find out
○	○	○	○	○	○	○

6. LEVEL OF DETAIL:

Data insufficiently detailed			Somewhat sufficiently detailed			Data sufficiently detailed
○	○	○	○	○	○	○

7. LACK OF CONFUSION:

Hard to use data stored in different places or in different forms			Somewhat able to use data in different places or in different forms			Easy to use data in different places or in different forms
○	○	○	○	○	○	○

D. INFORMATION TECHNOLOGIES AND THE DW: Listed below are a set of statements about **the impact of the DW on your work activities, and your perceptions of information technologies in general.** Please indicate the extent to which you disagree (left-hand side of scale) or agree (right-hand side of scale) with each statement.

	Strongly Disagree			Neutral			Strongly Agree
1. As a result of the DW, the speed at which I analyze decisions has increased.	○	○	○	○	○	○	○
2. If I heard about a new information technology, I would look for ways to experiment with it.	○	○	○	○	○	○	○
3. As a result of DW use, I am better able to set my priorities in decision-making.	○	○	○	○	○	○	○
4. Use of the information generated from the DW has enabled me to present my arguments more convincingly.	○	○	○	○	○	○	○
5. I like to experiment with new information technologies.	○	○	○	○	○	○	○
6. I intend to explore new ways in which business knowledge from the DW can be used to improve my contribution to the organization.	○	○	○	○	○	○	○
7. The DW has led to greater use of analytical tools in my decision-making.	○	○	○	○	○	○	○
8. I intend to explore the DW for potential applications to my work.	○	○	○	○	○	○	○
9. Using the DW has improved the quality of decisions I make in this organization.	○	○	○	○	○	○	○
10. I intend to spend considerable time and effort this year finding new ways of using the DW in my job.	○	○	○	○	○	○	○
11. I intend to explore new ways in which business knowledge from the DW can be applied to my work.	○	○	○	○	○	○	○
12. Among my peers, I am usually the first to try out new information technologies.	○	○	○	○	○	○	○
13. In general, I am hesitant to try out new information technologies.	○	○	○	○	○	○	○
14. I intend to explore the DW for enhancing the effectiveness of my work.	○	○	○	○	○	○	○
15. I intend to explore new ways of applying the business knowledge from the DW.	○	○	○	○	○	○	○

E. DW ACTIVITIES: The statements below address **the activities you engage in while using the data warehouse** (DW). Please indicate the extent to which you disagree (left-hand side of scale) or agree (right-hand side of scale) with each statement.

	Strongly Disagree			Neutral			Strongly Agree
1. I use the DW to look for information I need.	○	○	○	○	○	○	○
2. My browsing of the DW is wide-ranging.	○	○	○	○	○	○	○
3. I regularly focus on specific information contained in the DW.	○	○	○	○	○	○	○
4. I use the DW to find answers to specific questions.	○	○	○	○	○	○	○
5. I use the DW to see what's new.	○	○	○	○	○	○	○
6. I review a consistent set of reports in the DW.	○	○	○	○	○	○	○
7. I use the DW to analyze data with specific objectives in mind.	○	○	○	○	○	○	○
8. I use the DW to do routine queries.	○	○	○	○	○	○	○
9. I randomly browse through information contained in the DW.	○	○	○	○	○	○	○
10. I vary the information I look for in the DW.	○	○	○	○	○	○	○
11. When using the DW, I usually select the type of analysis to be performed.	○	○	○	○	○	○	○
12. I rely on data mining tools to reveal unexpected data patterns.	○	○	○	○	○	○	○
13. I use the DW to perform free-form analyses	○	○	○	○	○	○	○
14. I use the DW to detect emerging trends in the data.	○	○	○	○	○	○	○
15. I use the DW to perform a regular set of analyses.	○	○	○	○	○	○	○
16. I rely on data mining tools to interpret what is happening with the data.	○	○	○	○	○	○	○

17. I engage in data mining activities with no clear-cut objectives in mind.	(((((((
18. I use the DW to do specific calculations.	(((((((

F. DW VALUE: The purpose of this section is to understand **your perceptions of the value of the data warehouse and its benefits to the organization**. Please indicate the extent to which you disagree (left-hand side of scale) or agree (right-hand side of scale) with each statement.

	Strongly Disagree Neutral Strongly Agree
1. I believe that the DW adds business value.	(((((((
2. Use of the DW has enabled my organization to identify new business opportunities.	(((((((
3. I believe that the DW contributes to business intelligence.	(((((((
4. Use of the DW has led to an improvement in the services that my organization provides	(((((((
5. I regard the DW as a valuable organizational resource.	(((((((
6. Use of the DW has enabled my organization streamline its operations	(((((((
7. The DW performs a valuable business function.	(((((((

G. EASE OF USE: How easy is the DW to use. Please rate the following on a scale of Not at all…To a great extent.

	Not at To a great
1. I feel comfortable using the DW on my own.	(((((((
2. It is easy for me to fulfill management requests using the DW.	(((((((
3. It is easy for me to fulfill external requests (from Legislature, Media, Boards, etc.) using the DW.	(((((((
4. I can easily manipulate the DW when I need to.	(((((((
5. It is easy for me to get data for strategic planning from the DW.	(((((((
6. I am able to use the DW when there is no one around to show me now to use it.	(((((((
7. It is easy for me to produce data for performance measures using the DW	(((((((

H. USING THE DW TO UNDERSTAND THE ORGANIZATION: DW applications are designed to support many different decision-making activities. The following questions relate to your interactions with the data warehouse. **What effect do these interactions have on your thought processes?** Please rate the following on a scale of Not at all…To a great extent.

Think about your understanding of the organization. To what extent does the use of the DW enable/cause you to…	**Not at all**			**Somewhat**			**To a great Extent**
1. Reinforce your perspectives?	○	○	○	○	○	○	○
2. Expand your knowledge?	○	○	○	○	○	○	○
3. Question your preconceptions?	○	○	○	○	○	○	○
4. Validate your point of view?	○	○	○	○	○	○	○
5. Reorient your thinking?	○	○	○	○	○	○	○
6. Verify your assumptions?	○	○	○	○	○	○	○
7. Confirm your beliefs?	○	○	○	○	○	○	○
8. Challenge your beliefs?	○	○	○	○	○	○	○

I. DEMOGRAPHICS

1. Gender:	○ Female	○ Male			
2. Age:	☐ Years				
3. Highest Level of Schooling:	○ High School	○ Associate	○ Bachelors	○ Masters	○ Doctorate
4. Race:	○ White	○ Black	○ Hispanic	○ Asian	○ Other

Please use the space below to provide additional information that you think may be useful:

(Optional) Additional Comments

☐

Thank you for your cooperation!

APPENDIX E

Web-Based Survey #2

SITE 2 DATA WAREHOUSE/COGNOS USER SURVEY

SURVEY OBJECTIVE: Your organization has adopted data warehousing (DW) technology and the Cognos suite of applications to support your decision-making activities, and to improve business intelligence throughout the organization. The purpose of this questionnaire is to understand how useful Cognos has been to you and what, if any, concerns you might have. We greatly appreciate your time and effort in completing this survey and ask that you be complete in your responses. A summary of the results will be provided on request and all responses will be kept completely confidential.

Enter your organizational title/role:

A. EXPERIENCE	
1. How many years have you worked in your current position?	Years
2. How many years have you been employed with this organization?	Years
3. How many years have you been using a computer (for work/school/home)?	Years
4. How long have you been using Cognos?	Months
Data Warehouse Access Using Cognos	
5. Do you use Cognos yourself or through an intermediary/analyst?	Self Analyst Both
6. Do you use Cognos to generate reports for others?	Yes No

7. Is adequate equipment available for you to access Cognos?	◯ Yes ◯ No
8. Which best characterizes your highest level of proficiency with Cognos?	◯ I refresh existing reports. ◯ I generate simple reports with basic formatting. ◯ I generate customized reports e.g. with special formatting and/or sub-queries

9. To what extent do you use the following applications to access data/reports that you need?	*Not at all*		*Somewhat*		*To a great extent*
Access	◯	◯	◯	◯	◯
Excel	◯	◯	◯	◯	◯
SAS	◯	◯	◯	◯	◯
Cognos	◯	◯	◯	◯	◯

B. SUPPORT FOR LEARNING: The following statements are intended to capture information about **the extent to which your organization supports learning and creativity**. Please indicate the extent to which you disagree (left-hand side of scale) or agree (right-hand side of scale) with each statement.

	Strongly Disagree			**Neutral**			**Strongly Agree**
1. The main function of members in this organization is to follow orders, which come down through channels.	◯	◯	◯	◯	◯	◯	◯
2. Creativity is encouraged here.	◯	◯	◯	◯	◯	◯	◯
3. Around here, a person can get into a lot of trouble by being different.	◯	◯	◯	◯	◯	◯	◯
4. This place seems to be more concerned with the status quo than with change.	◯	◯	◯	◯	◯	◯	◯
5. Learning in this organization is seen as a key commodity necessary to guarantee organizational survival.	◯	◯	◯	◯	◯	◯	◯
6. People around here are expected to deal with problems in the same way.	◯	◯	◯	◯	◯	◯	◯

7. Managers agree that organization's ability to learn is the key to our success.	○ ○ ○ ○ ○ ○ ○
8. The reward system here mainly benefits those who don't rock the boat.	○ ○ ○ ○ ○ ○ ○
9. Assistance in developing new ideas is readily available.	○ ○ ○ ○ ○ ○ ○
10. There are adequate resources devoted to innovation in this organization.	○ ○ ○ ○ ○ ○ ○
11. There is adequate time available to pursue creative ideas here.	○ ○ ○ ○ ○ ○ ○
12. This organization gives me the free time to pursue creative ideas during the workday.	○ ○ ○ ○ ○ ○ ○
13. A person cannot do things too different around here without provoking anger.	○ ○ ○ ○ ○ ○ ○
14. The basic values of this organization include learning as key to improvement.	○ ○ ○ ○ ○ ○ ○
15. This organization provides opportunities for professional development such as training, workshops, and seminars.	○ ○ ○ ○ ○ ○ ○
16. There is agreement on our organizational vision across all levels, functions, and divisions.	○ ○ ○ ○ ○ ○ ○
17. The sense around here is that employee learning is an investment not an expense.	○ ○ ○ ○ ○ ○ ○
18. This organization provides opportunities for individual development other than formal training, such as team activities and experimentation.	○ ○ ○ ○ ○ ○ ○
19. All employees are committed to the goals of this organization.	○ ○ ○ ○ ○ ○ ○
20. Around here, employees view themselves as partners in charting the direction of the organization.	○ ○ ○ ○ ○ ○ ○
21. There is a commonality of purpose in this organization.	○ ○ ○ ○ ○ ○ ○
22. In this organization, there is a commitment to sharing knowledge.	○ ○ ○ ○ ○ ○ ○

C. INFORMATION NEEDS: Please indicate your information needs. Check all that apply.

I need:

- [ ] Client information
- [ ] Provider information
- [ ] Performance information

D. DATA QUALITY: To what extent do the following characteristics reflect data that is available to you through Cognos?

1. ACCURACY:

Very inaccurate		Somewhat accurate			Highly accurate	
○	○	○	○	○	○	○

2. CURRENCY:

Very outdated		Somewhat up-to-date			Very current	
○	○	○	○	○	○	○

3. PRESENTATION:

Format not useful		Format somewhat useful			Format very useful	
○	○	○	○	○	○	○

4. COMPATIBILITY:

Difficult to compare/integrate data across multiple sources		Somewhat able to compare/integrate data across multiple sources			Easy to compare/ integrate data across multiple sources	
○	○	○	○	○	○	○

5. MEANING:

Exact meaning of data elements obvious or easy to find out		Somewhat able to discern meaning of data elements			Meaning of data elements not obvious or hard to find out	
○	○	○	○	○	○	○

6. LEVEL OF DETAIL:

Data insufficiently detailed		Somewhat sufficiently detailed			Data sufficiently detailed	
○	○	○	○	○	○	○

7. LACK OF CONFUSION:

Hard to use data stored in different places or in different forms		Somewhat able to use data in different places or in different forms			Easy to use data in different places or in different forms	
○	○	○	○	○	○	○

E. EXPERIENCE WITH INFORMATION TECHNOLOGIES: Listed below are statements about **the impact of Cognos on your work activities and your perceptions of information technologies in general.** Please indicate the extent to which you disagree (left-hand side of scale) or agree (right-hand side of scale) with each statement.

	Strongly Disagree			Neutral			Strongly Agree
1. As a result of Cognos, the speed at which I analyze decisions has increased.	○	○	○	○	○	○	○
2. If I heard about a new information technology, I would look for ways to experiment with it.	○	○	○	○	○	○	○
3. As a result of Cognos use, I am better able to set my priorities in decision-making.	○	○	○	○	○	○	○
4. Use of the information generated from Cognos has enabled me to present my arguments more convincingly.	○	○	○	○	○	○	○
5. I like to experiment with new information technologies.	○	○	○	○	○	○	○
6. I intend to explore new ways in which business knowledge from Cognos can be used to improve my contribution to the organization.	○	○	○	○	○	○	○
7. Cognos has led to greater use of analytical tools in my decision-making.	○	○	○	○	○	○	○
8. I intend to explore Cognos for potential applications to my work.	○	○	○	○	○	○	○
9. Using Cognos has improved the quality of decisions I make in this organization.	○	○	○	○	○	○	○
10. I intend to spend considerable time and effort this year finding new ways of using Cognos in my job.	○	○	○	○	○	○	○
11. I intend to explore new ways in which business knowledge from Cognos can be applied to my work.	○	○	○	○	○	○	○
12. Among my peers, I am usually the first to try out new information technologies.	○	○	○	○	○	○	○
13. In general, I am hesitant to try out new information technologies.	○	○	○	○	○	○	○
14. I intend to explore Cognos for enhancing the effectiveness of my work.	○	○	○	○	○	○	○
15. I intend to explore new ways of applying the business knowledge from Cognos.	○	○	○	○	○	○	○

F. DATA MINING WITH COGNOS: The statements below address **the activities you engage in while using Cognos**. Cognos provides an array of tools that enable you to generate reports/cubes/visualizations, and such activities are often referred to as **data mining**. Please indicate the extent to which you disagree (left-hand side of scale) or agree (right-hand side of scale) with each statement.

	Strongly Disagree			**Neutral**			**Strongly Agree**
1. I use Cognos to look for information I need.	○	○	○	○	○	○	○
2. My browsing of information using Cognos is wide-ranging.	○	○	○	○	○	○	○
3. I regularly focus on specific information available through Cognos.	○	○	○	○	○	○	○
4. I use Cognos to find answers to specific questions.	○	○	○	○	○	○	○
5. I use Cognos to see what's new.	○	○	○	○	○	○	○
6. I review a consistent set of reports in Cognos.	○	○	○	○	○	○	○
7. I use Cognos to analyze data with specific objectives in mind.	○	○	○	○	○	○	○
8. I use Cognos to do routine queries.	○	○	○	○	○	○	○
9. 9. I randomly browse through information available through Cognos.	○	○	○	○	○	○	○
10. I vary the information I look for in Cognos.	○	○	○	○	○	○	○
11. When using Cognos, I usually select the type of analysis to be performed.	○	○	○	○	○	○	○
12. 12. I rely on data mining tools to reveal unexpected data patterns.	○	○	○	○	○	○	○
13. I use Cognos to perform free-form analyses.	○	○	○	○	○	○	○
14. I use Cognos to detect emerging trends in the data.	○	○	○	○	○	○	○
15. I use Cognos to perform a regular set of analyses.	○	○	○	○	○	○	○
16. I rely on data mining tools to interpret what is happening with the data.	○	○	○	○	○	○	○

17. I engage in data mining activities with no clear-cut objectives in mind.	
18. I use Cognos to do specific calculations.	

G. COGNOS VALUE: The purpose of this section is to understand **your perceptions of the value of Cognos and its benefits to the organization**. Please indicate the extent to which you disagree (left-hand side of scale) or agree (right-hand side of scale) with each statement.

	Strongly Disagree — Neutral — Strongly Agree
1. I believe that Cognos adds business value.	
2. Use of Cognos has enabled my organization to identify new business opportunities.	
3. I believe that Cognos contributes to business intelligence.	
4. Use of Cognos has led to an improvement in the services that my organization provides.	
5. I regard Cognos as a valuable organizational resource.	
6. Use of Cognos has enabled my organization to streamline its operations.	
7. Cognos performs a valuable business function.	

H. EASE OF USE: How easy is Cognos to use? Please rate the following on a scale of Not at all…To a great extent.

	Not at all — Somewhat — To a great Extent
1. I feel comfortable using Cognos on my own.	
2. It is easy for me to fulfill management requests using Cognos.	
3. It is easy for me to fulfill external requests (from Legislature, Media, Boards, etc.) using Cognos.	
4. I can easily manipulate Cognos when I need to.	
5. It is easy for me to get data for strategic planning from Cognos.	
6. I am able to use Cognos when there is no one around to show me now to use it.	

7. It is easy for me to produce data for performance measures using Cognos	

I. USING COGNOS TO UNDERSTAND THE ORGANIZATION: Data warehouses and applications like Cognos are designed to support many different decision-making activities. The following questions relate to your interactions with Cognos. **What effect do these interactions have on your thought processes?** Please rate the following on a scale of Not at all…To a great extent.

Think about your understanding of the organization. To what extent does the use of Cognos enable/cause you to…	Not at all			Somewhat			To a great Extent
1. Reinforce your perspectives?							
2. Expand your knowledge?							
3. Question your preconceptions?							
4. Validate your point of view?							
5. Reorient your thinking?							
6. Verify your assumptions?							
7. Confirm your beliefs?							
8. Challenge your beliefs?							

J. DEMOGRAPHICS

1. Gender:	Female	Male			
2. Age:	Years				
3. Highest Level of Schooling:	High School	Associate	Bachelors	Masters	Doctorate
4. Race:	White	Black	Hispanic	Asian	Other

Please use the space below to provide additional information that you think may be useful:

(Optional) Additional Comments

Thank you for your cooperation!

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