Investigating the Relationship between Knowledge Management Capability and Knowledge Transfer Success

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ABSTRACT

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To gain a competitive advantage, a company must have the ability to effectively manage its chief asset, knowledge. Out of various types of knowledge that firms possess, its ability to satisfy customer requirements plays a crucial role in its ability to provide a quality product/service. More specifically, in information technology (IT) projects, customer requirements need to be effectively and efficiently transferred to the IT department. In return, the IT department must efficiently and effectively meet these needs.

This thesis examined the relationship between knowledge management capabilities and knowledge transfer success in IT departments in Canadian companies. An online survey collected empirical data from 54 IT managers. This data was analyzed using the partial least square (PLS) structural equation modeling method.

The findings show that for knowledge transfer to be successful in an IT project, the IT department must have both a solid knowledge infrastructure and a knowledge process capability. Within these capabilities, key infrastructure factors and knowledge processes were identified. Application and Acquisition proved to be significant in ensuring a solid process infrastructure, while Culture of Learning, Culture of Sharing, Collaboration Technology, Opportunity Generation Technology, Structure that supports Collaboration and System of Rewards were found to be important infrastructure elements. Furthermore, the findings reveal that knowledge processes are key to ensuring knowledge transfer efficiency, but not necessarily effectiveness; while knowledge infrastructure determines knowledge transfer effectiveness, but not necessarily efficiency.

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1 Introduction

The necessity for sharing knowledge has never been greater in the economy where the basic resource is no longer capital or natural resource, but knowledge (Drucker 1995). While knowledge has always been used in firms' activities, it is not until the last decade, or so, that it has been hailed as a strategic asset with the company's ability to manage it as a prerequisite to organizational success (Beijerse 1999; Dawson 2000). The ability to effectively manage knowledge constitutes an integral part of a company's core capabilities (Leonard-Barton 1995). The changing dynamics of the relationships not only between strategic partners, but also between competitors, clearly demonstrate the great need companies have to learn from each other (Loebecke et al. 1999). Indeed, researchers claim that the company's central activity is the integration (Grant 1996), application (Teece 1998) and processing of knowledge (Dawson 2000; Firestone 2001).

The evolution of knowledge management (KM) into a field of study owes its origins to a change in economic theory. In the second part of the twentieth century, information and knowledge replaced land and capital as the main inputs of production (Beijerse 1999). As knowledge began to be increasingly recognized as a strategic and unique resource and asset, attempts were made at devising formal methods for its management.

A definition by Wiig (1997) specifies four main aspects of KM as facilitating knowledge-based activities, creating and maintaining a knowledge infrastructure, managing knowledge assets, and using them to create value. The purpose of KM is thus to

> "Maximize the enterprise's knowledge-related effectiveness and returns from its knowledge assets and to renew them constantly. KM is to understand, focus on, and manage systematic, explicit, and deliberate knowledge building, renewal and application- that is, manage effective knowledge processes" (Wiig 1997, p. 8).

There is no agreed upon definition of KM. Rather, as Alavi and Leidner (2001) mention, how one views KM largely depends on one's view of knowledge. A more detailed discussion of the different views and definitions of knowledge follow in the literature review. Based on that discussion, we will present the definition of KM that this research will adopt.

KM plays a crucial role in knowledge-intensive firms companies where most tasks are intellectual in nature (Alvesson 2000). In such companies, *customer requirements* surfaces as one type of knowledge central to the firm's core capabilities, as it plays a crucial role in product development. Knowledge of, and adherence to, customer requirements determine the success and quality of the delivered product (Kusters et al. 1997; Grunbacher and Briggs 2001). This is particularly evident in the software industry.

Customer-centered software design is becoming a common strategy for many firms (Smart and Whiting 2001) and several researchers have studied the links between the customer and the developers (Grudin 1991; Keil and Carmel 1995). The significance of this issue is not exclusive to software firms. In information technology (IT) related projects, every IT department, regardless of the firm's industry, is acting as a supplier of

an IT solution to a client department. Knowledge of internal customer requirements is a prerequisite to a company's effective and efficient utilization of IT. For the IT solution to correspond to the clients' needs, such knowledge has to be transferred for use by the IT department (see Byrd et al. 1992).

Knowledge transfer (k-transfer) is at the center of knowledge management research (Argote and Ingram 2000a; Szulanski 2000). It is a process through which one entity is affected by the knowledge of another. Although the absence of such a process will lead to a gap between customers' needs and the end-product delivered to them, its presence alone is not a guarantee that this gap will be any smaller. The capability of the receiver to use the transferred knowledge must also be taken into consideration (Cohen and Levinthal 1990).

Knowledge transfer has been shown to play a key role in increasing a company's productivity and helping it gain a competitive advantage. For example, Darr et. al (1995) found that in franchise restaurants the unit cost of production decreased as a result of knowledge transfer. Research in strategic management and in interconnected organizations (alliances, franchises and chains) has shown that knowledge transfer has a positive effect on productivity and profitability (Argote and Ingram, 2000b).

A capability is the "firm's capacity to deploy its assets" (Maritan 2001 p. 514). Knowledge management capability is defined by the presence of knowledge infrastructure (structural, technical and cultural) that is supported by critical knowledge

processes (acquisition, conversion, application and protection) (Gold et al. 2001). Although various authors point out that various aspects of such capability are essential to achieving k-transfer success, few have actually empirically tested this relationship. This thesis sets out to address the following research question: *Is an IT department's knowledge management capability related to knowledge transfer success during an IT project?*

Investigating the relationship between KM capability and k-transfer in IT projects is important from both practical and academic points of view. First, given that an IT project is knowledge-intensive, it would be appropriate to assume that some form of deliberate management of knowledge should be present in both the development and implementation processes of IT projects. Certain similarities exist between k-transfer and the traditional IS development models. In what is known as the *system development lifecycle* (SDLC, developed in the 1960's), the major stages of IS development are: definition, construction and implementation (Ahituv and Neumann, 1986). Each step is a prerequisite of the next and can be further broken down into detailed phases. For example, the definition step involves the preliminary analysis of the business problem, a feasibility study, the analysis of information (customer requirements) and the design of the solution. The construction step involves programming and development. Finally, during implementation the users are trained and the solution is installed and tested. Although not all companies explicitly outline their IT projects along these steps, SDLC represents the mainstream approach to IS development. The k-transfer model as presented by Szulanski (2001, to be discussed in detail later) has striking similarities with

SDLC. This correspondence facilitates the study of IT projects using the perspective of k-transfer for both academics and IT managers.

The answer to the above research question will show which knowledge infrastructure and process elements are critical for both efficient and effective k-transfer. However, not all companies will have knowledge management processes within their IT projects. Hence, a confirmation of a positive relationship between the knowledge management capability and success of the transfer will serve to encourage them to implement such processes.

Furthermore, a surprisingly small number of researchers have looked into the role of knowledge management in IT. Although the issue of intra-firm k-transfer has been addressed extensively (O'Dell 1998; Hansen 1999; Gruenfeld et al. 2000; Gupta and Govindarajan 2000), there is still a considerable lack of research in inter-departmental k-transfer. This research gap is especially significant since most of IT projects are cross-functional and hence inter-departmental (Sharda et al. 1998; Hoopes 2001). The present research attempts to narrow this gap by conducting an empirical investigation into departmental k-transfer. By selecting the department as our unit of analysis, we hope to provide lower level managers practical recommendations for their knowledge management initiatives.

To answer the research question, we conducted an online survey of IT departments in Canadian companies. Fifty four IT department managers completed the questionnaire. Managers provided answers regarding the knowledge management capabilities of their

department. Furthermore, they rated the success of k-transfer during a typical IT project they have implemented for another department in the last year, judging both its effectiveness and efficiency.

The results of the survey showed that both aspects of knowledge management capability play an important role in ensuring the success of k-transfer. More specifically, certain key knowledge processes and knowledge infrastructure elements were identified as critical in ensuring k-transfer success. Through detailed testing we were also able to judge whether these infrastructure elements and processes had significant bearings on the specific aspects of k-transfer success, namely its efficiency and effectiveness.

This thesis report is structured as follows: first, the relative literature will be reviewed. Next, the research objectives, variables, hypotheses and model will be discussed. The third section will describe the methodology used for this research project. Then, the analysis of the collected data will be presented. After discussing the results, the last section will expound on the limitations and contributions of this research.

2 Literature Review

Our literature review discusses the relatively new field of knowledge management from the perspective of the resource-based view of the firm. First, we provide the theoretical background for this view. Next, we introduce a short discussion of the meaning of knowledge. Subsequently, we explain two concepts specific to this research: k-transfer and knowledge management capabilities.

2.1 Resource-Based View of the Firm

The resource-based view of the firm was proposed in response to certain weaknesses to the economic theory of the firm. Economic theory states that a firm's strategic performance is largely dependent on industry structure, i.e. the competitive situation and the technological, sociological and environmental context (Von Krogh and Grand 2002). As empirical research only partially supported this theory, an alternative was suggested. Resource-based view argues that a firm's strategic performance is largely tied to what type of inputs (resources) it has access to and how it is using them (Dierickx and Cool 1989; Grant 1991; Peteraf 1993). This use of resources over time develops into organizational capabilities (Amit and Shoemaker 1993).

Resources are 'those tangible and intangible assets that are tied semi permanently to the firm at a given point in time' (Wernerfeldt 1984, quoted by Von Krogh and Grand 2002, p. 167). A capability can be defined as "a firm's capacity to deploy its assets, tangible or intangible, to perform a task or activity to improve performance" (Maritan 2001 p. 514). Other authors define it as "the firm's ability to manage people to gain competitive

advantage" (Ulrich and Lake 1991, p.78). In other words, a capability is the capacity to take action using certain resources.

According to the resource-based view of the firm, firms obtain sustainable competitive advantage by optimally managing and maximizing the value of its resources and capabilities. As mentioned earlier, the basic organizational resource is knowledge (Drucker 1995; Brooking 1996). Not surprisingly, the resource-based view was adapted to the knowledge management (KM) field.

Notably, Grant (1996) argued that the primary activity of the firm is the integration of knowledge into products and services. Organizational capabilities are hence the outcome of the knowledge integration activities of the firm. More recently, Von Krogh and Grand (2002) also argued for a knowledge-based theory of the firm, focusing rather on knowledge creation as the principal activity of the firm. However, as both the above authors and Grant point out, that while the resource-based view of the firm is inadequate in so far as not considering knowledge as the chief strategic asset, the knowledge-based theory is far from being robust and generally accepted.

We will now proceed to present three important concepts from the perspective of the resource-based view of the firm. First, we will discuss the most important resource a firm has- knowledge. Next, we will present and underline the importance of transferring knowledge. Last, we will discuss the concept of KM capabilities.

2.2 What is Knowledge?

A key argument proposed by the resource-based view of the firm is that since firms compete based on the resources and capabilities they possess, competitive advantage will be achieved by firms whose resources and capabilities will be hard to imitate (Von Grogh and Grand 2002). Knowledge is one resource that is difficult to replicate and hence is key in achieving advantage over other firms (Lubit, 2001). Although a philosophical discussion of what is knowledge is beyond the scope of this research, its several key aspects need to be reviewed in order to understand the context within which knowledge will be used in this research. In the next paragraphs we describe the definitions of these aspects.

First, knowledge can be tacit or explicit. Tacit knowledge is subconsciously understood, unarticulated and rooted in action and experience (Polanyi 1962). Explicit knowledge is formally articulated and expressed, albeit taken away from its context of use (Zack 1999). While a good example of tacit knowledge would be knowing how to drive a car, its explicit counterpart, conveyed in symbolic form, would be exemplified in a driving manual.

Second, Nonaka and Takeuchi (1995) have taken the tacit/explicit categorization of knowledge and have applied it to the organizational setting. They saw knowledge as a justified, true belief and added another dimension to the classification- that of individual vs. collective knowledge. They differentiated between knowledge that is possessed by the

individual (skills, expertise, etc.) and those possessed by a group (culture, shared mental models, trust, etc.). Their model will be discussed in detail later.

Third, the Alavi and Leider study (2001) suggested six categories of views of knowledge, each having particular implications on the approach used to manage it. The first view of knowledge is that of a state of mind. This view considers that knowledge can only exist within an individual. Once separated, it is no longer knowledge, but information. The second view is knowledge as an object that can be stored and manipulated. A third view is knowledge as a process, i.e. it cannot be separated from action. The fourth view is knowledge as a condition of access to information. This view is an extension to the view of knowledge as an object, with a focus on accessibility of knowledge objects. The fifth view is knowledge as a capability to take action based on interpreted information. The last view is of knowledge vis-à-vis data and information. Data are raw facts, information is data with a meaning and knowledge is personalized information.

Fourth, Zack (1999) defines knowledge as 'that which we come to believe and value on the basis of information (messages) through experience, communication or inference' (p.46). His definition corresponds to two categorizations by Alavi and Leider: knowledge as an object and knowledge as a process. Knowledge can be seen as object, i.e. what is known; as well as the process of knowing, i.e. applying expertise. Zack also distinguishes three types of knowledge: declarative knowledge (know-what), procedural (know-how) and causal (know-why). This classification is based on cognitive science theory on types of memory (Tulving 1985). All of these types of knowledge are present in IT projects.

For example, declarative knowledge describes concepts, things and elements of the environment. Having such knowledge in common facilitates effective communication. Within the context of IT projects, an example of such knowledge would be the customer requirements. Procedural knowledge is embedded in organizational routines and processes. It represents knowing and using the interaction of elements in the system in order to produce a certain result. An example of such knowledge would be the different methodologies and processes used to convert the customer requirements into the end-product. Last, causal knowledge represents an understanding of fundamental principles and is used to formulate goals and strategies. Within the IT context this knowledge would be exemplified by the company's IT strategy. As can be seen from the above examples, any one of the three types can be either tacit or explicit.

In considering the above, we accept Zack's definition of knowledge as appropriate for this research, particularly since it highlights the importance of communication. This research accordingly views knowledge as a belief and value resulting from information received through experience, communication or inference. More specifically, the customer knowledge possessed by the IT department can be the result of explicit communications by the customer, past IT project experiences, or inferences based on the company's strategy, business, etc. Such knowledge can be either tacit (implicitly contained in the IT department employees) or explicit (formal and expressed customer requirements).

Having discussed what knowledge means, we can now discuss what KM means within the context of this research. Out of the KM definitions provided in the introduction, Alavi and Leidner's (2001) and Beijerse's (1999) focuses more on the process perspective. Wiig's definition on the other hand is more generic and accounts for knowledge as a process and an object. When referring to KM we focus our research with Wiig's (1997) definition in mind.

KM deals with many knowledge processes. One of them, knowledge transfer has been studied for many years before KM was even termed as a concept (for example, technology and cognitive skill transfer). We now discuss this construct.

2.3 Knowledge Transfer

Within the past 20 years an extensive interest has appeared in the topic of knowledge transfer (k-transfer) (Wiig 1997). The resource-based view of the firm underlines the importance of transferability of the company's resources and capabilities as vital in its gaining of competitive advantage (Barney, 1986). The transferability is especially important within the firm (Grant, 1996).

The sections that follow discuss the most important issues resulting from previous research. Each of these sections highlights issues that influence the eventual success or failure of the transfer process. To begin, the definition of the concept will be discussed. Next, the link between k-transfer and communications theory will be emphasized, as the former builds on the latter. Special attention is given to the theory of absorptive capacity, which is also closely linked to k-transfer theory. Next the discussion presents different k-

transfer models and highlights the one used by this research. The section concludes with the discussion of what constitutes the success of k-transfer.

2.3.1 Definition

One of the important deficiencies in the studies on k-transfer is the lack of definitions of the concept. Although many articles theorize on this topic, most seem to assume that the reader will understand what is meant by k-transfer (Goh 2002). Yet, such an assumption leaves many unanswered questions, such as: What is the difference between k-transfer and learning? and, Does k-transfer simply refer to the communication process and stops short of its use?

To facilitate an understanding of k-transfer, we consider two definitions from among the numerous articles that might provide a clear meaning to the concept. One such study defines k-transfer as a 'process through which one unit is affected by the experience of another' (Argote and Ingram 2000a p. 151). Another study sees it as a process where 'an organization recreates and maintains a complex, causally ambiguous set of routines in a new setting' (Szulanski 2000, p.10). Although the first definition seems to allow the possibility of negative effect resulting from the transfer, both suggest an entity importing or acquiring knowledge it did not previously possess. K-transfer is one aspect of learning, that of acquiring knowledge from an external entity (Garvin 1993).

The process of k-transfer goes beyond the simple communication process through which knowledge is transmitted. It must be successfully absorbed (Lane and Lubatkin 1998) or

create the capability of using it, and hence create value (Argote and Ingram 2000a). Unlike the proposal of some research to classify absorption as a firm-level mechanism (Rivera et al. 2001), the absorption is an integral part of any transfer process (Szulanski 2000) and involves knowledge utilization (Verkasslo and Lappalainen 1998).

The above discussion is well summarized by a Davenport and Prusak's (1998, p. 101) definition: "the transfer of knowledge then involves both the transmission of information to a recipient and absorption and transformation by that person or group". This definition also captures the fact that a k-transfer is a two-way process. It can be broken down into two sub-processes: knowledge distribution (transmission) from the sender's point of view and k-acquisition from the receiver's point of view (Huber 1991; Schulz 2000; Bolino 2001). We will elaborate on the origins of such view of k-transfer next.

2.3.2 K-Transfer from the Communications Perspective

A close relationship exists between the studies in k-transfer and studies in communication (Jensen 1998). Shannon and Weaver (1949) have proposed a communications model that serves as a basis for many k-transfer models today (Gupta and Govindarajan 2000; Bozeman and Rogers 2001; Boer et al. 2002). Although some terminology has changed since, the basic elements of the model remain the same: sender, receiver, channel and content.

Moreover, there are similarities in definitions of communication and k-transfer. Effective communication is defined as one that produces a change in receiver's behavior that was

intended by the information source (Rogers and Shoemaker 1971; Rogers and Agarwala-Rogers 1976; Lievens and Moenaert 2001). This is similar to the definition of k-transfer as used by Argote et al. (2001, p. 151): "a process through which one unit is affected by the experience of another".

Furthermore, in one of the few research reports on the inter-departmental level of analysis, Lievens and Moenaert (2001) used the information processing perspective to measure the effectiveness of communication. Focusing on the communication between departments during the process of innovation in financial services, they deemed communication as effective if it reduced uncertainty on the part of the receiver. They offer that the reduction of uncertainty was the result of a cognitive change, i.e. an increase in knowledge.

The above contributions imply that k-transfer is a communication process that goes beyond transmission/reception to include the actual absorption (Bresman et al. 1999). And as Bozeman and Rogers (2001) point out in their study on valuation of knowledge, such a perspective enriches earlier communications research by providing a broader view.

2.3.3 Absorptive Capacity

Any discussion of k-transfer would be incomplete if it did not address the issue of absorptive and relative absorptive capacity. We will present both the original and the modified theories. Contemplated from the resource-based view of the firm, absorptive

capacity can be seen as one of the critical capabilities that are needed in the management of the company's chief resource- knowledge.

As mentioned in the definition of k-transfer, the process doesn't stop at the reception of knowledge. Cohen and Levinthal (1990) postulated that the process is completed only when the knowledge is absorbed. Only then can the transfer be called successful. They argue that a critical element of any k-transfer process is the ability of the receiving end to actually take in or absorb the knowledge. They define absorptive capacity as "the capability to recognize the value of new, external knowledge, assimilate it, and apply it to commercial ends" (p. 128).

This capability is greatly dependent on the current knowledge possessed by the receiving entity. As learning is cumulative, knowledge assimilation is easier and quicker for an entity that already possesses considerable knowledge (sufficiently diverse, but related to the knowledge being received). Absorptive capacity has been at the center of KM research, being studied from different angles and at different levels of analysis. Notably, there has been a number of articles investigating it at the organizational level (Gupta and Govindarajan 2000; George et al. 2001; Knudsen et al. 2001; Tasi 2001), and more specifically in the context of strategic alliances (George et al. 2001; Reid et al. 2001), and organizational capabilities (Van den Bosch et al. 1999; Zahra and George 2002).

However, based on the criticism that the theory focuses only on the receiving end of the process, Lane and Lubatkin (1998) propose that both the sender and the receiver must be

included in the equation. They postulate that relative absorptive capacity is thus determined not by the characteristics of the learning entity alone, but jointly by the receiver and sender. Knowledge has a greater chance of being absorbed if there is a right 'match' between the two entities, i.e. similarity between the basic knowledge possessed by the two entities (know-what); similarity between their knowledge-processing systems (know-how); similarity between commercial objectives in using their knowledge (know-why).

2.3.4 Knowledge Transfer Models

Two perspectives dominate knowledge transfer research. One was proposed by Nonaka and Takeuchi (1995) while the other one includes variations from the communications model discussed above. To provide some background and by way of comparison, we present both below.

A) SECI Model

Building on their proposed knowledge taxonomies, Nonaka and Takeuchi (1995) put forth their KM framework, SECI (socialization, externalization, combination, internalization). It focuses on the conversion processes that occur between the different types of knowledge: tacit/explicit and individual/collective.

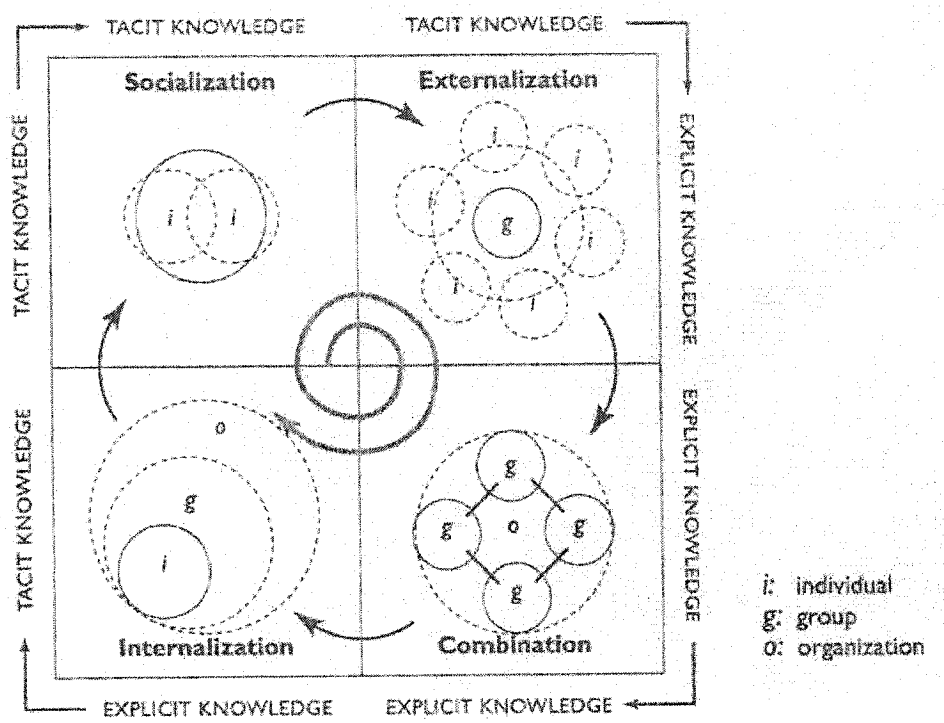

Figure 1: SECI Model

Nonaka and Konno (1998)

As depicted in Figure 1, the four conversion processes result in the creation and transfer of new knowledge. This is illustrated by the widening spiral, which keeps growing and transcends the individual level to include the group, the organization, and eventually to other organizations. Socialization is the process of transferring tacit knowledge from one individual to another. A typical example of this process is apprenticeship, wherein the transfer of knowledge occurs through interaction with another individual, rather than from manuals and written instructions. In externalization, tacit knowledge is converted to explicit knowledge. Product development illustrates this process- ideas and solutions are verbalized and eventually end up in a finished product that embodies the tacit knowledge used. In combination, explicit knowledge gets converted into more complex sets of

explicit knowledge. A good example is of a manager that collects information across the company to compile a financial report. Finally, internalization takes explicit knowledge and converts it into tacit knowledge. When a manager reads a financial report, the explicit knowledge contained in that report becomes tacit once the manager understands it.

Despite its wide recognition, the framework has its flaws. As some researchers point out (Alavi and Leidner 2001), the tacit/explicit taxonomy is too simplistic. It does not take into consideration the more specific types of knowledge that exist (e.g. the distinctions made by Zack (1999) and discussed above). Moreover, although indirectly including k-transfer, the focus of the model is knowledge creation.

B) Szulanski's Model

Szulanski's article (2000) serves as a good illustration of k-transfer models based on the communication theory. The process of k-transfer is seen as analogous to the transfer of a message from source to recipient. Such a one-way transfer view permits the breaking down of k-transfer into further sub-processes. As shown in Figure 2 Szulanski proposed four such sub-processes: Initiation, Implementation, Ramp-up and Integration. These are discussed below.

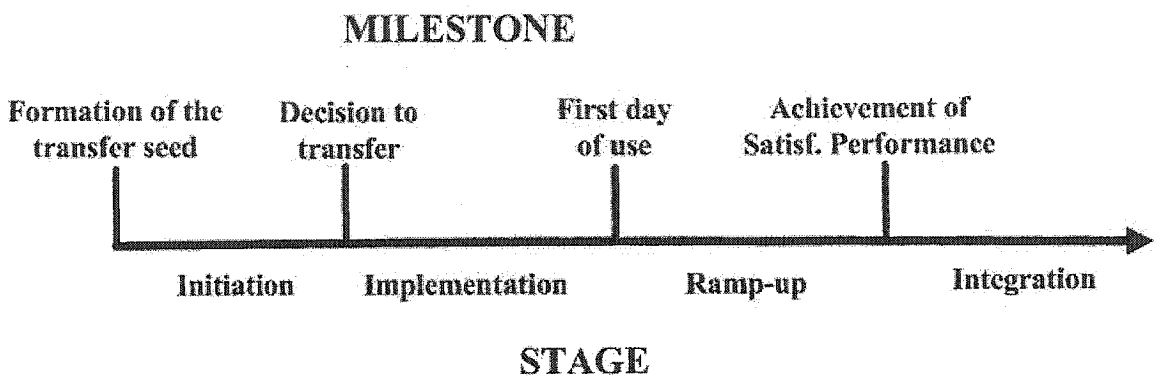

Figure 2: Knowledge Transfer Process Model, Szulanski (2001)

In the initiation stage, the opportunities to transfer are recognized. The gap between what an entity knows and what it needs to know becomes apparent. The transfer includes all activities leading to the decision to transfer. Once the decision to transfer has been made, the focus switches to the actual interaction between the two entities. Hence, communication peaks at the implementation stage. At some point, the necessary amount of knowledge will be received. Ramp-up stage begins when that knowledge is being put to use. It serves as a testing ground for the new knowledge. Once problems of first use are resolved and a certain level of performance is achieved, the last stage of integration begins. The use of knowledge is routinized and integrated with the overall activities and objectives of the recipient.

Our research takes the approach that knowledge transfer is based on the communications theory, and as illustrated by Szulanski's model. There are several reasons why this approach is more appropriate for our purposes.

First, we are dealing with two entities (departments), one of which is the source of knowledge while the other is the recipient. Once the customer requirements are transmitted to the receiver, the process is finished from the sender's point of view. The communications model view provides a transactional view of such a one-way process. Furthermore, once an IT project ends, the transfer process is finished from the IT department's point of view. Whatever happens after the project is beyond the scope of that project. Nonaka's (1998) model on the other hand sees knowledge creation/transfer as a spiral, i.e. a process that repeats itself. Nonaka's model takes a more global view which is not necessary for our purposes. A simpler context justifies the choice of a simpler model.

Second, although Nonaka's model can be used to analyze a knowledge transfer process, the focus of this research is not the conversion between tacit and explicit knowledge. In our case, Nonaka's model would draw the focus away from the transfer of knowledge to its conversion during the transfer.

2.3.5 Knowledge Transfer Success

Knowledge transfer success is defined as the achievement of a desired or intended goal in a process where knowledge is transmitted by one entity and is absorbed by a second entity. A successful knowledge transfer process is one that is both effective and efficient. Effective k-transfer is one that has a "one-to-one correspondence between the transmitted and received knowledge" (Verkasslo and Lappalainen 1998, p.420). Process efficiency is the ability to attain process effectiveness using minimal amount of resources (cost). This

classification of efficiency and effectiveness provides a global measurement for the dependency between the process and its outcome. The outcome of k-transfer is reflected by a change in the k-repository.

K-repositories are the loci where knowledge is embedded, be this the culture, people, structures, routines and tools (Argote and Ingram 2000a). However, the state of the repository affects the transfer process and hence its outcome. This dependency has been demonstrated by research into the absorptive capacity theory (discussed above): learning by entities that possess greater k-repositories is easier and faster than by those possessing inferior repositories (Cohen and Levinthal 1990). The transactional view of IS development (i.e. the developer being the receiver of knowledge and the client being the sender) allows for a study of k-transfer success through the degree to which there is a correspondence between what was asked by the client and what was given to him (effectiveness); as well as how it was given (efficiency) (Verkasslo and Lappalainen 1998).

Accordingly, effective k-transfer is one that has a "one-to-one correspondence between the transmitted and received knowledge" (Verkasslo and Lappalainen 1998, p.420). On the other hand, one criterion of k-transfer effectiveness was proposed by Kostova (1999). The author defined k-transfer success as the degree of institutionalization of the knowledge transferred. Although the knowledge under question was organizational practices, her approach is based on the idea that effectiveness of k-transfer can be judged based on the value attached to the knowledge by the recipient unit. Furthermore, there is

a correlation between the attached value and the extent of its use (Bolino 2001; Bozeman and Rogers 2001).

However, this would only give a partial idea of the success. Even though the input might have been valued and received, it could have been wrongly interpreted (absorbed). The effectiveness of k-transfer results in value (Hodgson et al. 1998; Bozeman and Rogers 2001) and in IT projects this value is the end product (system, added functionality, network, software, etc). The value can be judged by both the success of the system and the success of the development project (Robey et al. 1993). When IT functionality is implemented it becomes clear to what extent the transferred knowledge (customer requirements) was clearly understood and applied by the developers.

Process efficiency is defined as the ability to accomplish the goal while minimizing the use of resources (Barrar et al. 2002). It is important to note that we are not looking at the efficiency of the IT project (which would involve examining the project cost, adherence to schedule, etc.), but rather of the k-transfer process. An IT project can be inefficient in its management of time, yet still be completed on schedule. This would normally be achieved at the cost of extra man-hours. Yet, a k-transfer process is efficient in its use of time only if the time lag between the sending and receiving of knowledge is minimized (Verkasalo and Lappalainen 1998).

Knowledge transfer is an important process that cannot be ignored by an organization. However, it is just one of the knowledge processes that support the company's ability to

effectively manage knowledge. These processes and their supporting infrastructures constitute the firm's KM capabilities which are discussed next.

2.4 Knowledge Management Capabilities

The company's organizational capability is its ability to effectively manage its resources. The basic resource available to firms is knowledge. Hence, their capabilities must effectively manage knowledge. Since resource-based view and organizational capabilities theories were formulated before there was a prevalent view of knowledge as the basic resource, it did not explicitly account for its management. However, several new theories were proposed which do exactly that. To provide some theoretical and varied foundation, two models from these new theories, Gold et al. (2001) and Leonard-Barton (1995) will be discussed next.

2.4.1 Core Capabilities Framework

Leonard-Barton (1995) proposed the concept of 'core capabilities' which she defined as capabilities that 'constitute a competitive advantage for a firm; they have been built up over time and cannot be easily imitated' (p.4). Her theory postulates that certain business processes interact with and build up the company's core capabilities. At the same time, these knowledge-building activities draw upon the existing capabilities. These are illustrated in the model below:

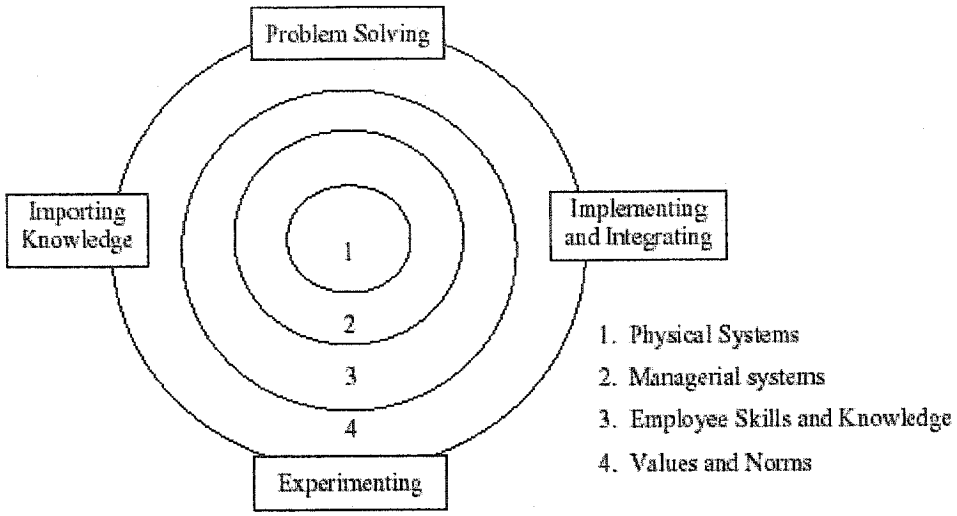

Figure 3: Core Capabilities and Knowledge Building Activities

Leonard-Barton (1995), adapted by Holsapple and Joshi (1999)

As shown in Figure3, a core capability comprises four main dimensions: physical systems (databases, infrastructure, software), managerial systems (incentive and reward programs, systems of education and training), employee skills and knowledge, and values and norms (rituals, corporate beliefs, culture). In order to enhance and grow its core capabilities, a firm must have certain key activities in place. These activities create the knowledge that is absorbed by the company and its individuals. According to Leonard-Barton (1995), the four key knowledge-building activities in any manufacturing firm include (i) shared problem solving in order to produce new and current products, (ii) implementing and integrating methodologies and tools in internal operations, (iii) experimenting to create new innovations, and (iv) importing knowledge and expertise from outside of the firm.

While the model (in Figure 3) identifies knowledge activities that are central to managing knowledge capabilities, its main limitation is context dependency. Leonard-Barton (1995) was studying the maintenance and development of technological capabilities at a steel company. Hence the physical systems play a central role in her model. Everything else is centered on this capability. Another weakness is on the process level. The four knowledge activities oversimplify reality. There are numerous other important knowledge processes, but these are largely ignored (e.g. conversion, protection, sharing, etc.). Conversely, the model proposed by Gold et. al (2001) is much more detailed and scalable to other contexts. Its discussion follows next.

2.4.2 Knowledge Management Capabilities Model

Although Gold et. al (2001) do not explicitly define what is a KM capability, from our previous discussion it can be viewed as the firm's ability to manage knowledge in order to improve performance or gain competitive advantage. This definition is inspired by one provided by Croteau and Li (2003), who saw KM as 'the ability of an organization to capture, manage, and deliver time authenticated customer, products, and services information in order to improve customer response and provide faster decision-making based on reliable information' (p. 23). The context of their study was customer relationship management (CRM) and this is reflected in their definition. Our definition provides a global view and one that is more appropriate for our context. Gold et al. studied the relationship between KM capabilities (infrastructure and process) and organizational effectiveness (Figure 4). To explain their view of KM capability, we will

separately examine the two constructs of knowledge infrastructure and process capabilities.

2.4.2.1 A) Knowledge Infrastructure Capabilities

The authors posit that knowledge infrastructure capability can be broken further into three main components: technological, structural and cultural capabilities. Since they do not define what a knowledge infrastructure capability actually means, from our previous discussion, we put forth the following definition: it is the firm's ability to manage its i) *technological*, ii) *structural* and iii) *cultural* infrastructures in order to improve its knowledge management effectiveness. Figure 4 illustrates this. Each of these is discussed next.

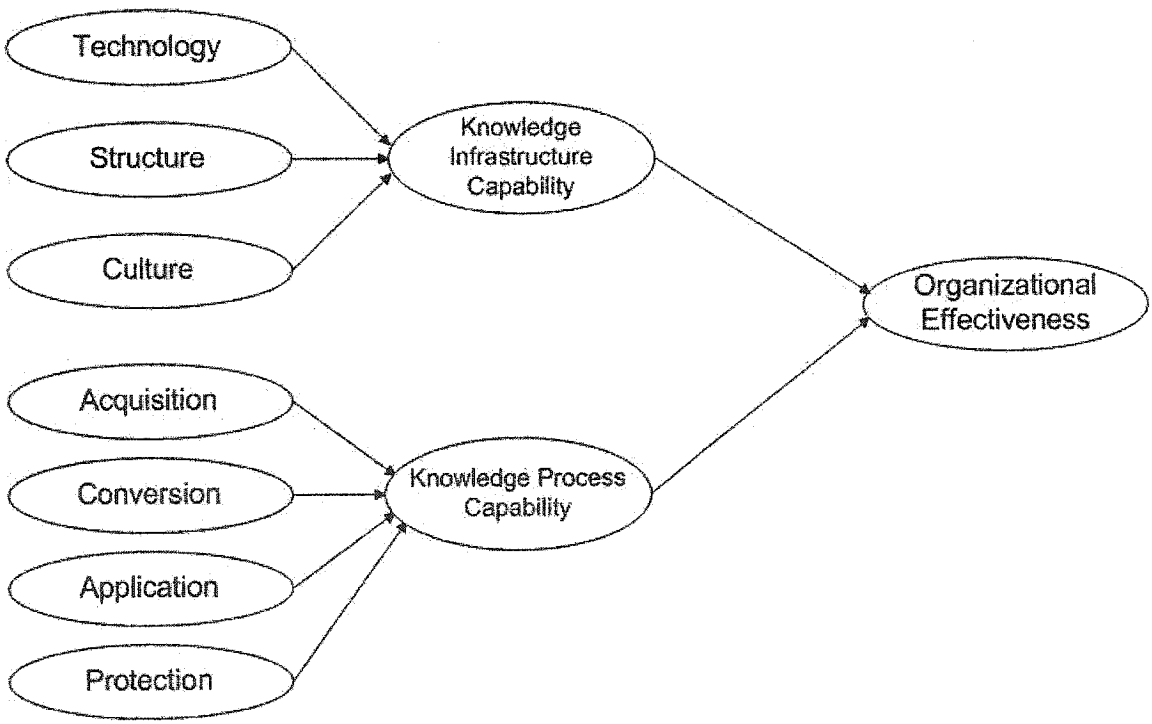

Figure 4: Knowledge Management Capability
Gold et al. (2001, p. 193)

i) Technology

Today, most companies rely on technology to facilitate knowledge transfer and learning (Huysman et al. 2002). This dimension of infrastructure capability refers to the "technology enabled ties that exist within a firm" (Gold et al. 2001, p.187). By enabling communication ties otherwise not possible, as well as improving existing ones, technology facilitates the flow of knowledge between entities as well as the creation of new knowledge (Junnarkar and Brown 1997; Ruggles 1997; Ruggles 1997). This dimension can be further broken down into: business intelligence, collaboration, distributed learning, knowledge discovery, knowledge mapping, opportunity generation and security (Gold et al. 2001). However, as emphasized in the literature, it is far from being enough for effective knowledge management (McDermott 1999; Cross and Baird 2000; Meso 2000). Much more weight needs to be given to the structural and cultural dimensions.

ii) Structure

The structure dimension of knowledge infrastructure capability refers to "the presence of norms and trust mechanisms" (Gold et al. 2001, p. 187). The structural element has been repeatedly stressed as relevant to KM as it can easily inhibit or enable it (Popper and Lipshitz 1998; O'Dell and Grayson Jr. 1999). An incentive and rewards system that doesn't recognize knowledge sharing will also impede the company's KM effort. For example, if certain structural units (departments, functions, locations, etc.) are rewarded for hoarding knowledge, it will be detrimental to the overall organizational knowledge

sharing. Likewise, if a proper compensation system is not in place, individuals will not be motivated to share their knowledge.

iii) Culture

Perhaps the most important dimension in enabling effective knowledge management is the cultural one (DeLong and Fahey 2000). One of the more comprehensive definitions of culture is

> "a pattern of basic assumptions, invented, discovered or developed by a given group as it learns to cope with its problems of external adaptation and internal integration, that has worked well enough to be considered valid and therefore is to be taught to new members as the correct way to perceive, think and feel in relation to those problems" (Schein 1990, p.111).

Values, such as trust and openness will create an environment where employees are willing to share their knowledge, knowing that others will do the same. Values also create a "shared context" (Gold et al. 2001, p.187), which facilitates effective knowledge sharing (Cohen and Levinthal 1990).

The above three infrastructure types are supported by what Gold et al. call knowledge process capabilities.

2.4.2.2 B) Knowledge Process Capabilities

As shown in our discussion of what knowledge is, numerous KM authors define knowledge as a process of applying expertise. They define KM as management of

processes that facilitate this application of expertise (Dawson 2000; Nissen 2000; Nissen and Espino 2000; Alavi and Leider 2001; Firestone 2001). Such a view builds on previous research on process management. Davenport (1998) defined a business process as "a set of ordered activities that have a start, a finish and identifiable inputs and outputs". But within the KM perspective, any business process can also be viewed as a knowledge process (k-process), since the activities within a process are guided by knowledge (Dawson 2000). Moreover, a knowledge management process is a business process with a goal that is within the KM domain (Firestone 2000; Sivan 2000). Based on the above, we put forth this definition of Knowledge Process Capability: it is the company's ability to use its knowledge processes for improving performance or to gain competitive advantage.

Process orientation in KM has direct implications for the organization's strategy (Maier and Remus 2001). Since all fundamental business processes can be viewed as k-processes, the ability to effectively perform these k-processes is the organization's knowledge capability (Dawson 2000). As depicted in Figure 4, in Gold et al. (2001) words, the organization's knowledge process capabilities are defined in terms of the capabilities to perform four fundamental KM processes: *acquisition, conversion, application* and *protection*. These will be elaborated in more detail below.

i) Acquisition

Acquisition processes are "those oriented toward obtaining knowledge" (Gold et al. 2001, p.190). This term has its origins in the development of expert systems and knowledge engineering (Gaines 1989). Acquisition is the process that separates knowledge from an

external source (Verkasslo and Lappalainen 1998; Soo et al. 2000). However, Gold et al. (2001) define its meaning in broader terms. Any process that helps the entity obtain knowledge, regardless weather it comes from an external or internal source, the authors present as a knowledge acquisition process. This includes knowledge creation through experimentation (Leonard-Barton 1995) and processes that lead to identifying knowledge gaps (difference between what one knows and what one should know) (Zack 1999). Processes that facilitate knowledge acquisition, such as collaboration (Grant 1996; Nonaka 1998) also play an integral part of acquisition process capability.

ii) Conversion

Acquiring knowledge is not enough: it has to be prepared for use. Conversion processes are "those oriented toward making existing knowledge useful" (Gold et al. 2001, p.191). Knowledge creates value when it is being efficiently used (Verkasslo and Lappalainen 1998; Bozeman and Rogers 2001). In order for such use to be possible, certain key enabling processes must be present. These processes include organization of knowledge- the structuring of knowledge repositories for optimal searching, indexing, creating, retrieving and sharing (Brown 1998; Sigel 2001). Knowledge must be kept relevant and up to date. Once knowledge is acquired, it has to be absorbed and integrated.

iii) Application

Once knowledge is available for use, certain processes need to be in place in order to properly apply it for problem-solving. Application processes are "those oriented toward the actual use of knowledge" (Gold et al. 2001, p.191). Knowledge can be viewed as an

object or a process (Zack 1999). When viewed as a process, it cannot be separated from its respective action, i.e. its application. However, when dealing with explicit knowledge on a level other than the individual, there is a gap between the point where new knowledge is acquired and when it is actually put to use. This is where application processes come into play in enabling effective use of such knowledge. While conversion processes organize knowledge for effective retrieval and sharing, it is through application processes that knowledge is actually retrieved and shared.

iv) Protection

As with any vital asset, security is an issue. Protection processes are "those designed to protect the knowledge within an organization from illegal or inappropriate use or theft" (Gold et al. 2001, p.192). Since knowledge is one of the firm's most important strategic assets, steps need to be taken to make sure the asset remains inimitable and rare (Barney 1991). The security involved ranges from the use of technology to applying appropriate policies and procedures to prevent unauthorized access to vital knowledge.

As the above discussion demonstrates, the KM Capability model proposed by Gold et. al is much more detailed than the one proposed by Leonard-Barton (1995). It is also more generic, in that it treats all dimensions and processes on the same level. This makes it easier to apply the model to other contexts.

Having completed the discussion of KM capabilities and k-transfer, the next sections provide an overview of literature that examines the links between these two concepts.

2.5 KM Capabilities and Knowledge Transfer

The discussion of KM capablities as it relates to k-transfer is broken down into two parts. First, we will discuss k-infrastructure capability and k-transfer. Subsequently, we will dwell on the research links between k-process capability and k-transfer.

2.5.1 K-Infrastructure Capability and K-Transfer

Various authors point out the positive relationship that exists between k-infrastructure capability elements and a k-transfer success. For example, Kostova (1999) theorized that a k-transfer success depends in part on the type of organizational culture that the recipient unit possesses. Indeed, the social aspect of KM cannot be overemphasized (Thomas et al. 2001). A culture that values high participation, interaction and involvement within the group as well as with other groups will positively influence k-transfer success (DeLong and Fahey 2000; McDermott and O'Dell 2001).

Others point out that a lack of appropriate k-infrastructure can seriously affect a department's ability to successfully transfer, as well as receive and absorb outside knowledge (O'Dell and Grayson Jr. 1999). For example, a structure of a department that inhibits cross-functional interaction will impede knowledge transfer success (O'Dell 1998). Goh (2002) in his model also includes organizational design and rewards systems as prerequisites of k-transfer effectiveness.

Having proper technology to use as a transfer medium will facilitate the transfer process and its effectiveness (Rasmus 2001; Goh 2002). The appropriate technological

infrastructure plays an especially critical role in managing codified knowledge by supporting key enabling processes: knowledge search, capture, storage and presentation (Zack 1999).

2.5.2 K-Process Capability and K-Transfer

Certain key processes allow an entity to successfully absorb knowledge. Without such absorption a transfer cannot be called successful (Bresman 99). Part of acquisition processes is the ability to obtain knowledge from an external source. If this process is not present, the transfer will hardly be successful (Byrd et al. 1992). Within the system development context, the customer requirements have to be translated into design specifications. For this task, appropriate knowledge conversion processes must be present.

Once the design specifications are completed, this knowledge must be applied to create the system using knowledge application processes (Walz et al. 1993). Across all of these activities, processes are needed for making the knowledge accessible, for effective team member collaboration (Calabrese 1999) as well as for keeping knowledge up-to-date. Verkasalo and Lappalainen (1998) pointed out that the efficiency of the k-transfer process depends on the presence and efficiency of its main sub-processes: k-acquisition, documentation, transmission, receival and perception. Thus, the lack of appropriate processes to manage knowledge will impede k-transfer success.

Before proceeding to the next section, we will briefly summarize the literature review. We began by presenting the theoretical basis of our research, the resource-based view of the firm. Using this perspective, we examined the major concepts used by this research project. We provided several definitions and categorizations of knowledge: tacit vs. explicit, individual vs. collective, object vs. process. We have selected Zack's (1999) definition for use by this research as it encompasses a view of knowledge as both an object and a process. It also highlights the importance of communication, which is relevant for this research. For the same reasons, we chose Wiig's (1997) definition of KM.

Knowledge transfer was defined as communication process involving the transmission of information by one entity to another and its absorption by the latter. It is key in allowing the firm to mobilize its resources and capabilities. We presented and discussed Nonaka and Takeuchi's (1995) and Szulanski's (2001) models of k-transfer. Szulanski's model was selected for use by this research due to its appropriateness for the context of IT projects. We then defined a successful k-transfer as both efficient and effective.

Two models of KM capabilities were presented and explained. Gold et al.'s (2001) model was elaborated in detail and chosen for study by this research. We concluded by discussing the links between KM capabilities and k-transfer. A discussion of the research objectives, variables and model is presented next.

3 Research Model

As mentioned in the introduction, this research has three main objectives. First, it sets to explore the impact that KM capabilities have on k-transfer success. Second, it aims at filling the existing research gap in the departmental level of analysis by focusing on inter-departmental k-transfer. Third, it replicates a part of Gold et al. (2001) model in a different context (IT projects), thereby assessing the external validity of their model.

This section begins with a discussion of the research model along with its respective constructs and hypotheses. This research attempts to answer the following research question: *Is an IT department's knowledge management capability related to the success of knowledge transfer during an IT project?* This question was represented by our two main hypotheses (see Figure 5).

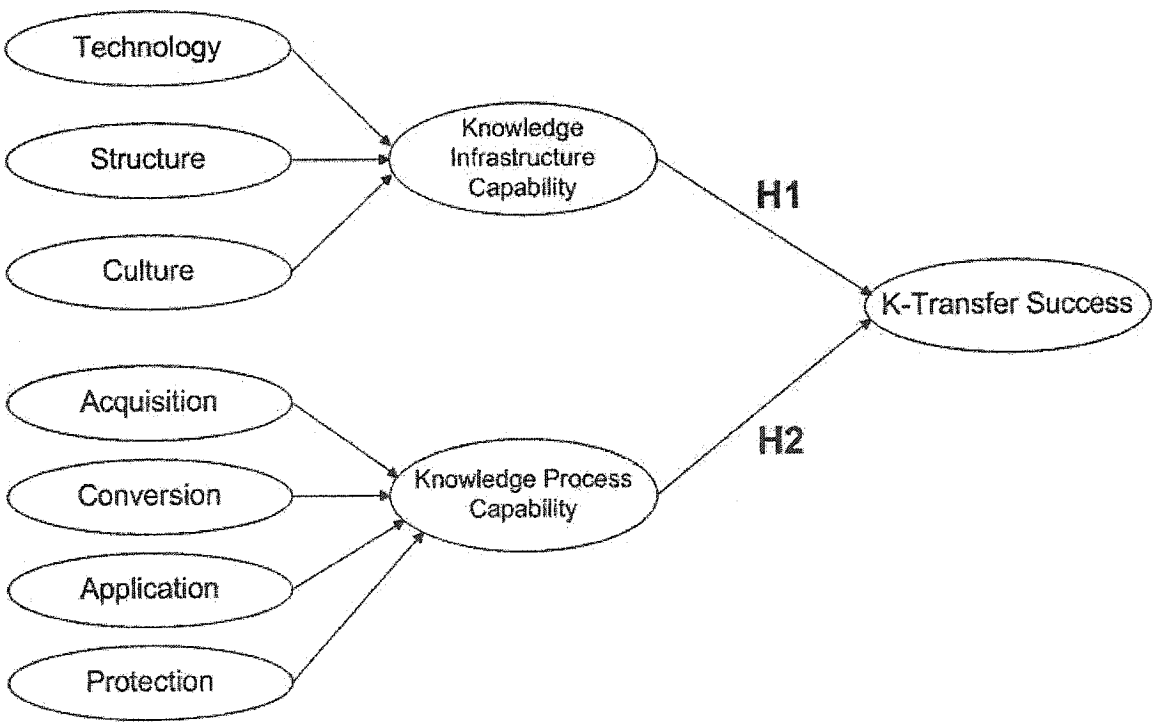

Figure 5: Research Model

However, we also attempted to answer the more detailed question: *Is an IT department's knowledge management capability (infrastructure and process) related to the effectiveness and efficiency of knowledge transfer during an IT project?* As depicted in Figure 6, our model was slightly altered to represent the test for this question using our sub-hypotheses (to be discussed later on).

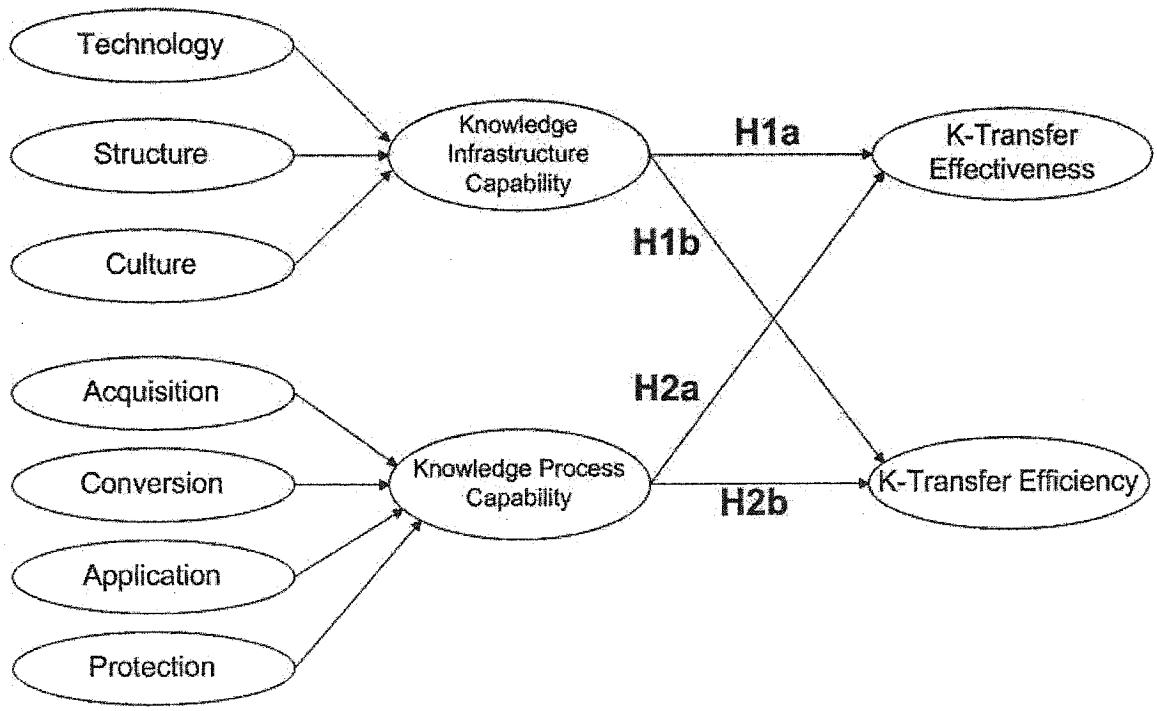

Figure 6: Research Model (part 2)

3.1 Research Constructs

The infrastructure and process constructs (i.e. the independent variables) are a replication of the Gold et al. 2001 model (their independent variables), but in a different context, that is, in IT projects. The authors originally tested organizational KM capabilities with relation to organizational effectiveness. This research will test KM capabilities on a departmental level of analysis and in a context of knowledge transfer success. The right

hand side of the model (i.e. the dependent variable) is to be tested as a new construct by this research. A detailed contrast between Gold's et al. model and the one used by this research is provided in **Appendix A**.

3.1.1 Knowledge Infrastructure Capability

In our model, knowledge infrastructure capability is a second order factor (latent construct) that is composed of three first-order factors: technological, structural and cultural infrastructures. The operational definitions of each of these constructs used by this thesis are those as given by Gold et al. These definitions, provided earlier the review of the literature, are repeated below.

Technological infrastructure refers to "technology enabled ties that exist within a firm" (Gold et al. 2001, p.187). These ties consist of: existence of common representation schemes for capturing knowledge, as well as collaboration, knowledge discovery, knowledge mapping, knowledge application and opportunity generation technologies.

KM structure refers to "the presence of norms and trust mechanisms" (Gold et al. 2001, p. 187). The presence of a flexible structure that encourages interactions among employees and incentive systems that reward k-sharing are the major elements of this construct.

Cultural infrastructure refers to "shared contexts" (Gold et al. 2001, p. 187). It pertains to the values accorded to knowledge sharing in the corporate vision and practice as well as the support given by senior management to knowledge practices.

3.1.2 Knowledge Process Capabilities

In the model, knowledge process capabilities is also a second-order factor that is composed of four first order factors: acquisition, conversion, application and protection processes. The following paragraph discusses their operational definitions, which were also mentioned earlier.

First, Gold et al. (2001) saw the term 'acquisition' as having a broader meaning than just acquiring external knowledge. Their definition included creation of knowledge within the firm, i.e. acquiring knowledge from an inside source. Thus, their operational definition sees *acquisition* processes as "those oriented toward obtaining knowledge" (Gold et al. 2001, p.190). Second, *conversion* processes consist of converting knowledge into a useful form. To achieve this, the following key processes must be present: knowledge organization and structure, knowledge integration and tacit to explicit knowledge conversion. Third, *application* processes are defined as those 'oriented toward the use of knowledge' (Gold et al. 2001, p. 195). For knowledge to be used, it must be accessible. Knowledge from past mistakes and experiences must be stored for later retrieval and use. Finally, processes for the *protection* of knowledge from inappropriate use or theft must exist in any company that wishes to preserve or generate its competitive advantage. These

must include procedures that limit the access to critical knowledge as well as protection policies that are openly communicated to all employees.

3.1.3 Knowledge Transfer Success

The purpose of k-transfer is to allow the receiver to generate value with the new knowledge that it wasn't able to generate before (Hodgson et al. 1998; Bozeman and Rogers 2001). Two main approaches are used in measuring the success of k-transfer: one measures changes in performance (value) while the other attempts to measure the change in recipient's knowledge (Argote and Ingram 2000a). Each of these approaches will be discussed.

Using the first approach, performance can be taken either as productivity or finance-related. Several studies have attempted such measurements, e.g. estimation of productivity in fast food stores due to experience of other stores in the franchise (Darr et al. 1995), hotel performance as affected by other hotels in the chain (Baum and Ingram 1998) and reduction of labor input based on experience in production (Benkard 1999). However, such an approach simply provides a proxy for measurement, since on all levels, but particularly on the organizational level of analysis, it is hard to isolate the increase in performance as due solely to the use of knowledge received.

The second approach attempts to measure the actual increase in knowledge. While less popular that the first approach, it has been applied at the individual level (Glazer 1998). However, as the bulk of acquired knowledge is tacit in nature, the recipient is usually

unable to verbalize it. A proposal was made to use this approach at higher levels of analysis by measuring the change in k-repositories (people, culture, structures, routines and tools) that results from k-transfer (Argote and Ingram 2000a). It argued that by moving the actual repository of knowledge (for example, transferring personnel from one unit to another), a greater effectiveness can be achieved. The outcome of k-transfer is measured through the change in the repository on the receiver's end, i.e. increase in personnel.

Similarly, using the concept of *embededness*, k-transfer effectiveness on the individual level can be measured through the changes that occur in the individual himself, again as a result of the transfer (Glazer 1998). One interesting approach was made in investigating the relationship between k-transfer and the mobility of k-holders (engineers) and the social networks they are part of (Almeida and Kogut 1999). Although the knowledge transferred was tacit in nature, the visible expression of k-transfer in a specific region was taken as the number of patents created in the area.

The effectiveness of k-transfer can be measured using the first approach: increase in performance/value. Effective process is one that puts to extensive use the customer requirements and whose end-product corresponds to original expectations and satisfies the user. Users' satisfaction with the system is one of the criteria by which the success of k-transfer was judged (Garrity and Sanders 1998) as it allowed us to evaluate whether the receiver of knowledge i) received the right knowledge, ii) correctly interpreted it, and iii) correctly applied it (DeLone and McLean 1992).

An efficient process is one that respects its schedule (Verkasalo and Lappalainen, 1998) and involves a minimal number of problems in its duration (Szulanski, 2001). A first proxy to measure the efficiency of k-transfer is the time requirements of the process (Jacob and Ebrahimpur 2001; Verkasalo and Lappalainen 1998). One extensive KM methodology (Firestone 2000) argues that time required to complete each of the sub-processes that make up k-transfer must be considered in such measurement. A study by Verkasalo and Lappalainen (1998) shows how it is possible to measure the efficiency of k-transfer through the time lag between the different sub-processes in k-transfer. Moreover, the time lag in communication between the client and developer will ultimately bear on the success of the project (Robey et al. 1993).

A second proxy for the efficiency of k-transfer is its stickiness (Szulanski 2000). Stickiness refers to the difficulties experienced during the transfer process and is often communication-related. As discussed previously, Szulanski broke down the k-transfer process into four stages: initiation, implementation, ramp-up and integration. A rise of unexpected problems in any of these stages will bear on the efficiency of the transfer. Causal ambiguity will create difficulties in identifying the gaps and sources of knowledge, measures of performance, etc. In the implementation stage, weak transfer ties may create communication gaps that will eventually bear on the efficiency of the transfer (Hansen 1999). Ramp-up stage stickiness refers to a rise in unexpected problems: misinterpreted knowledge, misinformation, causal ambiguity of the knowledge received. In the final stage, difficulties arise due to arrival of new members, lapses in performance

or changes in the scale of activities. These, even if eventually resolved, affect the transfer outcome in terms of time, cost and effort required to successfully accomplish the transfer.

The dependent variable, k-transfer success is a second-order factor as defined by effectiveness and efficiency. As discussed above, for a transfer to be considered as successful, it must be both *effective* and *efficient*. K-transfer process is effective if knowledge sent corresponds to knowledge received. It was efficient if it incurred minimal number of problems in its duration and was timely. Table 1 lists all the constructs, number of items in each and their sources.

Construct	Number of Items	Source (s)
Technology	12	Gold et al. (2001)
Structure	11	Gold et al. (2001)
Culture	13	Gold et al. (2001)
Acquisition	10	Gold et al. (2001)
Conversion	9	Gold et al. (2001)
Application	12	Gold et al. (2001)
Protection	10	Gold et al. (2001)
K-Transfer Efficiency	3	Franz et al. (1986); Doll et al. (1998); Kostova (1999)
K-Transfer Effectiveness	4	Szulanski (2000); Verkasslo et. al. (1998)

Table 1: List of Constructs

3.2 Research Hypotheses

The many articles reviewed in the literature lead us to expect positive relationships between our independent and dependent variables. An organization cannot accomplish certain critical processes if it does not possess the necessary capabilities. Without a solid technological, cultural and structural infrastructures knowledge transfer will hardly be successful.

H1: K-Infrastructure capability is positively related to k-transfer success.

The k-transfer success should increase if it is strongly supported by k-infrastructure. This hypothesis can be further broken down into parts H1a and H1b:

H1a: K-Infrastructure capability is positively related to the effectiveness of k-transfer.

Technology, structure and culture are all enablers of effective and efficient k-transfer (Goh 2002). A strong, cooperative and collaborative culture will create the necessary trust for k-transfer to take place. Culture is one of the most important elements for effective k-transfer in IT projects (Karlsen and Gottschalk 2004). The use of appropriate technologies will facilitate k-transfer, once the appropriate values are in place. A structure that encourages horizontal communication and cross functional teams while providing a reward system that recognizes knowledge sharing will further enhance the effectiveness of k-transfer.

H1b: K-Infrastructure capability is positively related to the efficiency of k-transfer.

Efficiency of k-transfer can be greatly affected by the cultural values of the recipient unit. If it is resistant to change or lacks motivation to collaborate, the transfer process is likely to be problematic. The term 'fertile' organizational context can be used to describe one that has the appropriate values, incentive systems and support for efficient k-transfer. (Szulanski 2000). Standardized IT infrastructure has been linked to efficiency of

operations and processes (Ross 2003). Technology and culture is positively related to both efficiency and effectiveness of k-transfer (Syed-Ikhsan and Rowland 2004).

Just as k-transfer cannot be successful without a proper infrastructure, neither can it be without certain basic KM processes. K-transfer is but one of many essential business processes which are closely interlinked. It is not enough to transfer knowledge. Its active management will ensure its effective use: it must be kept up-to-date, converted into appropriate formats, distributed to those concerned, protected, applied to relative problems and organized for efficient retrieval. These processes support k-transfer and without them we cannot expect the transfer to be successful. Thus,

H2: K-Process capability is positively related to k-transfer success.

The success of K-transfer should increase if strongly supported by k-process capability. Processes have direct bearing on operational efficiency and organizational effectiveness (Kallio et. al 2002). Knowledge is an important organizational resource, and a company can utilize it only with the presence of knowledge processes (Davenport 1996). Thus, as above, we posit:

H2a: K-Process capability is positively related to the effectiveness of k-transfer.

H2b: K-Process capability is positively related to the efficiency of k-transfer.

4 Research Methodology

This section discusses the various aspects of the methodology used by this thesis: the sample, the measurement, pre-testing, data collection and analysis procedures.

4.1 Sample

The survey used a specific email list of 3281 companies across Canada. The companies chosen were medium sized firms or larger (50 employees or more) to ensure sizeable IT departments. This categorization is in line with the one used by Statistics Canada[1] in the manufacturing sector. Small firms were taken as those with less than 50 employees, medium as those with 50-249 and large as having 250 or more. The list of companies was obtained from the Canadian Capabilities Directory (http://strategis.ic.gc.ca/sc_coinf/ccc/engdoc/homepage.html).

As the registration to the directory is voluntary, some self-selection bias was present. The bias is not toward the research, but rather the directory. Within this population, all subjects that have provided an email were contacted and requested to complete the survey. A large sample was necessary due to large constructs (5-10 observations per item, as accepted in the structural modeling literature (Bentler and Chou 1987)). The sample size was equal to the number of companies that have provided an email contact (3281). This is a convenience sample as no randomness is present in selection.

[1] http://strategis.ic.gc.ca/epic/internet/insbrp-rppe.nsf/vwGeneratedInterE/rd00655e.html

In order to avoid response bias, each IT manager was asked to base their answers on a 'typical' project their department implemented during the last year. It could well be that a typical project in a company can be consistently successful or consistently fail. However, in cases where there's a history of varying results of success, we judged the word 'typical' to reduce the respondents' tendency to formulate their answers based on success or failure alone. We also decided to ask the IT manager to forward a part of the questionnaire (the items for the dependent variable and satisfaction) to at least one customer department for which the system in question was implemented. This was done so we could compare the responses of both and see whether there were significant differences. The customers were also asked to give their answers based on a 'typical' project.

4.2 Measurement

The measurement of the independent variable (KM capabilities) was conducted using the Gold et al. (2001) instrument. The authors tested the model indicating that it had no serious departures from univariate and multivariate normality and had strong evidence of model identification (although they did not supply the detailed results). The model provided a good fit for the observed covariances among the item measures. However, since this instrument was used on the organizational level, certain items had to be modified in our research to measure a department's capabilities. The original instrument used 7-point Likert scales (1- strongly disagree to 7- strongly agree) which was also replicated in this study. The statistical results obtained by Gold et al. demonstrated that their measures were reliable and the model was valid.

For all items taken from Gold et al.'s instrument, initial phrases were modified to reflect that the respondents were being asked about their department, rather than the organization. Wherever the terms 'organization' and 'organizational' were encountered within the item, they were changed to 'department' and 'departmental'.

The measurement of the dependent variable was done with an instrument designed for the purposes of this research. The items were compiled from the relevant literature, sources for which are given in **Appendix B**. We used the same 7-point Likert scale as for the independent variables.

4.3 Pre-testing of the Instrument

The instrument was pre-tested with four practitioners in the Montreal area. The focus of the pretest was two-fold: first, to make sure that the presentation of the instrument was clear, concise, and easy to use; second, to ensure that k-transfer success construct was properly understood. Since the constructs used to measure the independent variables are a replication of Gold et al., it was not modified. However, as the dependent variable construct has not yet been tested, the results of the pretest were used to enhance validity in terms of both wording and content. A suggestion was made during the pretest to add a few items to test the satisfaction with the interaction process of both IT and non-IT respondents. Although this part was not included in the main model, it was added to enhance the descriptive analysis. Furthermore, the pretest revealed certain necessary changes to the wording of the survey's introduction page, instructions for each section, and design layout.

4.4 Data Collection and Analysis Procedure

Internet surveys' benefits include greater audience reach, design flexibility and anonymity, while being offset by such drawbacks as bias resulting from multiple and/or inappropriate responses as well as certain generalizability issues (Sheehan and Hoy 1999). Generalizability presents a problem on two levels (Smith 1997; Sheehan and Hoy 1999): first, only Internet users are likely to respond to an online survey. The second is the difficulty in determining the response rate. The latter can be avoided by only using a specifically identified email list, rather than posting invitations to participate on discussion boards and Usenet groups.

We decided to use the internet survey method of collecting our data. Once the pre-test and resulting corrections to the instrument were completed, an email was sent to each company's contact with an introductory message and a link to the survey. The survey contained two links: one for IT managers, the second for the customer department managers (those who received an IT solution within the last year from the IT department). Each link led to the appropriate questions for each respondent.

Inter-departmental IT projects were selected because they presented an opportunity to study a cross-functional process. As effective communication and understanding is relatively difficult to arrive at in such contexts, there is a need to establish what elements of KM capability will increase k-transfer success. IT projects are also transactional- there are two parties, one acting as supplier the other as customer of the end-product. As discussed in the literature review, such view is appropriate for the study of k-transfer.

The initial emailing took 2 days. Messages were sent in batches of 500, in order to prevent crashing either Microsoft Word or Outlook. A total of 3281 were sent out, out of which 856 came back as either undeliverable, out of office replies, or were blocked by spam/firewall filters. A total of 51 responses were received during this phase of data collection (21 IT and 30 customer responses).

Three different emails were sent, based on the type of email contact the company provided in the database. If the contact was an IT manager, he/she was asked to fill out the IT section of the survey and to forward the link to one or more managers of the department for which an IT product was implemented. If the contact was a non-IT manager, he/she was asked to fill out the second part of the survey, provided their department received an IT solution within the last year. They were also asked to forward the link to their company's IT department's head. If the contact was a general one, the email was identical to the one sent to IT managers, except for a note at the top asking for the message to be forwarded to the company's IT department head.

After 10 days, a reminder was sent to all those contacts who did not reply. This phase generated a better response rate, resulting in an additional 80 survey completions (33 IT and 46 customer responses). We suspect this has to do with the timing of the emails. The initial invitation was sent out on Thursday/Friday, while the reminder was sent on a Monday. The reminder generated quite a number of indignant responses. Several contacts protested against such data collection procedure (over email), saying it amounted to spam. Others were upset for receiving a reminder ('If I didn't answer the first time, it

means I'm not interested" was a common response). There were a total of 131 questionnaires completed, representing 50 companies. Since there were 2425 qualified emails sent, the response rate we received was 2%.

The online data was stored in a MS Access database from which it was imported into Excel and then into SPSS 10.0. The questionnaire was designed in a way to prevent missing values/unanswered questions for all parts except demographics. Four incomplete questionnaires had to be discarded. Descriptive statistics and model assessment were conducted using SPSS in conjunction with PLS-PC. Model analysis was conducted using PLS-Graph.

5 Analysis and Results

This chapter reviews the statistical procedures used to analyze the data and the results. First, we analyzed the sample to get an idea of its demographical characteristics. Then, we proceeded to assess the measurement model. Finally, the research hypotheses were tested using structural modeling techniques. Li's (2001) work was used as a reference for the overall structure of this section.

5.1 Sample Demographics

Sample traits were determined through the analysis of demographic questions asked at the end of the survey. These included the number of employees in the company, annual sales, industry, number of employees in the department, respondent's position and her/his department's location. It is important to note that these questions were optional. Hence not all respondents fully completed this section. Another issue we faced when analyzing

the demographic data was multiple responses per company. A total of 127 responses represented 48 firms (after the removal of incomplete responses). There were obviously some discrepancies in answers about the firm's size, sales, etc. A decision was made to analyze general information based on the answers from the IT respondents only (n=54). This included such data as company's employee number, sales and industry. The rest of the data was analyzed using all of the responses. For most questions, the respondents chose a range (rather than providing an absolute value) and hence it was not possible to compute averages.

i) Number of Employees per Firm

The criterion for selection when mailing the questionnaire was 50 or more employees per company. There were 2 instances where the company size was under 50 employees (these were still kept as part of the research sample). This is a relatively low number, given that that the updates to the directory listings, just like the initial listings themselves have to be made on a voluntary basis. In order to further grasp why this number should be considered low, we should take into consideration the downsizing trend of the last few years. As illustrated by Figure 7, we can thus say that the study achieved this goal for the study sample- 96% of companies had 50 employees or more.

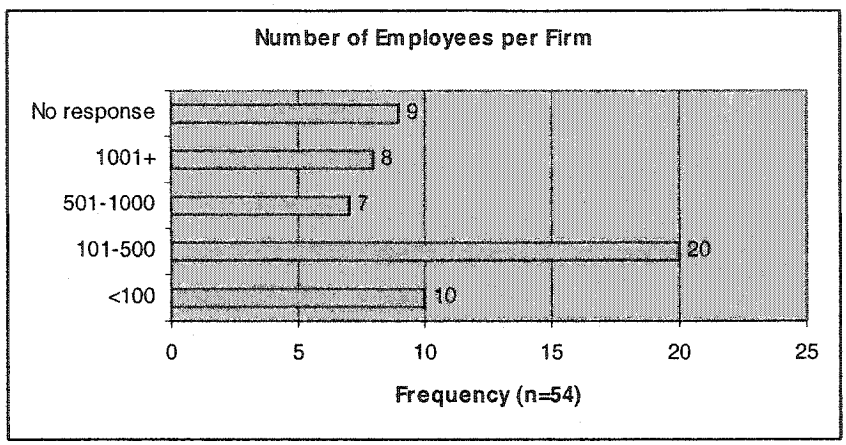

Figure 7: Employees per Firm

ii) Number of Employees per Department

When asked about the size of their department, the respondents had to enter a number (as opposed to a drop-down selection). As depicted in Figure 8, the responses were then classified into four categories. As can be seen from Graph 1, the majority (53%) of respondents belonged to small departments. Twenty seven percent came from medium to large departments. This reflects the fact that small to medium firms represent the majority of the sample. A further 18% of respondents declined to answer.

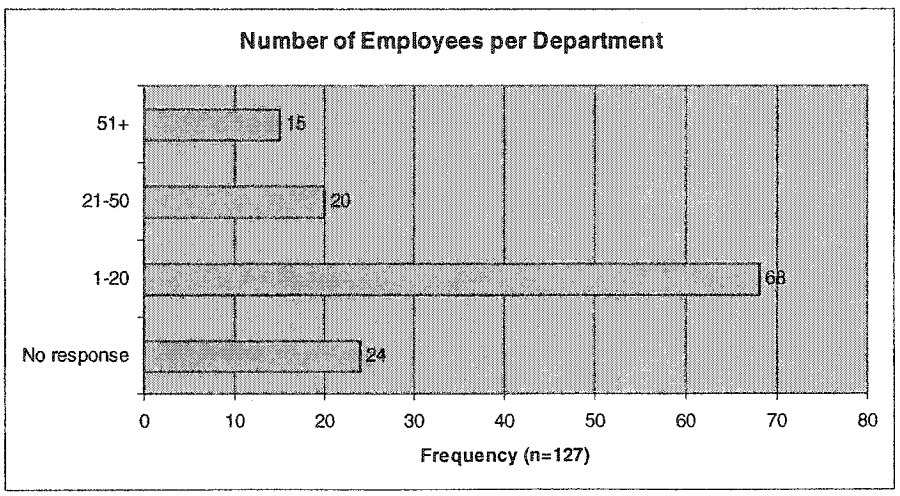

Figure 8: Number of Employees per Department

iii) Company's Sales

Among all demographic questions asked, this was a sensitive issue since many companies have strict policies regarding the divulging of their financial information. As depicted in Figure 9, it had the highest percentage of respondents that declined to answer (28%). From those who answered, the largest group (20%) reported sales between 10 and 25 million dollars. A further 25% reported sales in excess of 25 million dollars.

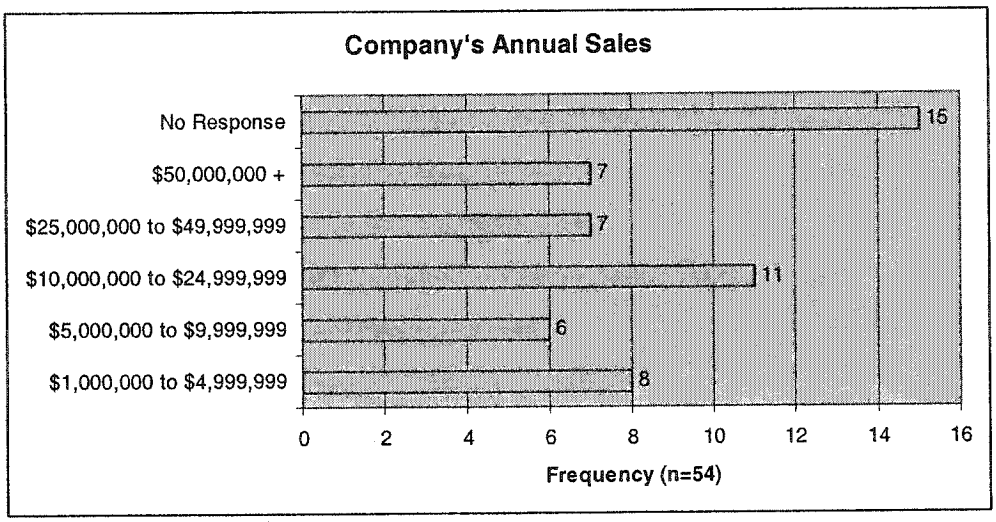

Figure 9: Company's Sales

iv) Company's Industry

As depicted in Figure 10, manufacturing represented the biggest category of respondents (30%), while business services followed.

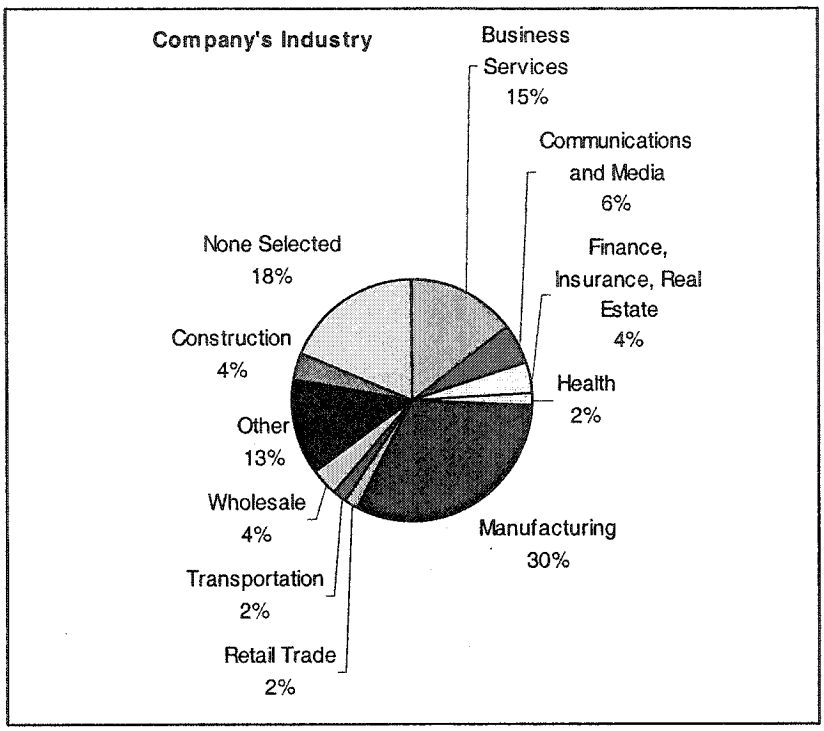

Figure 10: Company's Industry

v) Respondents Job Title Categories

The responses to this question were classified into four main categories, as shown in Figure 11: senior executives, senior managers, managers, technical/support and no response. The aim of this study was to reach department heads and project managers. Hence the largest group in the sample (36%) represents the middle management. However, a sizeable number of respondents belonged to the lower level of the corporate hierarchy. This can be due to our method of contacting the respondents. Since we had few contacts who were directly involved in IT, we relied on the customers and company administration personnel to forward our emails to the appropriate persons. It seems that in several cases the emails were forwarded to non-managers.

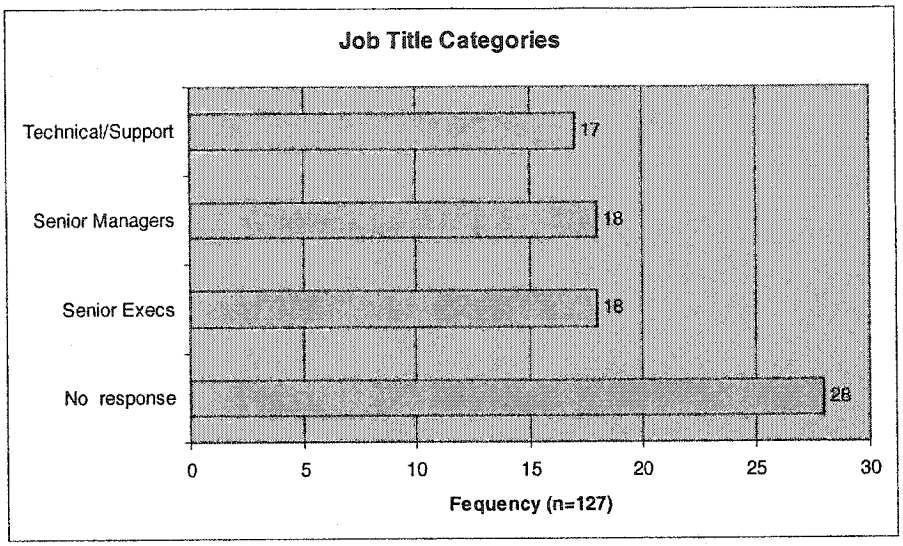

Figure 11: Job Title Categories

vi) IT Respondents by Province

As expected, most of the respondents were from Ontario. However, a relatively low response rate was received from Quebec. The reasons are two-fold. First, the questionnaire was only available in English. Hence, language was a barrier to individuals speaking only French. Second, since the directory was also in English, possibly fewer firms from Quebec registered. Since the registration was voluntary, its composition is not entirely representative of all the provinces. Although our study focused on Canadian companies, we did not forbid non-Canadian respondents, who constituted about 5.5% of the sample.

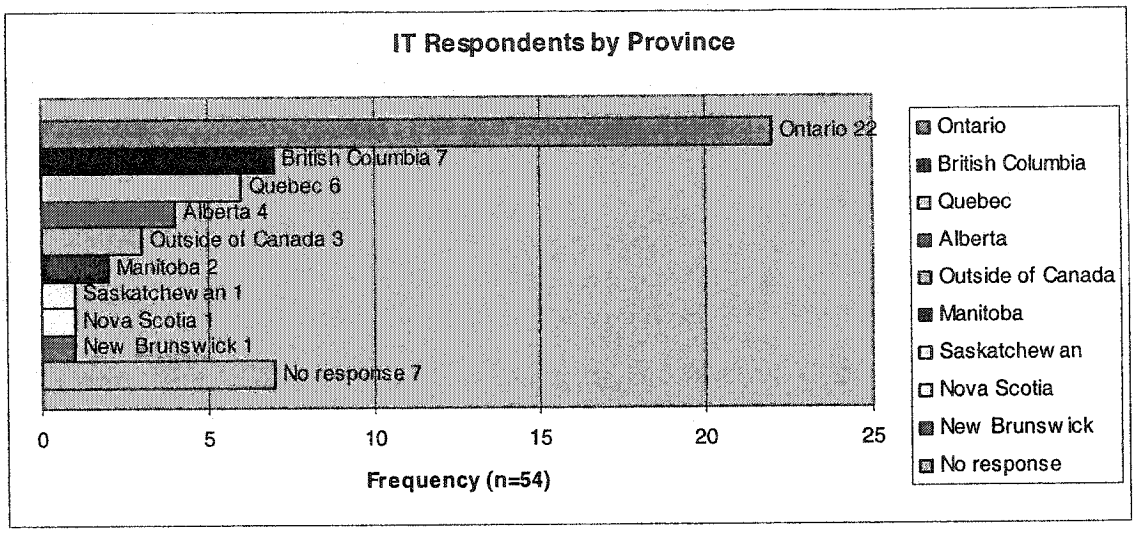

Figure 12: Respondents by Province

5.2 Assessment of the Measurement Model

Model assessment began by using confirmatory factor analysis (CFA). Construct unidimensionality, reliability and validity were tested. SPSS 10.0 was used in conjunction with PLS-PC 1.8 to run the analysis. While the initial factor matrices and coefficients were calculated using SPSS, the subsequent rounds of factor analysis were performed using PLS-PC. Each phase was tested separately on the three constructs (*k-process capability, k-infrastructure capability,* and *k-transfer success*).

Using PLS-PC, the factor numbers for *k-infrastructure* and *k-process* constructs were forced to three and four, respectively. Construct unidimensionality verifies whether all the items belonging to a certain construct measure only that construct (Hair et al. 1992). As proposed by Hair et al. (1992) and Raymond et al. (1998), the determinants of construct unidimensionality are the factor loadings for its items. The loadings (lambdas) of each item have to be superior to 0.50 and have the highest loading for the construct

they represent. In the *k-process* construct, four items (CP7, AP5, PP6 and PP10- see **Appendix D**) were found to have a loading <0.50 or to not have the highest value, and were hence dropped. In the *k-infrastructure* construct, two items (T2 and T3) were dropped as well. No items were dropped from the *k-transfer success* construct.

Once it was established that each item measured only the construct it should measure, it was necessary to determine the construct reliability. This step determines how well the items measure the construct to which they belong. Two tests were used, the ρ coefficient (rho) and Cronbach's alpha. The following formula was used to calculate ρ:

$$\rho = (\Sigma|\lambda_i|)^2 / (\Sigma|\lambda_i|)^2 + \Sigma(1-\lambda_i^2)$$ where λ_i is the loading for factor i.

As shown in Table 1, all Process, *k-infrastructure* and *k-transfer success* rho values were above 0.70, ranging from 0.79 to 0.96. This indicated that all constructs were reliable (Fornell and Larcker 1981).

Table 2: Construct Reliability (CFA)

Constructs	Initial No. of Items	Final No. of Items	Rho	Alpha
Technological Infrastructure	12	11	0.88	0.88
Structural Infrastructure	11	8	0.85	0.78
Cultural Infrastructure	13	13	0.91	0.89
Acquisition Processes	10	10	0.94	0.92
Conversion Processes	9	11	0.96	0.94
Application Processes	12	8	0.90	0.87
Protection Processes	10	8	0.94	0.92
K-Transfer Effectiveness	3	3	0.79	0.71
K-Transfer Efficiency	4	4	0.81	0.67

Convergent validity was assessed using value of the ρ and alpha coefficients. The cutoff used was 0.70 (Nunally 1967, Hulland 1999). All rho values were superior to 0.70. *K-transfer efficiency* alpha value was slightly below 0.70 and was nevertheless kept.

Discriminant validity determines whether there isn't any cross-measurement between the constructs, i.e. each measures only itself. The criterion is two-fold: first, items belonging to a construct have to have a higher correlation with other items belonging to the same construct than with those belonging to another construct. Second, the average variance extracted (AVE) has to be higher than all the shared variances and be superior to 0.50. The following formula was used to calculate AVE values:

$$AVE = \Sigma\lambda i2 / (\Sigma\lambda_i^2 + \Sigma(1-\lambda_i^2)) \text{ where } \lambda_i \text{ is the loading for factor i.}$$

The results are given in tables 2-4. All *process* AVE values were greater than 0.50. However, the *application* process AVE (0.52) was lower than the variances between *acquisition/conversion* (0.53) and *acquisition/application* (0.54). All AVE values for the *infrastructure* constructs were below 0.50. The *K-transfer success* construct presented no problems as it was respecting the requirements for successful CFA.

Table 3: K-Process Capability Discriminant Validity (CFA)

	Acquisition	Conversion	Application	Protection
Acquisition	**0.62**			
Conversion	0.53	**0.67**		
Application	0.54	0.38	**0.52**	
Protection	0.27	0.26	0.16	**0.66**

Table 4: K-Infrastructure Capability Discriminant Validity (CFA)

	Cultural	Technological	Structural
Cultural	**0.45**		
Technological	0.44	**0.46**	
Structural	0.46	0.35	**0.45**

Table 5: K-Transfer Success Discriminant Validity (CFA)

	Effectiveness	Efficiency
Effectiveness	**0.66**	
Efficiency	0.45	**0.53**

Because we were not able to confirm the Discriminant validity of certain constructs, we switched to exploratory factor analysis (EFA) for *infrastructure* and *process* constructs. Instead of trying to confirm our model using our data, we decided to do the reverse and let the data demonstrate the appropriate statistical model to which it will fit. Using SPSS, the calculations produced 7 factors with a total of 41 items for *k-process capability*. When testing for construct unidimensionality, item AP9 was dropped because its loading was inferior to 0.50. An attempt was made to find the logic behind the grouping of the 7 factors. Although some grouping certainly was clear, a decision was made to remove 3 factors whose grouping did not make any theoretical sense. These factors included items AP5, AP6, AP7, AP10, AP12, PP6, PP10 and ACP10. Since initially AP9 was removed due to the influence from these items, it was included in the second round of EFA. The tests for unidimensionality during the second round removed items CP8, ACP2 and ACP5 because they did not belong to any of the factors.

EFA produced 7 factors with 33 items for *k-infrastructure capability*. When testing for construct unidimensionality, CI9, CI3, TI8, SI3, SI4, SI1 were dropped. Construct reliability was tested using the same criteria as in CFA, namely Cronbach's alpha and

the ρ coefficient. The results are presented in Table 5. All values were above 0.50 and were hence deemed reliable.

Table 6: Construct Reliability (EFA)

Constructs	No. of Items	Rho	Alpha
Culture of Sharing	5	0.90	0.85
Opportunity Generation Technologies	5	0.91	0.87
Collaboration Technology	5	0.88	0.81
Corporate Values	3	0.85	0.73
Structure-supported Collaboration	4	0.88	0.75
Culture of Learning	3	0.87	0.75
Systems of Rewards	2	0.95	0.87
Knowledge Conversion	9	0.95	0.94
Knowledge Protection	6	0.96	0.94
Knowledge Acquisition	7	0.94	0.92
Knowledge Application	6	0.91	0.92
Knowledge Restriction	2	0.82	0.55
K-Transfer Effectiveness	3	0.79	0.71
K-Transfer Efficiency	4	0.81	0.67

Convergent validity was determined using the ρ and alpha coefficients' values. All ρ values were higher than 0.70. *K-transfer efficiency* alpha value was slightly lower than 0.70, but it was kept as previously. However, knowledge *restriction* was removed due to its low alpha value. Both *k-process* and *k-infrastructure* constructs passed the tests for Discriminant validity. The results are presented in tables 6-7.

Table 7: K-Process Capability Discriminant Validity (EFA)

	K-Conversion	K-Acquisition	K-Application	K-Restriction
K-Conversion	**0.69**			
K-Acquisition	0.26	**0.79**		
K-Application	0.47	0.26	**0.68**	
K- Restriction	0.35	0.12	0.61	**0.61**

Table 8: K-Infrastructure Capability Discriminant Validity (EFA)

	Culture of Sharing	Opp. Gen Tech.	Collaboration Technology	Corporate Values	Structure-supported collaboration	Culture of Learning	System of Rewards
Culture of Sharing	**0.65**						
Opportunity Generation Tech.	0.16	**0.67**					
Collaboration Technology	0.39	0.28	**0.58**				
Corporate Values	0.31	0.20	0.18	**0.66**			
Structure-supported Collaboration	0.23	0.20	0.22	0.20	**0.56**		
Culture of Learning	0.21	0.20	0.08	0.18	0.06	**0.68**	
Systems of Rewards	0.10	0.09	0.08	0.09	0.04	0.12	**0.90**

The resulting factors for *k-infrastructure* and *k-process capabilities* are presented with their items in **Appendix D**. The loadings for individual items are presented in **Appendix E**. The logic for their groupings is explained next.

5.3 Factor Groupings

Since the independent variables were based on Gold et al.'s (2001) model, we had to follow their format in our questionnaire. However, as the authors themselves have pointed out, each construct they used was in fact grouping several other constructs. For example, *technological infrastructure* included business intelligence, collaboration, distributed learning, k-discovery, k-mapping, opportunity generation and security. Two of these became separate constructs in our model: *collaboration* with items TI 4, TI 5, TI 6, TI 7 and TI 9; and *opportunity generation* with TI10, TI 11, TI 12, SI9 and SI10 (see Appendix D). *Collaboration* technology is defined as a set of tools used to support the sharing of knowledge. *Opportunity generation* technology is defined as a set of tools used

to identify new business prospects with respect to customers, partners, employees and suppliers.

The two *structural* items also relate to opportunity and new knowledge generation. In evaluating the structural infrastructure, Gold et al. (2001) focused on rewards and incentives as well as a structure that supports collaboration. In our analysis, the items pertaining to rewards and incentives formed a separate construct (SI5 and SI6). The rest of the significant items remained together in one construct, renamed *structure-supported collaboration* (SI2, SI7, SI8, and SI11). We defined it as the functional and hierarchical organizational system that facilitates the sharing of knowledge across the organization. *Cultural infrastructure* broke down into three separate constructs (also in accordance with Gold et al.): *corporate values* (CI1, CI2, and CI12), *culture of learning* (CI, CI5 and CI6) and *culture of sharing* (CI7, CI8, CI10, CI11 and CI13). *Culture of learning* is defined as shared contexts that enable individuals and groups to increase their capacity to take affective action. *Culture of sharing* is defined as shared contexts that facilitate the exchange of knowledge.

Similar results were obtained for the *k-process infrastructure* constructs. *k-protection* processes were broken down into *protection* (PP1, PP2, PP3, PP4, PP5, and PP7) and *restriction* (PP8, PP9). *Restriction* processes can be defined as those oriented toward tracking and limiting access to knowledge. The distinction was made by Gold et al. (2001) p. 192. The definitions provided by the authors of the original model for the other three processes were somewhat overlapping. For example, acquisition was defined as

'obtaining knowledge' (p.190), but it was taken broadly enough to encompass use of existing knowledge and collaboration. These could have also been part of application processes. The same can be said about conversion processes (defined as 'making existing knowledge useful' p. 191) – which had considerable overlap with application processes.

Not surprisingly the results grouped certain items from previously separate constructs. *Conversion* construct contained four application items (AP1, AP2, AP3, and AP4), four conversion items (CP1, CP4, CP5 and CP9) and one acquisition item (ACP1). All of the items fit the previously give definition of conversion processes. *Acquisition* construct contained three acquisition (ACP7, ACP8 and ACP9) and four conversion (CP2, CP3, CP6 and CP7) items. The last construct, *application* contained three application (AP8, AP9 and AP11) and three acquisition (ACP3, ACP4 and ACP6) items. All of them relate to the actual use of knowledge. The next section discusses the structural model.

5.4 Assessment of the Structural Model

PLS confirmatory path analysis was used to assess the structural model using PLS-PC package. The analysis was two-fold. First, the general model was assessed to test for Hypotheses 1 and 2. Then, a separate model was analyzed in order to test for Hypotheses 1a, 1b, 2a and 2b. The path coefficients were calculated using the PLS Jack-Knife procedure (Wildt et al., 1982). All the independent and dependent variables were assessed as second-order factors in the general model. The confirmatory path analysis is provided in Figures 13-15.

Hypothesis 1 tested for a positive relationship between *k-infrastructure capability* and *k-transfer success*. This relationship was confirmed (Path Coefficient = 0.492, $p<0.05$). Hypothesis 2 tested for a positive relationship between *k-process capability* and *k-transfer success*. This relationship was also confirmed (Path Coefficient = 0.276, $p<0.05$) (See Figure 13).

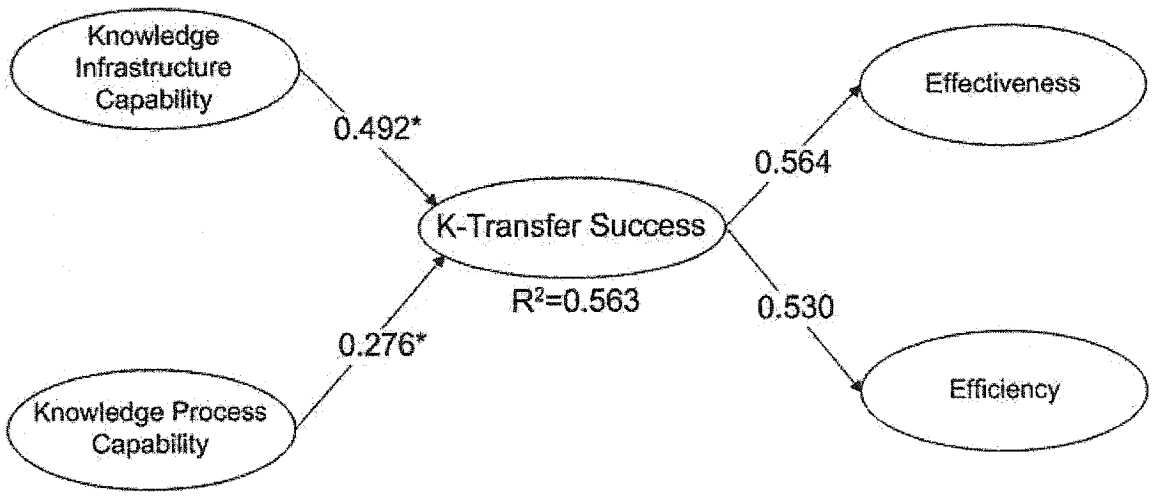

Figure 13: KM Infrastructure Path Analysis and Significance Results (one-tailed t-test *: $p<0.05$; n=54)

In the *k-process* construct, *conversion* and *protection* constructs were not significant as their loadings were inferior to 0.50. Only *acquisition* and *application* proved to be significant. In k-infrastructure, the construct *corporate values* was not significant. A second round of analysis was performed once these constructs were removed. Figures 14 and 15 present each of the second-order constructs with their respective sub-constructs whose loadings were above 0.50. Table 8 presents the loadings for the model during each round. Figure 16 presents the constructs that were kept for *K-infrastructure*: *opportunity*

generation technologies, structure-supported collaboration, system of rewards, collaboration technology, culture of learning and *culture of sharing*.

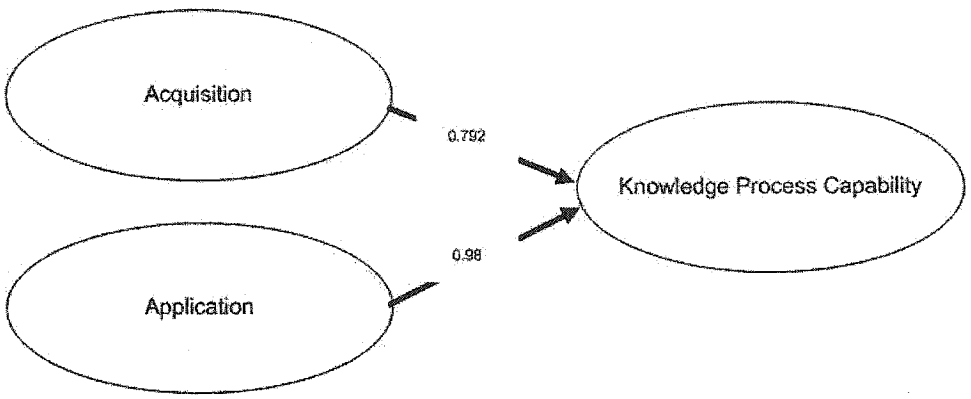

Figure 14: K-Process Path Analysis

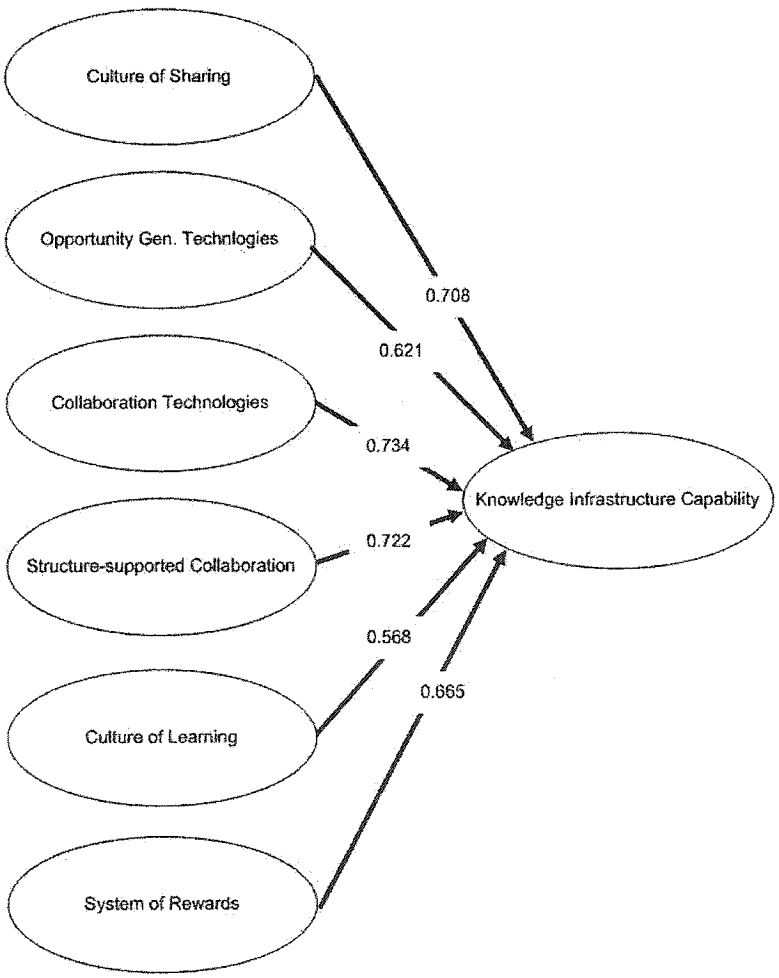

Figure 15: K-Infrastructure Path Analysis

Table 9: Comparison of Construct Loadings

Construct	Roud 1 λ	Roud 2 λ
Culture of Sharing	0.708	0.718
Opportunity Generation Tech.	0.621	0.634
Collaboration Technology	0.734	0.747
Corporate Values	0.435	removed
Structure-supported Collaboration	0.722	0.734
Culture of Learning	0.568	0.578
Systems of Rewards	0.665	0.675
Knowledge Conversion	0.463	removed
Knowledge Protection	0.370	removed
Knowledge Acquisition	0.792	0.807
Knowledge Application	0.980	0.999

The second part of the analysis was performed to test the sub-hypotheses. *K-infrastructure* and *k-process* constructs were tested in a direct relationship with *k-transfer efficiency* and *effectiveness*. Efficiency and effectiveness were assessed as second-order factors while *k-infrastructure* and *k-process capabilities* as second-order factors.

- Hypothesis 1a tested for a positive relationship between *k-infrastructure capabilities* and *k-transfer effectiveness*. This relationship was confirmed (path coefficient = 0.591, $p<0.01$).
- Hypothesis 1b tested for a positive relationship between *k-infrastructure capabilities* and *k-transfer efficiency*. This relationship was not confirmed (path coefficient = 0.238, $p>0.05$).
- Hypotheses 2a tested for a positive relationship between *k-process capabilities* and *k-transfer effectiveness*. This relationship was not confirmed (path coefficient = 0.096, $p>0.05$).
- The last sub-hypothesis (2b) was confirmed with a positive relationship between *k-process capabilities* and *k-transfer efficiency* (path coefficient = 0.533, $p<0.01$). Figure 17 illustrates the path coefficients between the constructs.

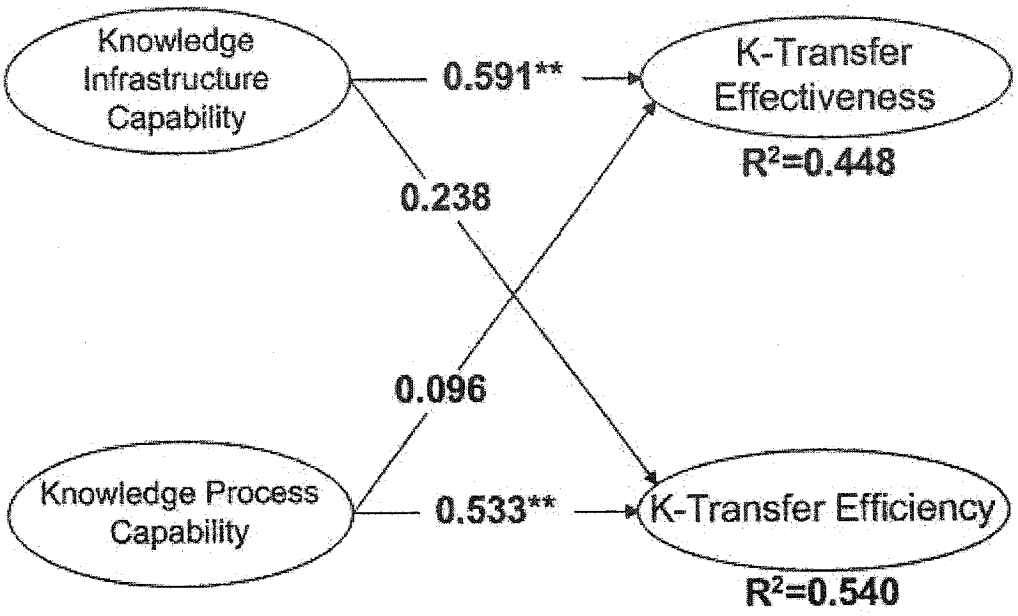

Figure 16: Path Analysis and Significance Results Part 2 (one-tailed t-test **: p<0.01; n=54)

5.5 Comparison of IT and customer responses

As pointed out in the research methodology section above, 2 sections of the questionnaire were answered by both IT and customer respondents. The sections concerned were *k-transfer success* (dependent variable) and satisfaction (not included in the research model). The responses were paired and compared using a paired sample t-test. The results showed there were significant differences between the IT and customer responses for both pairs. This will be further discussed in the next section.

6 Discussion

The model for our study was largely based on Gold et al. (2001) KM capabilities framework. We have taken a tested model and replicated it in a completely different setting. Furthermore, we devised a unique way of measuring the success of the k-transfer process based on the current literature. While revealing some inherent weaknesses in Gold et al.'s model, our study has shown that KM capabilities significantly contribute to the success of a k-transfer process.

Our results have shown that in order to achieve k-transfer success, certain key processes have to be present on the receiver's end. The two constructs that proved to be significant were *Acquisition* and *Application*. This confirms what the research literature has proposed (Verkasslo and Lappalainen, 1998; Garvin 1993). Two other constructs proved to be non-significant (*Protection* and *Conversion*). It can be argued that protection processes are important if the knowledge that is being protected is vital for the company's competitive advantage (Porter-Liebskind, 1996). However, our study dealt with a process internal to a company, namely the providing of an IT solution from one department to another. The knowledge in question was the internal customer IT requirements which are not necessarily central to the company's business.

Conversion processes make knowledge useful. The fact that they did not prove to be significant might be explained by the fact that we were dealing mostly with small IT departments. It could well be that such processes were not standardized or formal.

K-infrastructure capabilities proved to be central to k-transfer success. Out of seven constructs, only one (*corporate values*) proved to be non-significant. This can also be explained by the fact that the majority of our respondents belonged to small departments where values may not necessarily be explicitly stated.

The tests for our sub-hypotheses have shown that KM capabilities have a significant impact on the particular aspects of k-transfer. Particularly, *k-process capability* contributes to k-transfer efficiency and *k-infrastructure capability* contributes to k-transfer *effectiveness*. A k-transfer is said to be efficient if it is timely and involves a minimal number of problems. This can only be achieved if the processes, upon which k-transfer depends, function smoothly. We can say that if an IT department has such processes in place, it is poised to efficiently deliver IT solutions to its clients. Whether these solutions will correspond to the original client demands (effectiveness), will be largely determined by the presence of k-infrastructure elements within the IT department. Namely, whether its culture and structure promote sharing and collaboration, and whether it has technology that enables collaboration and new opportunity generation.

Interestingly, *k-infrastructure capability* did not prove to significantly contribute to k-transfer *efficiency*. Infrastructure elements can be viewed as a set of tools and enablers for k-transfer (Goh 2002). They do not however guarantee its efficiency. For example, recent research has shown that IT infrastructure contributes to efficiency only if standardization of IT is in place (Ross 2003). Our survey verified the presence of infrastructure elements, but not the extent and modes of their application.

Similarly, *k-process capability* did not prove significant with respect to k-transfer *effectiveness*. This was an unexpected result. Certainly, processes have an important bearing on improving efficiency (Kallio et. al 2002); but without their presence, effectiveness cannot be achieved. We can speculate that in cases where firms did have k-processes in place and were not able to achieve k-transfer effectiveness, these processes may have been either improperly implemented or badly managed.

The comparison of means between IT and customer responses revealed significant differences. However, we cannot interpret this as evidence of response bias. Since this wasn't a case study, we did not have access to the IT departments' project histories. Both IT managers and customers were asked to formulate their responses based on a 'typical' project done during the last year. There was no way for us to verify that in fact the answers of both parties pertained to the same project.

With hindsight, we realize that wording was not enough to eliminate response bias. Ideally, a more effective control should have been in place, but was impossible to accomplish without prior contact with the respondents. However, this did prove to be a useful learning exercise.

6.1 Contribution of the study

The current study is one of the few that empirically measure the success of a k-transfer process. Although several models were proposed for measuring k-transfer efficiency

and/or effectiveness, to our knowledge few actually went beyond the theoretical level and designed an instrument for its measurement. Using previous literature, we have combined proposed measurements of efficiency and effectiveness into one construct, *k-transfer success*. The statistical results have shown it to be both valid and reliable.

This research focused on the level of analysis largely untouched by the current academic literature. Although much of the internal communication within firms occurs between departments, most of the current research deals with a higher level of analysis. By using the department as our unit of analysis, we have furthered the research in this area.

This study has made an important contribution to practitioners by indicating the specific k-processes and k-infrastructure elements that are essential for successful communication between IT solution customers and developers. IT managers can improve the efficiency of their IT projects by making sure that their department has the necessary k-acquisition and k-application processes. They can also improve the effectiveness of their IT projects by implementing technology that will help their employees to collaborate and generate new opportunities; designing a rewards and incentive system that will encourage k-sharing; ensure that departmental structure does not inhibit collaboration; and promote a departmental culture of sharing and learning.

6.2 Limitations

Part of our research model was a replication of a previous study by Gold et al. (2001). Hence our model carried all the inherent weaknesses of Gold et al.'s model. As we discovered during the analysis of our data, the main limitation of their study was the

vague definitions of its constructs. The infrastructure constructs were in fact groupings of several other constructs and several process definitions constructs were overlapping. This was reflected in our research by the fact that confirmatory factor analysis was not possible and exploratory factor analysis resulted in groupings that did not correspond to the original model.

The study used the online survey methodology. Respondents were contacted through email. The low response rate can be explained by several factors combined. Fist, we believe that the prevalence of spam has made it very difficult for managers to cope with their email load. Second, we initially planned to purchase a list from Dun & Bradstreet or a similar provider of corporate mailing contacts. However Canadian law does not permit the sale of corporate emails. Hence, we had to resort to alternative means of getting our sample respondents, and used the Canadian Capabilities Directory.

We decided to use the Canadian Capabilities business directory to obtain our sample respondents. Since the registration to the directory is voluntary, a certain amount of self-selection bias was present. The directory presented us with several problems when contacting the companies. Not all registers provided their email addresses. Out of those that did, only a third gave a specific contact name. Very few of those contacts were IT managers. Out of a total of 3281 contact emails, 13 were IT-related and 1593 were general administration contacts. Not being able to personalize the message and email it directly to the respondent greatly reduced our response rate.

Another influence on the response rate could have been the fact that our questionnaire did not permit respondents to leave blank answers. If an item was not answered, they could not proceed to the next section. This was done in order to ensure that respondents did not overlook or forgot to answer a question. It was also done to facilitate data manipulation once the collection process was over. Four respondents abandoned the survey after answering the first section. In cases where the respondent did not want to provide an answer or was not sure of the right response, we cannot be sure if his choice was consistently 'Neutral' (4 on the Lickert scale).

6.3 Future Research Directions

While our study was limited by the type of companies that we could contact, it would be beneficial to replicate it using a bigger sample of companies with larger departments. A larger sample size would allow for a more flexible analysis and further confirm the reliability and validity of our model. Larger departments would mean that stronger sub-cultures would be present. It would be interesting to see whether in such cases different process and infrastructure elements would play a critical role in k-transfer.

The object of k-transfer in our study were the customer IT requirements. Normally such knowledge is expressed in an explicit form. It would be interesting to replicate this study in a k-transfer setting where the knowledge is of tacit nature. Tacit knowledge is much harder to elicit and it particularly remains to be seen whether the same processes would prove to be significant in such context.

While our study focused on one specific context of k-transfer (IT development), further research could look into k-transfer in marketing or sales departments. Regardless of whether the knowledge in question would still be customer requirements (for new product development, product improvement, etc), such study could include entities outside the firm.

6.4 Conclusion

Our research model was developed to analyze whether KM capabilities influence the success of knowledge transfer in IT projects. Our findings show that there is a positive relationship between k-transfer and k-process capabilities and between k-transfer and k-infrastructure capabilities. We have discovered that two processes (*acquisition* and *application*) and six infrastructure elements (*culture of learning, culture of sharing, collaboration technology, opportunity generation technology, structure that supports collaboration* and *system of rewards*) are key to achieving k-transfer success. More specifically, we have confirmed that the two k-processes are necessary to ensure k-transfer efficiency, while the k-infrastructure elements are determinants of k-transfer effectiveness.

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8 Appendix A: Research Model Contrast

For the purpose of highlighting the difference between Gold's et al. (2001) research model and the one used by this research, a graphical representation is given of both models side by side. The left hand side of our model (independent variables) remains identical to that of Gold's et al. The difference is in the dependent variables as well the level of analysis for which the models were designed. Gold et al. tested their model on the organizational level, with organizational effectiveness as the dependent variable. This research tested its model on the departmental level with k-transfer success as the dependent variable.

9 Appendix B: Dependent Variable

The items for our dependent variable were compiled from the relevant literature. They were adapted to fit the context of IT projects. The source is provided beside each item.

Project Effectiveness

1. The IT solution/end product corresponded to original specifications as requested by the customer. (Franz et al. 1986).
2. The customer was satisfied with the IT solution/end product (Doll et al. 1988).
3. Customer's input was put to extensive use in the development process (Bozeman et al. 2001, Kostova 1999).

Project Efficiency

4. From the time of the initial request until the IT department was able to begin developing the solution, a great amount of dialog/discussion took place between the user and the IT department. (Szulanski 2000).
5. From the time of the development began until the actual delivery of the product, a great amount of dialog/discussion took place between the user and the IT department (Szulanski 2000).
6. From the time of the actual delivery of the product until the user was satisfied with the final product (debugging), a great amount of dialog/discussion took place between the user and the IT department (Szulanski 2000).
7. The communication of relevant requirements from the customer to the developer was timely (Verkasslo et al. 1998).

10 Appendix C: Full Survey Instrument

Since the survey was administered to two different types of respondents, each one had a different presentation and items to answer. Both are presented in the following pages. The cover page for both IT and customer respondents was identical. IT respondents had 10 sections to complete (these are presented first) while the customer respondents had only 3 (these are presented last).

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Concordia University

Dear Sir/Madam,

Dr. Kevin Laframboise and I are conducting research regarding knowledge management. We are interested in examining the degree to which Information Technology (IT) departments are successful when they fulfill requests for IT solutions from other departments. Your firm's name was obtained from the Canadian Capabilities directory. We know that you are busy, but your response will be invaluable in helping us understand what variables influence the successful transfer of knowledge.

If you have any enquiries pertaining to the research in general or the way in which the survey is conducted, please direct them to Mantas Manovas at: m_manova@jmsb.concordia.ca or by phone at (514) 524-2887. If you are unsure about a question in the survey, please look for the information icon [r]. Clicking on it will bring up a small window with an explanation.

A different questionnaire has been prepared for two types of departments: the IT department (henceforth referred to as '**solution supplier**') and the department receiving the IT solution (henceforth referred to as '**customer**'). The survey will take approximately 3-5 minutes to complete for customer-departments and 15-20 minutes for solution suppliers. It is important, once you start the survey, that you please continue until the end, otherwise we will not be able to use your response.

If you are interested in filling out the survey, please select the appropriate department for which you work for using the buttons below. All information collected in the survey will be kept strictly confidential in accordance with Concordia University's guidelines. All information collected will be for research use only and will not be disclosed to third parties. Clicking on 'Continue Here' button gives your consent to include your information in our study database.

Thank you,

Mantas Manovas, MSc candidate

Dr. Kevin Laframboise

Supplier (IT Department) Continue Here

Customer (Other Department) Continue Here

I Do Not Wish to Participate

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Section 1/10: Technological Infrastructure

Technological infrastructure refers to technology enabled conditions that exist in your department, i.e. how information and communication systems tie together in order to support the management of knowledge.

Please indicate your level of agreement with the following items related to the current situation in your information technology department. Using a scale of 1-7, where 1 represents "Strongly disagree" and 7 represents "Strongly agree", please indicate your impression for the following questions. Please select the number that best represents your opinion; there are no right or wrong answers.

		Strongly disagree			Neutral			Strongly agree
		1	2	3	4	5	6	7
1.	My department has clear rules and procedures for formatting or categorizing its *product* knowledge.	○	○	○	○	○	○	○
2.	My department has clear rules and procedures for formatting or categorizing its *process* knowledge.	○	○	○	○	○	○	○
3.	My department uses technology that allows it to monitor its competition and business partners.	○	○	○	○	○	○	○
4.	My department uses technology that allows its employees to collaborate with other persons *inside* the organization.	○	○	○	○	○	○	○
5.	My department uses technology that allows its employees to collaborate with other persons *outside* the organization.	○	○	○	○	○	○	○
6.	My department uses technology that allows people in multiple locations to learn as a group from a *single* source or at a *single* point in time.	○	○	○	○	○	○	○
7.	My department uses technology that allows people in multiple locations to learn as a group from *multiple* sources or at a *multiple* points in time.	○	○	○	○	○	○	○
8.	My department uses technology that allows it to search for new knowledge.	○	○	○	○	○	○	○
9.	My department uses technology that allows it to identify the source (i.e. an individual, specific system, or database) of specific types of knowledge.	○	○	○	○	○	○	○
10.	My department uses technology that allows it to retrieve and use knowledge about its *products* and *processes*.	○	○	○	○	○	○	○
11.	My department uses technology that allows it to retrieve and use knowledge about its *markets* and *competition*.	○	○	○	○	○	○	○
12.	My department uses technology that allows generate new opportunities in conjunction with its partners.	○	○	○	○	○	○	○

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Section 2/10: Structural Infrastructure

This section refers to the different ways in which the structure of your department either helps or hinders your internal operations.

		Strongly disagree			Neutral			Strongly agree
		1	2	3	4	5	6	7
1.	My department's structure inhibits interaction and sharing of knowledge.	○	○	○	○	○	○	○
2.	My department's structure promotes *collective* rather than individualistic behavior.	○	○	○	○	○	○	○
3.	My department's structure facilitates the *discovery* of new knowledge.	○	○	○	○	○	○	○
4.	My department's structure facilitates the *creation* of new knowledge.	○	○	○	○	○	○	○
5.	My department bases our performance on knowledge creation.	○	○	○	○	○	○	○
6.	My department has a standardized reward system for sharing knowledge.	○	○	○	○	○	○	○
7.	My department designs processes to facilitate knowledge exchange across functional boundaries, i.e. between departments.	○	○	○	○	○	○	○
8.	My department encourages employees to go where they need for knowledge regardless of structure.	○	○	○	○	○	○	○
9.	My department's managers frequently examine knowledge for errors/mistakes.	○	○	○	○	○	○	○
10.	My department's structure facilitates the transfer of new knowledge across structural boundaries.	○	○	○	○	○	○	○
11.	My department's employees are readily accessible.	○	○	○	○	○	○	○

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Section 3/10: Cultural Infrastructure

This section refers to the values and norms that are prevalent in your IT department.

		Strongly disagree			Neutral			Strongly agree
		1	2	3	4	5	6	7
1.	My department's employees understand the importance of knowledge to corporate success.	○	○	○	○	○	○	○
2.	In my department, high levels of participation are expected in capturing and transferring knowledge.	○	○	○	○	○	○	○
3.	My department's employees are encouraged to explore and experiment.	○	○	○	○	○	○	○
4.	In my department, on-the-job training and learning are valued.	○	○	○	○	○	○	○
5.	My department's employees are valued for their individual expertise.	○	○	○	○	○	○	○
6.	My department's employees are encouraged to ask others for assistance when needed.	○	○	○	○	○	○	○
7.	My department's employees are encouraged to interact with groups in other departments.	○	○	○	○	○	○	○
8.	My department's employees are encouraged to discuss their work with people in other workgroups.	○	○	○	○	○	○	○
9.	My department's overall organizational *vision* is clearly stated.	○	○	○	○	○	○	○
10.	My department's overall organizational *objectives* are clearly stated.	○	○	○	○	○	○	○
11.	My department shares its knowledge with other departments.	○	○	○	○	○	○	○
12.	In my department, the benefits of sharing knowledge outweigh the costs.	○	○	○	○	○	○	○
13.	My department's senior management clearly supports the role of knowledge in our department's success.	○	○	○	○	○	○	○

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Section 4/10: Knowledge Acquisition Processes

This section refers to the the processes your department has for obtaining knowledge for your operations

		Strongly disagree			Neutral			Strongly agree
		1	2	3	4	5	6	7
1.	My department has processes for generating new knowledge from existing knowledge.	○	○	○	○	○	○	○
2.	My department has processes for acquiring knowledge about our *suppliers*.	○	○	○	○	○	○	○
3.	My department uses feedback from projects to improve subsequent projects.	○	○	○	○	○	○	○
4.	My department has processes for distributing knowledge throughout the department.	○	○	○	○	○	○	○
5.	My department has processes for interdepartmental collaboration.	○	○	○	○	○	○	○
6.	My department has processes for acquiring knowledge about new products/services within our industry.	○	○	○	○	○	○	○
7.	My department has processes for acquiring knowledge about competitors within our industry.	○	○	○	○	○	○	○
8.	My department has processes for benchmarking performance.	○	○	○	○	○	○	○
9.	My department has teams devoted to identifying best practices.	○	○	○	○	○	○	○
10.	My department has processes for exchanging knowledge between individuals.	○	○	○	○	○	○	○

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Section 5/10: Knowledge Conversion Processes

This section refers to the the processes your department has for making existing knowledge useful.

	Strongly disagree			Neutral			Strongly agree
	1	2	3	4	5	6	7
1. My department has processes for converting knowledge into the design of new products/services.	○	○	○	○	○	○	○
2. My department has processes for converting competitive intelligence into plans of action.	○	○	○	○	○	○	○
3. My department has processes for filtering knowledge.	○	○	○	○	○	○	○
4. My department has processes for transferring organizational/departmental knowledge to individuals.	○	○	○	○	○	○	○
5. My department has processes for absorbing knowledge from *individuals* into the department.	○	○	○	○	○	○	○
6. My department has processes for distributing knowledge throughout the department.	○	○	○	○	○	○	○
7. My department has processes for integrating different sources and types of knowledge.	○	○	○	○	○	○	○
8. My department has processes for organizing knowledge.	○	○	○	○	○	○	○
9. My department has processes for replacing outdated knowledge.	○	○	○	○	○	○	○

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Section 6/10: Knowledge Application Processes

Knowledge application processes are those oriented toward the actual use of knowledge.

		Strongly disagree			Neutral			Strongly agree
		1	2	3	4	5	6	7
1.	My department has processes for applying knowledge learned from *mistakes*.	○	○	○	○	○	○	○
2.	My department has processes for applying knowledge learned from *experiences*.	○	○	○	○	○	○	○
3.	My department has processes for using knowledge in development of new products/services.	○	○	○	○	○	○	○
4.	My department has processes for using knowledge to solve new problems.	○	○	○	○	○	○	○
5.	My department matches sources of knowledge to problems and challenges.	○	○	○	○	○	○	○
6.	My department uses knowledge to improve efficiency.	○	○	○	○	○	○	○
7.	My department uses knowledge to adjust strategic direction.	○	○	○	○	○	○	○
8.	My department is able to locate and apply knowledge to changing competitive conditions.	○	○	○	○	○	○	○
9.	My department makes knowledge accessible to those who need it.	○	○	○	○	○	○	○
10.	My department takes advantage of new knowledge.	○	○	○	○	○	○	○
11.	My department quickly applies knowledge to critical competitive needs.	○	○	○	○	○	○	○
12.	My department quickly links sources of knowledge in solving problems.	○	○	○	○	○	○	○

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Section 7/10: Knowledge Protection Processes

This section refers to the the processes your department has to protect the knowledge from illegal or inappropriate use or theft.

		Strongly disagree			Neutral			Strongly agree
		1	2	3	4	5	6	7
1.	My department has processes to protect knowledge from inappropriate use *inside* the department.	○	○	○	○	○	○	○
2.	My department has processes to protect knowledge from inappropriate use *outside* the department.	○	○	○	○	○	○	○
3.	My department has processes to protect knowledge from theft from *within* the department.	○	○	○	○	○	○	○
4.	My department has processes to protect knowledge from theft from *outside* the department.	○	○	○	○	○	○	○
5.	My department has incentives that encourage the protection of knowledge.	○	○	○	○	○	○	○
6.	My department has technology that restricts access to some sources of knowledge.	○	○	○	○	○	○	○
7.	My department has extensive policies and procedures for protecting trade secrets.	○	○	○	○	○	○	○
8.	My department values and protects knowledge embedded in individuals.	○	○	○	○	○	○	○
9.	My department clearly identifies knowledge that is restricted.	○	○	○	○	○	○	○
10.	My department clearly communicates the importance of protecting knowledge.	○	○	○	○	○	○	○

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Section 8/10: Successful Knowledge Transfer

A successfull knowledge transfer is one that is both efficient and effective. This section attempts to determine whether the transfer of knowledge from the customer to your IT department was efficient and/or effective in hindsight (the customer is any other department for whom your IT department provided a product; the knowledge is the customer requirements).

Please answer the following questions using an example of a typical IT project your department implemented in the last year.

	Strongly disagree			Neutral			Strongly agree
	1	2	3	4	5	6	7
1. The IT solution/end-product corresponded to original specifications as requested by the customer.	○	○	○	○	○	○	○
2. The customer was satisfied with the IT solution/end-product.	○	○	○	○	○	○	○
3. Customer's input was put to extensive use in the development process.	○	○	○	○	○	○	○
4. From the time of the initial request until the IT department was able to begin developing the solution, a great amount of dialog/discussion took place between the user and the IT department.	○	○	○	○	○	○	○
5. From the time of the development began until the actual delivery of the product, a great amount of dialog/discussion took place between the user and the IT department.	○	○	○	○	○	○	○
6. From the time of the actual delivery of the product until the user was satisfied with the final product (debugging), a great amount of dialog/discussion took place between the user and the IT department.	○	○	○	○	○	○	○
7. The communication of relevant requirements from the customer to the developer was timely.	○	○	○	○	○	○	○

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Section 9/10: Satisfaction

Please indicate the degree of your satisfaction concerning the interactions between the developers and customers during each phase of the project. Keep in mind how often you had to communicate; how easily that was done; and whether you adhered to the planned schedule.

Using a scale of 1-7, where 1 represents "Not at all Satisfied" and 7 represents "Extremely Satisfied", please indicate your impression for the following questions:

	Not at all Satisfied			Neutral			Extremely Satisfied
	1	2	3	4	5	6	7
1. How satisfied were you with the interaction-process during the **project definition** stage?	○	○	○	○	○	○	○
2. How satisfied were you with the interaction-process during the **project construction** stage?	○	○	○	○	○	○	○
3. How satisfied were you with the interaction-process during the **project implementation** stage?	○	○	○	○	○	○	○

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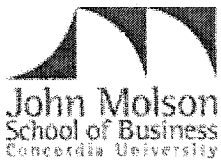

Section 10/10: General Company Information

Please provide us with some general information about your company. All answers will be kept strictly confidential.

1. How many employees work in your company?

2. How many employees work in your IT department?

3. What is your company's primary industry?
Please choose...
Other (please specify):

4. What are your company's total sales? Please choose...

5. What is your position?

6. In which province is your IT department located? Alberta

7. Enter your email address **only** if you wish to receive a personalized report of this survey's results (to be emailed in early 2004).

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Section 1/3: Successful Knowledge Transfer

A successfull knowledge transfer is one that is both efficient and effective. This section attempts to determine whether the transfer of requirements by your department to the supplier of the IT solution (IT department) was efficient and/or effective in hindsight. 'Customer' refers to your department.

Please answer the following questions using an example of a typical IT solution your department received in the last year.

	Strongly disagree			Neutral			Strongly agree
	1	2	3	4	5	6	7
1. The IT solution/end-product corresponded to original specifications as requested by the customer.	○	○	○	○	○	○	○
2. The customer was satisfied with the system or IT solution/end-product.	○	○	○	○	○	○	○
3. Customer's input was put to extensive use in the development process.	○	○	○	○	○	○	○
4. From the time of the initial request until the IT department was able to begin developing the solution, a great amount of dialog/discussion took place between the customer and the solution supplier.	○	○	○	○	○	○	○
5. From the time of the development began until the actual delivery of the product, a great amount of dialog/discussion took place between the customer and the solution supplier.	○	○	○	○	○	○	○
6. From the time of the actual delivery of the product until the user was satisfied with the final product (debugging), a great amount of dialog/discussion took place between customer and the solution supplier.	○	○	○	○	○	○	○
7. The communication of relevant requirements from the customer to the solution supplier was timely.	○	○	○	○	○	○	○

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Section 2/3: Satisfaction

Please indicate the degree of your satisfaction concerning the interactions between the developers and customers during each phase of the project. Keep in mind how often you had to communicate; how easily that was done; and whether you adhered to the planned schedule.

Using a scale of 1-7, where 1 represents "Not at all Satisfied" and 7 represents "Extremely Satisfied", please indicate your impression for the following questions:

	Not at all Satisfied			Neutral			Extremely Satisfied
	1	2	3	4	5	6	7
1. How satisfied were you with the interaction-process during the **project definition** stage?	○	○	○	○	○	○	○
2. How satisfied were you with the interaction-process during the **project construction** stage?	○	○	○	○	○	○	○
3. How satisfied were you with the interaction-process during the **project implementation** stage?	○	○	○	○	○	○	○

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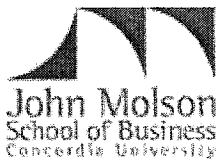

Section 3/3: General Company Information

Please provide us with some general information about your company. All answers will be kept strictly confidential.

1. How many employees work in your company?

2. How many employees work in your department?

3. What is your company's primary industry?
Please choose...
Other (please specify):

4. What are your company's total sales?
Please choose...

5. What is your position?

6. In which province is your department located?
British Columbia

7. Enter your email address **only** if you wish to receive a personalized report of this survey's results (to be emailed in early 2004).

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11 Appendix D: Items and their Numberings

The purpose of this appendix is to group all the original items along with the names used in the statistical analysis.

Knowledge Infrastructure Capabilities

Technological KM Infrastructure

TI1. My department has clear rules and procedures for formatting or categorizing its product knowledge.
TI2. My department has clear rules and procedures for formatting or categorizing its process knowledge.
TI3. My department uses technology that allows it to monitor its competition and business partners.
TI4. My department uses technology that allows its employees to collaborate with other persons inside the organization.
TI5. My department uses technology that allows its employees to collaborate with other persons outside the organization.
TI6. My department uses technology that allows people in multiple locations to learn as a group from a single source or at a single point in time.
TI7. My department uses technology that allows people in multiple locations to learn as a group from multiple sources or at a multiple points in time.
TI8. My department uses technology that allows it to search for new knowledge.
TI9. My department uses technology that allows it to identify the source (i.e. an individual, specific system, or database) of specific types of knowledge.
TI10. My department uses technology that allows it to retrieve and use knowledge about its products and processes.
TI11. My department uses technology that allows it to retrieve and use knowledge about its markets and competition.
12. My department uses technology that allows generate new opportunities in conjunction with its partners.

Structural KM Infrastructure

SI1. My department's structure inhibits interaction and sharing of knowledge.
SI2. My department's structure promotes collective rather than individualistic behavior.
SI3. My department's structure facilitates the discovery of new knowledge.
SI4. My department's structure facilitates the creation of new knowledge.
SI5. My department bases our performance on knowledge creation.
SI6. My department has a standardized reward system for sharing knowledge.
SI7. My department designs processes to facilitate knowledge exchange across functional boundaries, i.e. between departments.

SI8. My department encourages employees to go where they need for knowledge regardless of structure.
SI9. My department's managers frequently examine knowledge for errors/mistakes.
SI10. My department's structure facilitates the transfer of new knowledge across structural boundaries.
SI11. My department's employees are readily accessible.

Cultural KM Infrastructure

CI1. My department's employees understand the importance of knowledge to corporate success.
CI2. In my department, high levels of participation are expected in capturing and transferring knowledge.
CI3. My department's employees are encouraged to explore and experiment.
CI4. In my department, on-the-job training and learning are valued.
CI5. My department's employees are valued for their individual expertise.
CI6. My department's employees are encouraged to ask others for assistance when needed.
CI7. My department's employees are encouraged to interact with groups in other departments.
CI8. My department's employees are encouraged to discuss their work with people in other workgroups.
CI9. My department's overall organizational vision is clearly stated.
CI10. My department's overall organizational objectives are clearly stated.
CI11. My department shares its knowledge with other departments.
CI12. In my department, the benefits of sharing knowledge outweigh the costs.
CI13. My department's senior management clearly supports the role of knowledge in our department's success.

Knowledge Process Capabilities

Acquisition Processes

ACP1. My department has processes for generating new knowledge from existing knowledge.
ACP2. My department has processes for acquiring knowledge about our suppliers.
ACP3. My department uses feedback from projects to improve subsequent projects.
ACP4. My department has processes for distributing knowledge throughout the department.
ACP5. My department has processes for interdepartmental collaboration.
ACP6. My department has processes for acquiring knowledge about new products/services within our industry.
ACP7. My department has processes for acquiring knowledge about competitors within our industry.
ACP8. My department has processes for benchmarking performance.
ACP9. My department has teams devoted to identifying best practices.

ACP10. My department has processes for exchanging knowledge between individuals.

Conversion Processes

CP1. My department has processes for converting knowledge into the design of new products/services.
CP2. My department has processes for converting competitive intelligence into plans of action.
CP3. My department has processes for filtering knowledge.
CP4. My department has processes for transferring organizational/departmental knowledge to individuals.
CP5. My department has processes for absorbing knowledge from individuals into the department.
CP6. My department has processes for distributing knowledge throughout the department.
CP7. My department has processes for integrating different sources and types of knowledge.
CP8. My department has processes for organizing knowledge.
CP9. My department has processes for replacing outdated knowledge.

Application Processes

AP1. My department has processes for applying knowledge learned from mistakes.
AP2. My department has processes for applying knowledge learned from experiences.
AP3. My department has processes for using knowledge in development of new products/services.
AP4. My department has processes for using knowledge to solve new problems.
AP5. My department matches sources of knowledge to problems and challenges.
AP6. My department uses knowledge to improve efficiency.
AP7. My department uses knowledge to adjust strategic direction.
AP8. My department is able to locate and apply knowledge to changing competitive conditions.
AP9. My department makes knowledge accessible to those who need it.
AP10. My department takes advantage of new knowledge.
AP11. My department quickly applies knowledge to critical competitive needs.
AP12. My department quickly links sources of knowledge in solving problems.

Protection Processes

PP1. My department has processes to protect knowledge from inappropriate use inside the department.
PP2. My department has processes to protect knowledge from inappropriate use outside the department.

PP3. My department has processes to protect knowledge from theft from within the department.
PP4. My department has processes to protect knowledge from theft from outside the department.
PP5. My department has incentives that encourage the protection of knowledge.
PP6. My department has technology that restricts access to some sources of knowledge.
PP7. My department has extensive policies and procedures for protecting trade secrets.
PP8. My department values and protects knowledge embedded in individuals.
PP9. My department clearly identifies knowledge that is restricted.
PP10. My department clearly communicates the importance of protecting knowledge.

Knowledge Transfer Success

KS1. The IT solution/end product corresponded to original specifications as requested by the customer.
KS2. The customer was satisfied with the IT solution/end product.
KS3. Customer's input was put to extensive use in the development process.
KS4. From the time of the initial request until the IT department was able to begin developing the solution, a great amount of dialog/discussion took place between the user and the IT department.
KS5. From the time of the development began until the actual delivery of the product, a great amount of dialog/discussion took place between the user and the IT department.
KS6. From the time of the actual delivery of the product until the user was satisfied with the final product (debugging), a great amount of dialog/discussion took place between the user and the IT department.
KS7. The communication of relevant requirements from the customer to the developer was timely.

12 Appendix E: Factors and Items resulting from EFA

F1 Knowledge Conversion

ACP1. My department has processes for generating new knowledge from existing knowledge.
AP1.My department has processes for applying knowledge learned from mistakes.
AP2. My department has processes for applying knowledge learned from experiences.
AP3. My department has processes for using knowledge in development of new products/services.
AP4. My department has processes for using knowledge to solve new problems.
CP1. My department has processes for converting knowledge into the design of new products/services.
CP4. My department has processes for transferring organizational/departmental knowledge to individuals.
CP5. My department has processes for absorbing knowledge from individuals into the department.
CP 9.My department has processes for replacing outdated knowledge.

F2 Knowledge Protection

PP1. My department has processes to protect knowledge from inappropriate use inside the department.
PP2. My department has processes to protect knowledge from inappropriate use outside the department.
PP3. My department has processes to protect knowledge from theft from within the department.
PP4. My department has processes to protect knowledge from theft from outside the department.
PP5. My department has incentives that encourage the protection of knowledge.
PP7. My department has extensive policies and procedures for protecting trade secrets.

F3 Knowledge Acquisition

ACP7. My department has processes for acquiring knowledge about competitors within our industry.
ACP8. My department has processes for benchmarking performance.
ACP9. My department has teams devoted to identifying best practices.
CP2. My department has processes for converting competitive intelligence into plans of action.
CP3. My department has processes for filtering knowledge.
CP6. My department has processes for distributing knowledge throughout the department.

CP7. My department has processes for integrating different sources and types of knowledge.

F4 Knowledge Application

ACP3. My department uses feedback from projects to improve subsequent projects.
ACP4. My department has processes for distributing knowledge throughout the department.
ACP6. My department has processes for acquiring knowledge about new products/services within our industry.
AP8. My department is able to locate and apply knowledge to changing competitive conditions.
AP9. My department makes knowledge accessible to those who need it.
AP11. My department quickly applies knowledge to critical competitive needs.

F5 Knowledge Restriction

PP8. My department values and protects knowledge embedded in individuals.
PP9. My department clearly identifies knowledge that is restricted.

Inf1 Culture of sharing

CI7.My department's employees are encouraged to interact with groups in other departments.
CI10.My department's overall organizational objectives are clearly stated.
CI11.My department shares its knowledge with other departments.
CI8.My department's employees are encouraged to discuss their work with people in other workgroups.
CI13.My department's senior management clearly supports the role of knowledge in our department's success.

Inf2 Opportunity Generation Tech.

TI10.My department uses technology that allows it to retrieve and use knowledge about its products and processes.
TI11.My department uses technology that allows it to retrieve and use knowledge about its markets and competition.
TI12.My department uses technology that allows generating new opportunities in conjunction with its partners.
SI10.My department's structure facilitates the transfer of new knowledge across structural boundaries.
SI9.My department's managers frequently examine knowledge for errors/mistakes.

Inf3 Collaboration technology

TI4.My department uses technology that allows its employees to collaborate with other persons inside the organization.
TI5.My department uses technology that allows its employees to collaborate with other persons outside the organization.
TI6.My department uses technology that allows people in multiple locations to learn as a group from a single source or at a single point in time.
TI7.My department uses technology that allows people in multiple locations to learn as a group from multiple sources or at a multiple points in time.
TI9.My department uses technology that allows it to identify the source (i.e. an individual, specific system, or database) of specific types of knowledge.

Inf4 Corporate values

CI1.My department's employees understand the importance of knowledge to corporate success.
CI2.In my department, high levels of participation are expected in capturing and transferring knowledge.
CI12.In my department, the benefits of sharing knowledge outweigh the costs.

Inf5 Structure supporting collaboration

SI2.My department's structure promotes collective rather than individualistic behavior.
SI7.My department designs processes to facilitate knowledge exchange across functional boundaries, i.e. between departments.
SI8.My department encourages employees to go where they need for knowledge regardless of structure.
SI11.My department's employees are readily accessible.

Inf6 Culture of learning

CI4.In my department, on-the-job training and learning are valued.
CI5.My department's employees are valued for their individual expertise.
CI6.My department's employees are encouraged to ask others for assistance when needed.

Inf7 System of rewards

SI5.My department bases our performance on knowledge creation.
SI6.My department has a standardized reward system for sharing knowledge

13 Appendix E: Factor Loadings (EFA)

Presented below the item loadings obtained during exploratory factor analysis. All values were above 0.50, thus respecting the necessary criteria in order to be kept in the model.

KM Process Infrastructure Factor Loadings

F1	loadings
ACP1	0.81
AP1	0.88
AP2	0.86
AP3	0.76
AP4	0.82
CP1	0.83
CP4	0.84
CP5	0.91
CP9	0.76

F2	loadings
PP1	0.89
PP2	0.83
PP3	0.96
PP4	0.92
PP5	0.88
PP7	0.83

F3	loadings
ACP7	0.81
ACP8	0.87
ACP9	0.83
CP2	0.84
CP3	0.80
CP6	0.83
CP7	0.81

F4	loadings
ACP3	0.77
ACP4	0.82
ACP6	0.73
AP8	0.80
AP9	0.79
AP11	0.79

F5	loadings
PP8	0.83
PP9	0.83

KM Structural Infrastructure Factor Loadings (EFA)

inf1	loadings
CI7	0.81
CI10	0.82
CI11	0.86
CI8	0.70
CI13	0.84

inf2	loadings
SI9	0.76
SI10	0.87
TI10	0.75
TI11	0.85
TI12	0.84

inf3	loadings
TI4	0.76
TI5	0.78
TI6	0.82
TI7	0.72
TI9	0.74

inf4	loadings
CI1	0.85
CI2	0.78
CI12	0.80

inf5	loadings
SI2	0.70
SI7	0.81
SI8	0.80
SI11	0.74

inf6	loadings
CI4	0.88
CI5	0.72
CI6	0.87

inf7	loadings
SI5	0.95
SI6	0.95

Knowledge Transfer Success Factor Loadings

effectiveness	loadings
KS1	0.77
KS2	0.86

KS3	0.76
efficiency	loadings
KS4	0.85
KS5	0.57
KS6	0.80
KS7	0.65