ERP SYSTEMS INSTITUTIONALIZATION: THE EFFECT OF ORGANIZATIONAL AND PERCEIVED TECHNOLOGICAL CHARACTERISTICS

By

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Abstract

Enterprise Resource Planning (ERP) systems mark a major shift in organizational approach to informational technology. These systems are a move from proprietary made-to-order, or homegrown, legacy systems to generic off-the-shelf and vendor-developed applications. Organizations adopting ERP systems undergo a complex process of organizational innovation and change. However, despite using a similar basic technology, not all organizations implementing ERP systems have been successful in realizing all of the potential benefits associated with these systems. This has provided us with a research topic to study: how ERP systems are institutionalized in organizations in the post implementation phase.

Institutionalization refers to the adaptive social process in the organization that infuses an organizational innovation, such as ERP systems, with a value beyond the technical requirements of the task at hand (Selznick, 1957). Organizations face many challenges in institutionalizing ERP systems: these challenges include resistance to change, the cognitive limitations of employees, and an inadequate supporting infrastructure. Moreover, the degree of institutionalization of ERP systems can vary depending on the extent of their use, diffusion, and entrenchment in the organization.

In this research we model the process of ERP institutionalization in organizations using a multi-phase, multiple case study approach. We delineate the ERP institutionalization process and associated key challenges. Data collected is further analyzed to explore the relationship between organizational characteristics and an organization's success in institutionalizing ERP systems and the effect of adopting organization's context, such as size and sector on those relationships. The study provides a structured road map for understanding the complex process and some of the critical issues in institutionalizing ERP in the organization.

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Chapter 1 Introduction

1.1 Preamble

Commonly recognized as one of the most significant innovations in the information systems (IS) area, Enterprise Resource Planning (ERP) systems have been widely adopted by organizations in both public and private sectors worldwide. Widespread adoption of these systems marks a paradigm shift in the organizational approach to IS, as the adopting organizations in most cases have moved from a proprietary made-to-order or homegrown legacy functional system to an integrated and vendor-developed generic system (Davenport, 2000). Organizations adopting ERP systems undergo a complex process of organizational innovation and change, i.e., organizations adopt not just one but many complementary and interlinked technological and administrative innovations that affect the whole organization (Markus and Tanis, 2000; Waarts *et al.*, 2002; Basoglu *et al.*, 2007).

Using the IS innovation typology proposed by Swanson (1994), ERP systems can be placed in the most complex IS innovation category (Type III) without any doubt. Institutionalization of complex organizational innovations in the post-implementation phase is an important process which infuses an innovation with value beyond the technical requirements of the task at hand (Selznick, 1957; Tolbert and Zucker, 1996; Greenwood *et al.,* 2002). Both innovations and the adopting organization undergo a significant change in form and function as the new systems are put to use in the organization. However, very few studies have delved into details of how ERP systems are institutionalized in the organization in the post-implementation phase. The key idea in this research is to understand the process of institutionalization of ERP systems in organizations while taking into account the differences and similarities in both the

organizations and their ERP systems. To accomplish this task, we focus on exploring two separate, but related, issues.

Objective 1: To explore and delineate the process of ERP institutionalization in ERP adopting organizations during the post-implementation phase.

Objective 2: To explore the relationship between organizational characteristics that are normally considered determinants of a firm's innovativeness with the ERP adopting organization's success in institutionalizing ERP systems.

To achieve the objectives of the study we have adopted both process and variance approaches. Both of these approaches have a fairly strong line of enquiry set by a number of acclaimed research studies that have been extremely useful in guiding the research approach taken in this study (e.g., van de Ven *et al.*, 1999; Zaltman *et al.*, 1973). However, as little literature exists on the subject of this study, ERP institutionalization, this research study is, for the most part, exploratory in nature.

The theoretical foundation of the first research objective of this study is based on the innovation process theory approach in which we focus on the post-implementation phase and view it using the perspective provided by neo-institutional theorists. We took the process approach to enhance our understanding of how the process of ERP institutionalization unfolds in different organizations that adopted ERP in the post-implementation phase. Studies in the process approach rely largely on collecting and analyzing qualitative data on events and activities in the organizations undergoing the process. Primarily exploratory in nature, process studies have proved extremely useful in understanding complex phenomena in organizations and in ensuring that adequate knowledge about the nature of a management problem is gained.

The second research objective is addressed using the variance theory approach to explore the correlations between organizational characteristics and the success of an ERP adopting

organization in institutionalizing ERP systems. We adopted the variance approach to explore how the observed differences in the variables considered as determinants of innovation in literature influence the outcome of a complex process or the phenomenon of institutionalizing ERP in organizations. The studies in the variance approach rely largely on quantitative data and statistical analyses to find evidence of the relationship between the independent and dependent variables being investigated.

Considering the need for both qualitative and quantitative data on a complex organizational phenomenon, multiple case studies of adopting organizations in both public and private sectors were conducted. A multi phase design was used to introduce structure to both the problem and the case study methodology. We delineated the ERP institutionalization process based on our analysis of the data collected from 30 ERP adopting organizations. An ERP Institutionalization Model was developed and empirically validated in this research. As most organizations move from implementing ERP systems to actual usage, ERP institutionalization is a current issue. An understanding of the ERP institutionalization process and its determining organizational characteristics can give managers immense help in successfully dealing with these complex and systemic organizational innovations.

1.2 Motivation

Institutionalization of ERP systems takes place as a continuous adaptation process that includes the development of a support organization, infrastructure, regulations, norms, and cognition of the organizational members (Markus and Tanis, 2000). Organizations face many challenges in institutionalizing ERP systems in the post-implementation phase, such as resistance to change, cognitive dissonance, and a steep learning curve. ERP institutionalization in

organizations may vary depending on the extent of their diffusion in the organization. As well, ERP systems due to their enterprise-wide scope and associated large scale changes offer a distinctly different problem to adopting organizations in institutionalizing them than any other technological innovation.

Organizations adopting ERP systems vary immensely in size, sector, and activities; this makes the process of understanding how the process of institutionalization unfolds in organizations. For example, immense organizations - such as General Motors (private) and the US Navy (public) - are using the same ERP applications as those used by organizations that are 1/1000 of their size in terms of number of employees and budget. Some organizations invest heavily in their employees and rely on in-house support for ERP systems, while others are more capital intensive and outsource most of their work. Public agencies may vary from private firms, even when they carry out the same kind of work, because they function in a different context (Holdaway *et al.*, 1975; Perry and Rainey, 1988). Many previous studies have found a deterministic relationship between organizational characteristics and a firm's innovativeness/adoption of innovation. We argue that challenges and difficulties in the institutionalization of ERP systems can be associated with organizational characteristics.

An organization's characteristics - which vary depending on the organization's environment, form, size, culture, objectives, and activities - can significantly influence its systems and the need for the systems (Woodward, 1965). The impact of organizational characteristics on the organizational innovation process is evident from the literature of manufacturing best practices, such as lean production, just in time manufacturing, and total quality management (Ferguson and Ferguson, 2000). These practices, which have been central to the success of many Japanese firms, often proved disappointing when adopted by non- Japanese

firms in a piecemeal manner and without appreciating the differing organizational characteristics and associated cultural underpinnings (Ferguson and Ferguson, 2000). While a number of available studies have focused on the determinants of innovation adoption in the organization, researchers have not yet explored the relationship between the organizational determinants of innovation and the institutionalization process.

Some researchers have tried to separate organizational challenges in organizational adoption of technological innovations into two categories: technical and behavioral (Joshi and Lauer, 1999). However, the problems encountered in adopting technological innovations are quite complex and fused together. Considering the complete transformation that ERP-adopting organizations have undergone in the nature of work and organizing, the challenges cannot be understood without considering both technological innovations and institutional contexts. In a recent review of research on technology and organizations, Orlikowski and Barley (2001) argue that

"..because of important epistemological differences between fields of information technology and organization studies, much can be gained from greater interaction between them." (Orlikowski and Barley, 2001: pg.145)

"Institutional theory" used in this research is a popular strand of organizational studies which we think extends an excellent means of explaining how ERP systems are used, routinized, and assimilated into the organization in the post-implementation phase. Institutional theory has risen to prominence as a powerful explanation for both individual and organizational action (Dacin *et al.*, 2002). The distinctive feature of institutional theory is its focus on entrenchment. The literature explaining the concept of entrenchment uses many labels such as "establishment" of a practice (Leblebici *et al.*, 1991), "cultural persistence" (Zucker, 1977), "structuration" (Giddens, 1976), "order" or "pattern" (Jepperson, 1991), "reproduction" (Powell, 1991). The

concept of entrenchment makes institutional theory an important part of the study of post-implementation benefits realized from organizational innovations such as ERP.

Theoretically, this study enables us to extend the innovation theory (which deals largely with adoption and diffusion of innovations) by incorporating lessons from organizational studies literature (which focuses on the organizational behavior of an organization using an innovation). This process helps to understand the actual process of institutionalizing innovations in the organizations in the post-implementation phase. This distinction also brings to the fore the processes and mechanisms by which innovations evolve, adapt, and become institutionalized in the organization.

Institutionalization of ERP is important not only because it is critical for realizing the benefits of ERP, but also because it provides foundations for further innovations, e.g., ERP systems provide a backbone for e-governance/e-business initiatives in most organizations. For a practicing manager, this research provides an important way of managing innovations destined to be institutionalized. These innovations, referred to as proto-institutions by Lawrence *et al.* (2002), may warrant more resources and managerial attention than transitory practices (Zeitz *et al.*, 1999). An understanding of the ERP institutionalization process in the post-implementation phase will help managers improve the process of managing innovation adoption. This understanding is also important as the major benefits of complex organizational innovations such as ERP are realized in the post-implementation phases of the adoption process where they are entrenched and institutionalized in the organization (Markus and Tanis, 2000; Davenport and Brooks, 2004).

1.3 Organization of the Thesis

This thesis is organized into 8 chapters. The first three chapters (1-3) provide a foundation of this research project by providing an introduction, literature review, and the research methodology used in the project. The following three chapters (4-6) present the results of the study, and the last two chapters (7-8) provide a discussion of the results and a conclusion to the research. Chapter 2 provides a review of the literature on ERP systems and some key theoretical concepts which form the foundations of this study. We first review ERP as a term and its evolution over the years. We view ERP adoption as an organizational innovation process and focus in this study on understanding the institutionalization of ERP systems in the adopting organization during the post-implementation phase. The remaining sections of Chapter 2 are devoted to reviewing the relevant literature on Organizational innovation and Institutional theory. Chapter 3 describes the research design and the methodology adopted in the study. It discusses the multi-phase multiple case study research design and elaborates upon the key mechanisms such as the study protocol used to enhance the rigor and reliability of the methodology.

Chapters 4, 5, and 6 discuss the results of the study. Chapter 4 focuses on the outcomes of the first phase of the research. We conducted three detailed pilot case studies in the first phase to develop the research questions and an *a priori* model in this phase. Chapter 5 focuses on the outcomes of the second phase of this research, which is devoted to pre-testing the research protocol and the tools. A discussion of the case studies done in the second phase, changes made to the research protocol, and the insights gained into the understanding of the ERP institutionalization process is provided in this chapter. Chapter 6, which is also the largest chapter in this thesis, discusses the results of the third phase of the study. The chapter provides

the profiles of case study organizations and then presents the results of the variance and the process theory components of the study. We discuss and present the additions and changes made to the *a priori* process model based on the new understanding gained from the analysis of data gathered in the third stage of the study.

Chapter 7 provides a discussion of the key results and their managerial implications. The understanding gained from process and variance aspects of the study are reconciled to enhance our understanding of the phenomenon in general. Finally, Chapter 8 provides a conclusion to this research with a discussion of the contribution this study makes, its limitations, the implications for managers and suggestions for future research.

Chapter 2 Literature Review and Key Theoretical Concepts

This chapter provides a review of the literature on ERP systems and some of the key theoretical concepts which provide a foundation to this research. ERP systems, along with the Internet, are very easily the two most important innovative information technologies (IT) to have evolved in the last fifteen years. However, ERP systems are still a relatively new development, and they have been changing with the advancement in technologies supporting them. Current versions of ERP systems are considerably expanded in scope and abilities over those introduced ten years ago.

Because ERP systems are quite new and the systems and supporting technologies continue to evolve, we provide an overview of ERP systems, some of their key characteristics, and a review of the ERP literature in the second section of this chapter. The following sections of this chapter contain a review of theories used in this research. Section three focuses on the innovation process and variance theories. We conceptualize adoption of ERP systems as an organizational innovation process which consists of three broad phases of adoption, implementation, and post-implementation. In this study, we focus on the post-implementation phase of ERP adoption and explain how ERP systems are institutionalized in this phase. The fourth section of this chapter focuses on the institutional theory and the available literature on the process of institutionalization. Concluding remarks are provided in the last section to briefly highlight some key findings in the literature review.

2.1 ERP Systems

ERP is a widely used term. It is an acronym for Enterprise Resource Planning, a concept that was introduced in the early 1990s by the Gartner Group to refer to the next generation of

Manufacturing Resource Planning (MRP II) systems. This concept, which posited integration of manufacturing software applications to those of other functions such as finance and human resources, was received well by both the business community and enterprise software vendors. Enterprise software vendors gradually extended the ERP systems to other organizations in both public and private sectors.

With the growing needs of organizations and advances in underlying technologies, ERP systems have been extended considerably over time. Originally, they were mainly transaction processing systems and the primary development objective of these systems was to provide operational process support and control (Watson and Schneider, 1999). However, today's ERP systems have been extended to include Internet capability and many advanced non-transactional applications primarily in data-analysis and decision support, such as analyzing historical trends, drawing conclusions, building scenarios, and planning. Enterprise applications - such as business intelligence, data warehousing and mining, supply chain optimization, advance planning and scheduling, and customer relationship management - can be integrated with ERP systems.

ERP systems continue to evolve with growing organizational and market needs. ERP systems today assist modern supply chains by supporting inter-organizational processes through dedicated or virtual private networks (Kumar and Hillegersberg, 2000). They play a key role in providing the infrastructure and support to e-business/e-governance programs worldwide (Davenport and Brooks, 2004; Akkermans *et al.,* 2003; Al-Mashari, 2003). In post Enron times, the ability to confirm to the Sarbanes-Oxley Act requirements have become another prime feature for organizations deploying ERP systems (Sarich, 2005). Today, the term ERP encompasses all integrated information systems that can be used across any organization (Koch *et al.,* 1999; Mabert *et al.,* 2003). Some researchers have re-coined the concept as ERPII to more

precisely denote current ERP reality as an organizational strategy that supplants ERP systems as enablers of inter and intra-organizational process efficiency (Moller, 2005).

2.1.1 Definition

ERP systems are comprehensive packaged software solutions that automate and integrate organizational processes (Kumar *et al.*, 2003). The core of an ERP system is a single relational database. The database is shared by inter-linked functional applications which have a unified interface (Figure 2-1). The system thus not only unifies enterprise-wide information, but also provides a seamless information flow, making real time and updated information available to all the applications (Davenport, 1998; Bingi *et al.*, 1999). Unified applications ensure tight integration of all functions and units (Bingi *et al.*, 1999). For example, in an integrated ERP system a purchase order entered by a sales person triggers the necessary action at the production, inventory management, accounting, and distribution levels of the organization at the same time. If the systems interface with the supplier's systems, the same order also provides information to the suppliers for activating the necessary actions required at their end to fulfill the order.

The integrative design of ERP systems enables an organization to achieve operational efficiencies and even extend the systems' reach beyond the organizational boundaries, encircling supply chain partners and customers through various front end and e-commerce interfaces (Pliskin and Zarotski, 2000). With ERP systems that interface with those of its suppliers and customers, an organization can have access to and view real time information across the value chain (Davenport and Brooks, 2004). By integrating this information from partner systems into production schedules and inventory levels, organizations can further lower operation costs, improve forecasting, reduce cycle times, improve relationships with suppliers, and increase customer satisfaction.

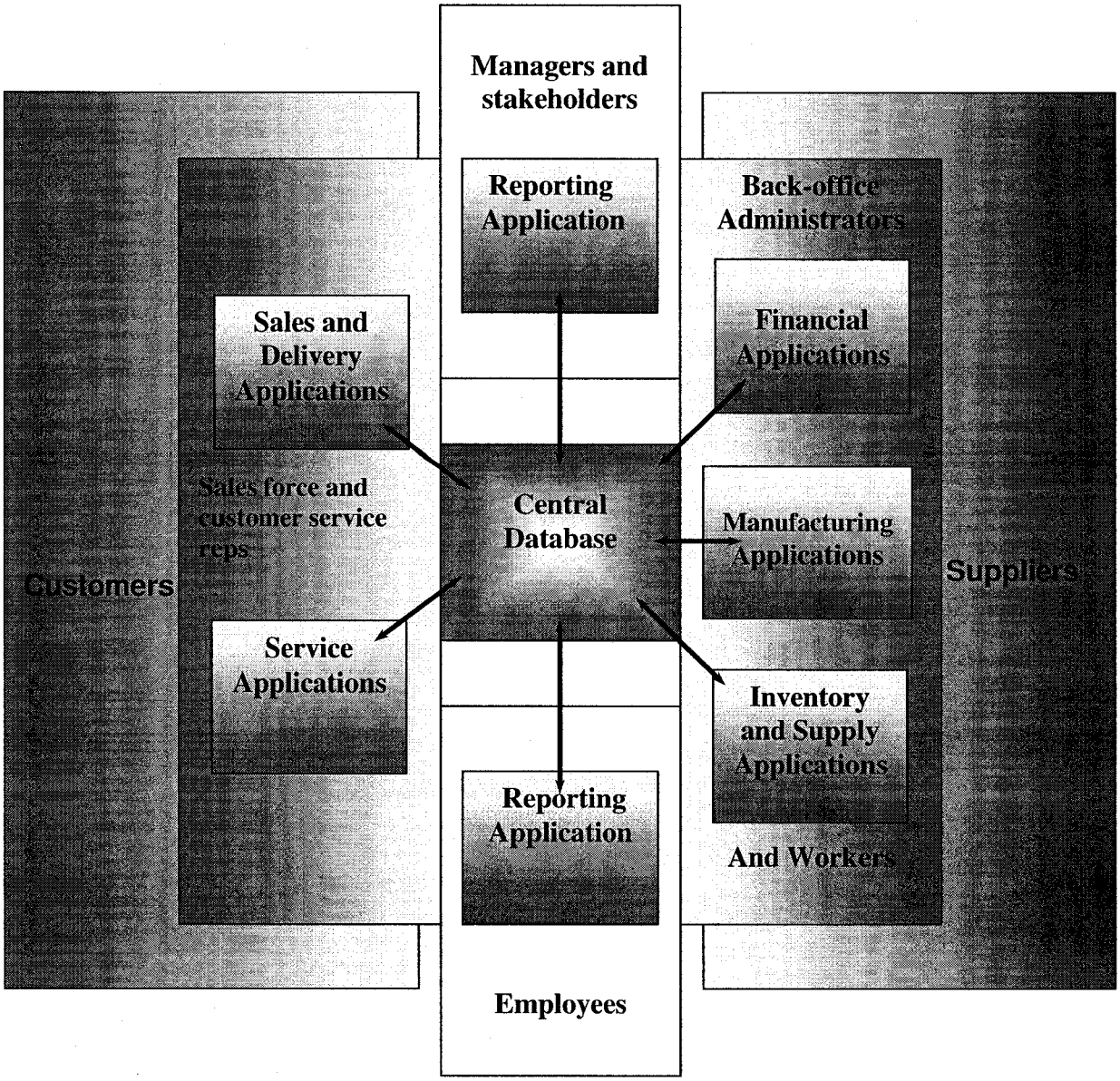

Figure 2-1: Anatomy of an ERP System (adopted from Davenport (1998), pg.124)

Watson and Schneider (1999) describe ERP as a generic term for an integrated enterprise computing system. They define it as an integrated, customized, and packaged software-based system that handles the majority of an enterprise's system requirements in all functional areas, such as finance, human resources, manufacturing, sales, and marketing. It has a software

architecture that facilitates the flow of information among all functions within an enterprise. It sits on a common database and is supported by a single development environment. Various other descriptions have been provided in the literature, but for the purpose of our research we adhere to this description of ERP that Watson and Schneider (1999) have provided.

2.1.2 Main Characteristics of an ERP System

Enterprise systems have several characteristics, each with important implications for the organizations adopting them (Markus and Tanis, 2000). In the following two sub-sections we discuss the two main characteristics of enterprise systems: enterprise integration and supporting best business practices.

2.1.2.1 Enterprise Integration

Enterprise integration is the key idea underlying the development of ERP systems. Enterprise resource planning posits using IT to achieve a capability to plan and integrate enterprise-wide resources, by integrating the applications and processes of the various functions of the enterprise (design, production, purchasing, marketing, finance, etc.). This idea is not new. Diebold (1952, pg.91) stated that:

"... the new technology will ultimately bring many of the office functions into closer contact with the production functions."

Blumenthal proposed an integrated architecture for organizational IS in 1969, but the idea was not successfully used till the late 1980s (Kerr, 1988). While there are unparalleled performance benefits in integrating enterprise systems, achieving effective integration remains still very problematic due to the numerous technical and organizational challenges (e.g. Joshi and Lauer, 1999).

The organizational approach to configuring and using enterprise systems is critical for achieving integration benefits (Bingi *et al.*, 1999; Koch *et al.*, 1999; Markus and Tanis, 2000). An organization may purchase only one module of the enterprise system, or may allow its business units to adopt a different enterprise system, or may allow each unit to configure the same system as they see fit, overlooking the integration benefits. Conversely, implementing an ERP system without proper analysis may push a company towards full integration by imposing the systems logic even when a certain degree of business unit segregation may be in its best interests (Davenport, 1998). Davenport refers to system integration as a challenge of portfolio assembly, in which firms pull together a wide variety of programs with ERP modules as the core or backbone. Every firm implementing ERP has to think about how to meet the entire organization's needs and what percentage of needs will be encompassed by the basic ERP package. In many cases, the organization adopting an ERP system needs to interface the integrated standard applications packages to its own proprietary "legacy" systems for which the enterprise system does not provide an adequate replacement. The organization may also need to acquire and interface the packages to a number of "bolt-on" applications from third-party vendors for various tasks.

Even with today's state of the art technology, no single enterprise system meets all the information-processing needs of the majority of organizations (Davenport, 2000; Kumar *et al.*, 2003; Bradford and Florin, 2003). Many of the claims of ERP vendors are overstated marketing pitches. Deciding which systems to adopt, between various available integrated systems and best of breed applications, is a significant challenge for managers. To achieve a globally integrated system that provides all their business needs, organizations have to connect standard integrated ERP packages with some best-of-breed, stand-alone applications or critical legacy applications

with available or custom-developed middle wares. When organizations are structurally complex and geographically dispersed this is a very difficult task that poses unique technical and managerial challenges (Markus *et al.*, 2000). It also calls for developing an effective enterprise data strategy and a need for viewing all business procedures in an enterprise from the process performance perspective rather than an individual functional performance perspective. The organizational difficulty in making an effective systems and enterprise data strategy is further enhanced by rapid technological development and a shortened technology life cycle.

Alsène (1999) asserts that integration with ERP systems is problematic also because of the imprecision and confusion of terms used in practice and academic literature. Authors frequently use expressions such as "computer integration of the enterprise"[1] and "systems integration"[2] as equivalent; these terms are sometimes even confused with enterprise integration[3]. Enterprise integration goes beyond physical computer integration (i.e., using computer communication networks and protocols) and system integration (i.e., building integrated systems based on shared data, exchange formats, and common architecture). A salient feature of enterprise integration is business integration, i.e., efficiently executing business processes using the enterprise means (e.g., human resources, applications, and physical resources) and depending on the availability of internal or external enterprise objects (e.g., events, information entities, and physical entities) or conditions. Understanding the way business processes and enterprise policies are structured and how the business processes are related to one another is important for achieving business integration (Davenport, 1998).

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[1] Computer integration of the enterprise is the integration achieved through the application of information technology.
[2] Systems integration involves interconnecting systems and making applications talk to each other.
[3] Enterprise integration refers to forming an ensemble, a coherent whole, of the various administrative units that make up the enterprise, each of which assumes certain functions.

Confusing enterprise integration with computer integration of enterprise or systems integration, or treating computer integration and systems integration as equivalent to enterprise integration are misapprehensions in which ends and means are confused. Organizations, by implementing an ERP system, merely provide means for enterprise integration. There is no doubt that ERP systems are important for enterprise integration. Other coordinating and integrating mechanisms - such as standardization of work processes, norms, skills and output, and supervision structure - are equally important for realizing the potential benefits of integration (Davenport, 1998; Bradford and Florin, 2003; Kumar *et al.,* 2003; Alsène, 2007).

2.1.2.2 Best Business Practices

Embodying best business practices is another key underlying premise used in developing ERP systems. ERP applications represent a set of unique business practices that are automatically acquired by the ERP-adopting organization within a certain degree of flexibility for modifying them to adapt to their existing business processes. In this way ERP adoption not only provides an opportunity for organizations to shed their aging legacy systems, but also to change old work processes, counter-productive company cultures, and radically redefine how the business is run (Koch *et al.*, 1999).

Implementing best practices embedded in the systems reference models is a major reason to adopt enterprise systems. ERP systems have also been cited as catalysts and enablers for many corporate re-engineering activities (Bancroft *et al.*, 1998; Davenport, 1998; Bingi *et al.*, 1999). When implementing ERP, organizations get to redesign all their processes for cross-functional efficiency and effectiveness embedded in the systems reference model, which is the stated purpose of business process re-engineering (Hammer, 1996). However, the plain vanilla (without modification) adoption of these ERP packages has been criticized because they force the

organizations towards generic processes by imposing the system's logic on the company's strategy, organization, and culture (Davenport, 1998; Lee, 1998). ERP vendors have been adding functionality and providing added flexibility to organizations to customize their systems according to their business processes. Conversely, there are high risks both in terms of technical challenges as well as in terms of incorporating future evolutions or new releases for the systems; customizing/modifying these complex systems is also associated with high costs. ERP implementation poses a serious challenge to adopting organizations to find a balance between re-engineering their processes and modifying their ERP system.

Organizations adopting ERP expect radical transformations in response to customers, flexibility, productivity, and several other tangible and intangible benefits (Kumar *et al.*, 2003; Davenport and Brooks, 2004). In order to realize the advantages of these best practices, organizations adopting ERP must commit themselves to some degree of business process re-engineering (Markus and Tanis, 2000). The relative advantages of re-engineering before, during, or after enterprise systems implementation have been debated by many authors (Weston, 1999; Soliman and Youssef, 1998; Ng *et al.*, 1999). However, there is a consensus that the difficulty of managing large scale human, organizational, and technological changes in both ERP and business process reengineering add considerably to project expenses and risks. Planners should be able to either reconfigure the business process or the ERP system when a business process does not fit system functionality (Weston, 1999).

2.1.3 ERP Literature Survey

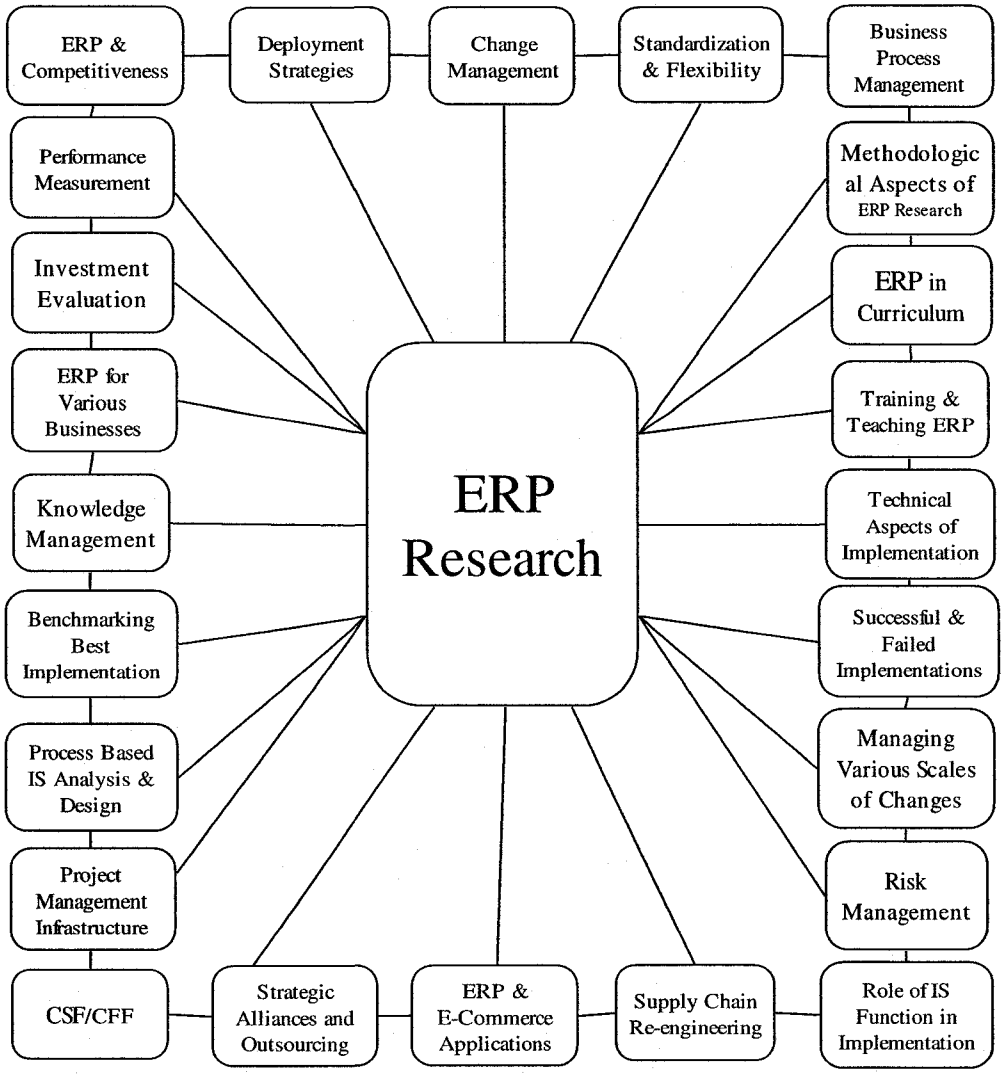

Figure 2-2: ERP Research Directions (adopted from Al-Mashari (2003), pg. 23)

ERP systems mark a paradigm shift in organizational IT. Most firms moved from proprietary functional systems to integrated vendor-developed systems when they adopted ERP systems. Organizations adopting these systems face both technical and behavioral challenges that are quite complex and fused together. As numerous organizations have accumulated experience in adopting these systems, a growing body of academic research has described and analyzed

various aspects of these systems. Al-Mashari (2003) lists 24 major streams of ERP research (see Figure 2-2). Most of these 24 research streams can be related to activities, issues, and problems associated with the ERP adoption process: some to the early adoption stage and others to the implementation stage, but very few to the post-implementation stage. Interest in ERP systems has steadily increased since the early 1990s when few innovative firms adopted these standard integrated software packages. However, the field of ERP research can still be best described as being in its early stages of development because very little empirical research is available.

2.1.3.1 ERP Adoption Literature

High risks and difficulties in realizing potential ERP benefits require that adoption decisions be viewed and analyzed in terms of their strategic importance. The bankruptcy of FoxMeyer drugs may be one of the extreme examples of not getting strategic ERP adoption choices right, but a number of other sub-optimal ERP implementations signify the strategic importance of the ERP adoption process (Davenport, 1998). A large percentage of research on ERP systems has focused on various ERP adoption challenges, such as systems need analysis, risk factor analysis, and selecting the software package. Other challenges in adopting ERP are organizing an implementation project that includes selecting the project manager, deciding on implementation strategy and partners, and approving a budget and schedule (Markus and Tanis, 2000; Thornburg, 1998; Davenport, 1998; Rolland and Prakash, 2000; Klaus *et al.*, 2000; Kumar *et al.*, 2002).

While analyzing the motivations for adopting ERP systems, it is suggested that companies should carefully judge how their choices would fit their strategic objectives (Davenport, 1998). ERP systems integrate key data and information across the organization and provide enhanced functionality, but a key issue raised by Buckhout *et al.* (1999) is that of needs

analysis. The adopting organizations should analyze the amount of control and functionality that its ERP system needs to provide and that depends on the flow of products and services in the company. Davenport (2000) stresses the importance of establishing that the ERP system fits the business and its needs for information. The adopting organizations should not assume that an available ERP system will fit every organization or every part of the organization.

More complex workflows require greater system control, leading to system complexities, while a simple workflow can be managed by a simpler and a far less expensive system (Buckhout *et al.*, 1999). Many organizations overlook simplifying process and workflow while adopting ERP systems, thus they do not realize organizational efficiencies that are evolving due to simpler processes. However, re-engineering the process at the same time adds significant complexities to the adoption project.

2.1.3.2 ERP Implementation Literature

ERP implementation involves significant technical and organizational challenges which often force organizations to rethink their IT strategies. The flexibility provided by ERP systems also transforms an ERP implementation program into a potentially risky program of organizational innovation and change (Fichman and Moses, 1999). The technologies offer users an abundance of functionality. However, they also demand that the users choose well from this abundance to ensure that their chosen configuration is not only internally consistent, but also complements organizational processes, policies, and measures. A number of authors have focused on the debate on organizing the implementation projects (Tchokogué *et al.*, 2005; Bradford and Florin, 2003; Kumar *et al.*, 2003; Davenport, 2000; Markus and Tanis, 2000).

Buckhout *et al.* (1999) suggest that the problems in ERP projects take root if the company has not made the right strategic choices needed to configure the systems and processes.

The issue is critical and spans the overall decision-making process for adoption. Management's difficulty in deciding on technological choices is made worse by the fact that many of the applications are new and the organization does not understand them at this early stage (Thornburg, 1998). A large part of ERP literature is focused on ERP implementation challenges (Mabert *et al.*, 2003; Bradford and Florin, 2003; Kumar *et al.*, 2003; Soh *et al.*, 2000; Markus *et al.*, 2000; Ross and Vitale, 2000)

Many organizations see an ERP implementation as a technology-driven initiative rather than viewing it as an opportunity to take a fresh look at the organization's strategies and structure. Considering the far-reaching strategic and organizational implications of ERP implementation, ERP analysts find that making decisions about ERP based on technical criteria alone can be a serious mistake (Davenport, 1998; Bingi *et al.*, 1999). There is consensus in the literature that an implementation strategy based on business drivers is most effective for ERP implementation. One likely explanation can be that a focus on business drivers leads to a better understanding of organizational needs.

Implementation of ERP systems dramatically changes the work environment because these systems are integrative and information intensive. The availability of updated and accurate information about activities in other functional areas leads to work enhancement and increased productivity. Workers with a better understanding of the whole process can perform tasks previously done by their supervisors. On the other hand, workers need to upgrade their skills in order to adapt to new requirements imposed by the new technology and changed work profile (Siegel *et al.*, 1997). The systems also enforce a shift from a functional to a process focus in the organization leading to wide-scale changes in the organization. Managing organizational change

has been considered as a key challenge in implementing ERP systems (Davenport, 1998; Bingi *et al.*, 1999; Kalakota and Robinson, 1999).

Major implementation challenges that have been highlighted in the literature include a shortage of personnel skilled in ERP, training, technical complexity, organizational resistance to change, and difficulty in interfacing with legacy existing systems. Other challenges are mid-stream changes in project scope, difficulties in customizing ERP to meet specific requirements, turnover of key project personnel, project leadership, and a shortage of resources (Davenport, 1998; Bingi *et al.*, 1999; Buckhout *et al.*, 1999; Holland and Light, 1999).

2.1.3.3 Post ERP Implementation Literature

The importance of the post-implementation phase of IT-based innovations was highlighted in the early 1990s when some of the scholars investigating the IT productivity paradox proposed the "lag hypothesis," i.e., the benefits of IT innovations are realized only once they are institutionalized (Sharpe, 1999). In the context of ERP, a 1999 consulting study by Deloitte of ERP implementing companies refers to post-implementation activities as ERP's second wave. More than 53 percent of the respondents of the study recognized that going live was not the end of the ERP program, but rather the end of the beginning. An executive quoted in the study considered the visible portion of an iceberg analogous to the tangible return on investment that companies achieve in implementing the ERP systems. Intangible benefits, which have a much greater scope, are analogous to the unseen portion of the iceberg below water; these benefits have yet to be discovered by the companies bringing about massive changes and implementing supporting technology. Only a few researchers have focused on the Post implementation ERP issues such as organizational change and learning, benefits analysis, and continuous improvement of the ERP systems (e.g. Lee and Lee, 2000; Robey *et al.,* 2001; Shang

and Sheddon, 2002; Scott and Vessey, 2002; Davenport, 2000). The clear need for more research on post-implementation issues has been identified by many prominent IS researchers and journal editors (e.g., Lee, 2002; Markus and Tanis, 2000).

2.2 ERP Adoption: An Organizational Innovation Process

The field of innovation research is very broad, dynamic, multi-disciplinary, and complicated (Tornatzky and Klien, 1982). The primary concern in innovation studies is the concept of innovation, which is a situational quality. The term is used in the literature in multiple contexts: "an invention" (Tushman *et al.*, 1986), "a new object" (Tushman *et al.*, 1986), and "a new process" (Daft, 1978). Something new to a particular setting is also termed as an innovation, even when it may be a thing of the past in other settings (Tornatzky and Fleisher, 1990); as well, a particular innovation desirable in one situation may not be needed in another (Rogers, 2003).

The field has grown considerably in the last few decades and a vast amount of literature is available that focuses on various aspects, issues, and challenges of managing innovation. Authors have made several distinctions between studies on innovation based on criterion such as the perspective of researchers, the unit of analysis, and a focus in the study leading to a number of typologies of innovation studies. For example, a distinction is made between studies of "adoption" and "diffusion" of innovation (Kimberly, 1986). Diffusion of innovation describes how new technologies, ideas, products, or processes spread through a population of potential adopters, while adoption of innovation describes the process of adopting new ideas, technologies, products, or processes. Diffusion and adoption are two different perspectives of the same underlying process with a certain degree of overlap.

The focus in much of the earlier literature has been on innovation by individuals; however, an equally large number of innovations are perceived, developed, and adopted by organizations (Rogers, 1995). Van de Van *et al.*(1999) argue that organizations undertake an innovation process each time they invent, develop, and implement new products, programs, services, or administrative arrangements. Market forces such as competitive threats, changes in stakeholder expectations, and/or changes in the business environment drive organizations to continuously improve their processes, products, strategies, and support structures. Unless an organization is prepared to work continuously at renewing what it offers and the ways it creates and delivers that offering, there is a good chance that it will not survive in today's turbulent environment. Innovation research which became established as an important research field with investigations of how innovations are diffused/adopted by individuals, has significantly expanded in the last three decades with studies where the unit of analysis is an organization.

Innovation adoption in organizations is a complex phenomenon and theories of innovation have been criticized for empirical instability and theoretical confusion (Downs and Mohr, 1976). Many efforts have been made to date to develop typologies to classify innovation into different types to resolve theoretical inconsistencies in innovation research. Again, with a certain degree of overlap, many potentially useful typologies have been proposed, each providing insight into our understanding of the innovation process. Researchers have mainly used three criteria to distinguish innovation types: innovation characteristics, product complexity, and impact on the adopter. Three of the most popular broad typologies are based on the distinction between technological and non-technological innovations, product and process innovations, and radical and incremental innovations (Tornatzky and Fleisher, 1990). These typologies have been further classified by researchers based on innovation activities in the scope of their study. For

example, Chesbrough and Teece (1996) distinguish between autonomous and systemic innovation. "Some innovations are autonomous—that is, they can be pursued independently from other innovations. In contrast, some innovations are fundamentally systemic, i.e., their benefits can be realized only in conjunction with related complementary innovations" (Chesbrough and Teece, 1996, p. 66)."

Organizational innovation represents the core renewal process in any organization. It can come in response to the changes in external and internal environments or as a preemptive action taken to influence the environment (Damanpour, 1991). Innovations are generally intended and expected to contribute to the performance or effectiveness of the organization. This belief is further strengthened by studies showing that innovative organizations consistently perform better than less innovative ones (Nonaka and Takeuchi, 1996). Organizations are described by Rogers (1995) as stable systems of individuals who work together to achieve common goals through a hierarchy of ranks and division of labor. The efficiency in organizing human endeavors attributed to organizations is in part, due to the stability efficiency imparts to organizational actions through an authority structure, predefined goals, prescribed roles, rules and regulations, and formal and informal patterns of communications. Given the relative stability of organizations, they can be perceived as averse to innovations, but, on the contrary organizations continually adopt innovations over time (Rogers, 1995; Damanpour, 1991).

In the context of this study, the term innovation refers to adoption of a systemic organizational change program. ERP systems have systemic implications and represent multiple innovations that affect the whole organization. Most organizations develop and deploy ERP systems with purchased technologies and products invented by vendors. IS and technologies are not in themselves an innovation (Clemens and Row, 1991) and organizations cannot depend on

advanced IT to produce sustainable advantages because of their ready availability to all their competitors at a price (Clemens and Row, 1991; Powell and Dent-Micallef, 1997). The process of innovation that includes the use of IS and technology, and the development of complimentary business and human resources, is more important in drawing competitive advantage from IS and technology implementation than the technology and the systems (Powell and Dent-Micallef, 1997).

2.2.1 Organizational Innovation Research

In recent years researchers have accorded much attention to the topic of organizational innovation and change. The focus in this stream of innovation literature is mainly on organizational activities such as the search for, discovery of, and experimentation and development of new technologies, new products and/or services, new production processes, and new organizational structure to support innovations. Organizational innovation research can be split into two broad areas of inquiry based on their focus. The first area is based on a macro-economic tradition; it examines differences in the patterns of innovation in organizations across countries and industrial sectors, the evolution of particular technologies over time, and intra-sector differences in the propensity of the firms to innovate. The second area is based on micro-economics and organization-oriented tradition; it focuses on how innovations are developed, diffused, adopted, and/or used. In this study, we focus on adoption of innovation by organizations.

Two broad approaches are commonly used in the literature for study of organizational behavior in general, and of innovation adoption in particular: the variance theory and the process theory (Mohr, 1982). In the variance theory approach, investigators attempt to identify characteristics of the organization, the environment, or the factors that lead to organizational

adoption of innovations (Dean Jr., 1986). While variance theory excels at explaining variation in the magnitude of certain outcomes, it tends not to do so well when the outcomes are uncertain. By contrast, process theory provides powerful explanations even when necessary causal agents cannot be demonstrated as sufficient for the outcomes to occur. Studies in the process theory approach consider the events and behaviors occurring within an organization that is considering an innovation. We adopt strands of both process and variance theories for this research.

2.2.1.1 Variance Approach

Organizations of all types adopt innovations to respond to changes in their external and internal environments. However, large variations observed in outcomes for organizations adopting similar innovations have been a constant source of curiosity for researchers and practitioners alike. This has led to a number of studies which explore the relationship of an adopting organization's characteristics to dependent variables such as organizational innovativeness and/or success of adoption (Damanpour, 1991; Kwon and Zmud, 1987; Tornatzky and Klein, 1982). The rationale behind these studies is that technological innovations cannot be studied without careful attention to the organizational context in which the innovations are implemented. Organizational innovation studies in the variance theory approach strive to gain insight into how context influences the complex process of innovation in the organization. The innovativeness of an organization (often denoted by the number of innovations adopted) has been related to numerous structural, people-related, technological, and environmental attributes that characterize the organization.

Different studies have focused on different innovation types with varying scope, which is a key reason for the differences in their conclusions. A number of studies provide confirmatory evidence of a deterministic relationship between several organizational characteristics and

organizational innovativeness (Damanpour, 1991; Downs and Mohr, 1976). Researchers have also relied upon forming sub-theories of innovation to explain this inconsistency in their research results by using moderating variables such as the type of organization, scope of innovation, and stage of innovation (e.g., Damanpour, 1991). Organizations have evolved in many forms: business enterprises, state-owned companies, government agencies, charities and voluntary bodies, mutual societies, clubs, and trade unions. Individual organizations have been characterized in the literature by distinct attributes - such as structure, people, and technology - which are shaped over time as an organization works to increase its effectiveness contingent to the context in which it operates (Donaldson, 2000). Many differences in the technologies and underlying dimensions of structure in different organizations have been reported in previous research (Pugh *et al.*, 1968); for example, technologies and organizational structures for a service-oriented organization may differ considerably from a manufacturing organization. Organizational factors may unequally influence innovation in different types of organizations, as the intra-organizational context and the industry or sector in which an organization is located also influence innovativeness (Van de Ven, 1986).

Researchers have formed numerous typologies of organizations in studies of innovation along a continuum from innovative to non-innovative. For example, Miller and Friesen (1982) found the impact of organizational variables on product innovation to differ considerably between "entrepreneurial" and "conservative" firms. Differences can also exist among facilitators of the adoption of innovation in different organization types. Distinct differences also exist between private (for-profit) and public (not-for-profit) sector organizations. The distinctions between the two sectors produce useful insights into differences in strategies for innovation, the effect of structure, and incentive systems that induce organizational members to

initiate and implement innovations (Roessner, 1977). For example, the high degree of external control characteristic of public organizations has a negative influence on managers' desires to delegate authority and it causes higher levels of bureaucratic control than are typical in private organizations (Holdaway *et al.*, 1975; Perry and Rainey, 1988). In turn high bureaucratic control (i.e., high formalization and centralization) inhibits innovativeness (Aiken and Hage, 1971; Pierce and Delbecq, 1977).

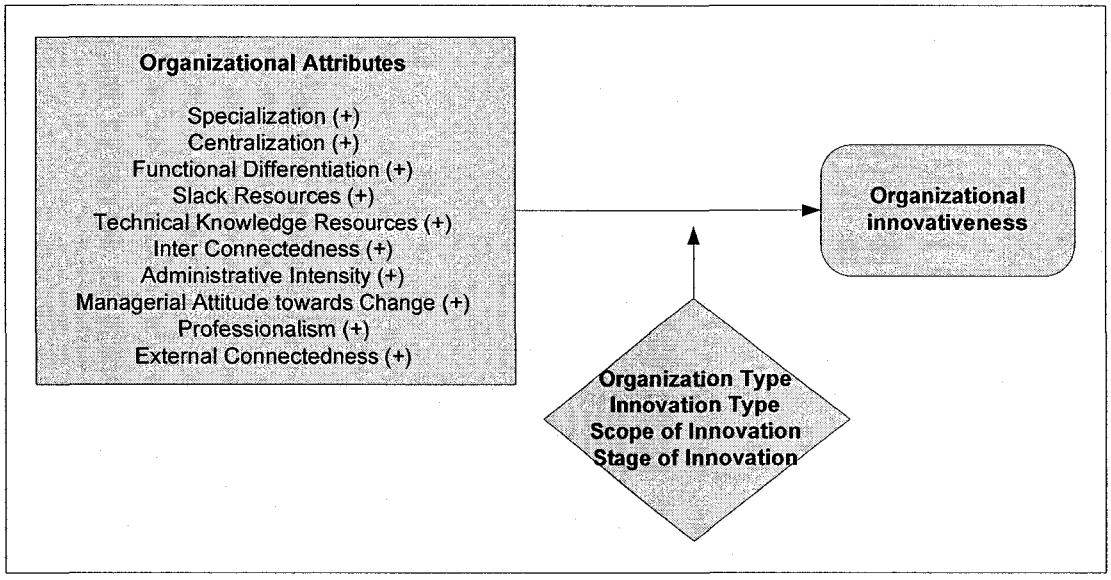

Figure 2-3: Organizational Characteristics and Innovativeness (given by Damanpour (1991))

Many theoretical efforts have been made to consolidate the fragmented efforts of innovation researchers. A number of meta-studies have been conducted to highlight the factors that have been found to affect innovativeness in organizations consistently across various studies. For example, Tornatzky and Klein (1982) describe the relationships between 10 characteristics of an innovation and implementation of that innovation in a meta-analytic study. The authors found that three characteristics (compatibility, relative advantage, and complexity) had the most consistently significant relationships to innovation adoption in the studies that they

analyzed. Damanpour (1991), in another meta-analytic study of determinants and moderators of organizational innovations, focused on the effects of 13 organizational determinants, a group mainly composed of structural variables but also including process, resource, and cultural variables. The author considered Organization type, Scope of innovation, Innovation type, and Stage of innovation as the four moderating variables. Out of those, the author found that only 10 variables had a statistically significant relationship with organizational innovativeness (Figure 2-3).

Several authors have also used extensive literature reviews to model the deterministic relationship between contextual variables and firm innovativeness. For example, Rogers (1995) reviews a number of innovation studies to list eight organizational context factors affecting innovativeness. In his book on diffusion of innovations he places these eight factors into three categories: Individual and Managerial Characteristics, Internal Characteristics of Organizational Structure, and External Characteristics of the Organizational Structure (Figure 2-4).

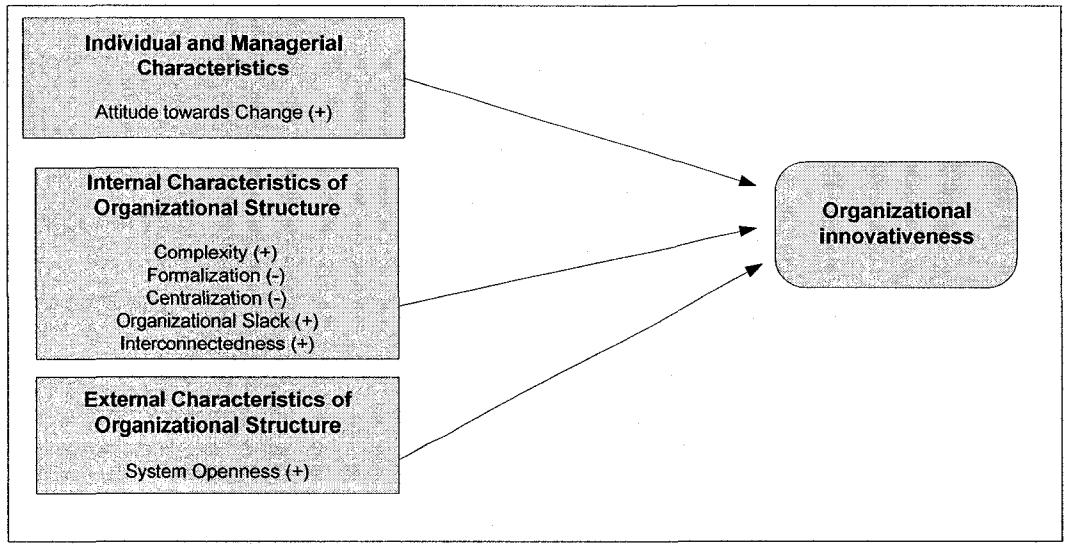

Figure 2-4: Organizational Characteristics and Innovativeness (given by Rogers (1995))

Tornatzky and Fleisher (1990) provide a unifying framework based on their review of the extent literature on innovation adoption. They categorize attributes that characterize organizations and have been found in the literature to determine organizational innovativeness into three broad categories: organizational, technological, and environmental. We adapt the classification given by Tornatzky and Fleisher (1990) for this study.

Organizational Characteristics: Organizations are typically characterized in terms of descriptive attributes such as organization structure, quality of human resources, amount of slack resources available, management culture, work processes, and interconnectivity, both within the organization and with the external environment. Several studies have examined the relationship between organizational structure and innovation (e.g., Burns and Stalker, 1961; Aiken and Hage, 1971). Authors have further tried to disaggregate the gross concepts popularly used in early studies to denote structure (such as organic/mechanistic structure) into their constituent variables (such as centralization, formalization, inter-connectedness, complexity, and availability of slack resources) and examine the impact of those variables on a firm's innovativeness. However, making inferences from these studies for the whole process of organizational innovation is, at best, ambiguous (Tornatzky and Fleisher, 1990) as some of the studies find opposing influences of structural variables on different phases of innovation process. For example, Zaltman *et al.* (1973) found that while organizational complexity aided adoption of the innovation, it was not helpful in implementation of innovation.

Technological Characteristics: A large number of researchers have also explored how the technological context in the organization influences the innovation process. As most innovations in the organizations are associated with technological advancements, many studies refer to technological attributes as innovation attributes. A number of generic technological attributes

(such as compatibility, complexity, relative advantage, trialability, and observability), operationalized in the literature, have been found to significantly affect adoption of innovations in organizations (Rogers, 1995; Kwon and Zmud, 1987). These factors have also been termed subjective or secondary characteristics of innovation as they are defined based on how the adopting organization perceives the innovation (Tornatzky and Klein, 1982). They can only be measured subjectively.

Technological factors, however, play an obvious and important role in determining organizational innovativeness. Collins *et al.* (1988) , in their study of 54 manufacturing plants, found that an organization's current technology placed broad limits on the extent of subsequent technological change, as the organization has to ensure the compatibility of new technology with its current technological assets and capabilities. Tornatzky and Klein (1982), in their meta-analysis of research literature on technological characteristics, identify three characteristics which have been found to have a consistent association with innovation activity in organizations: compatibility, relative advantage, and complexity.

Environmental Characteristics: Environmental context is the arena in which the organization operates. Environment is seen as both a source of information and as a stock of resources (Aldrich, 1979; Scott, 1981). Competition, heterogeneity, inter-organizational interdependence, and uncertainty are some of the key environmental attributes that have been studied in the literature for their impact on innovativeness of an organization. A number of studies found that organizations often adopt technological innovations in response to the pressures from the business environment in which they operate; as well, they depend heavily on the environment to provide supporting infrastructure and resources to sustain the innovation (Tornatzky and Fleisher, 1990).

While researchers have made significant advances in identifying the determinants of organizational innovation, several issues remain largely unexplored. Innovation has been treated as a discrete phenomenon in most studies, and variations in the form of innovations and the adoption process have been often neglected (Westphal *et al.*, 1997). While some innovations are discrete, the definition or content of innovation can be open to interpretation particularly in the case of systemic organizational innovations such as ERP systems. In such cases it becomes equally important to explore how organizations define and implement an innovation. The success of systemic organizational innovations depends on how they are conceived, implemented, and institutionalized in the post-implementation phase (LawlerIII and Mohrman, 1985). Interestingly, the focus of these studies has not been on post-implementation phase. Studies have not explored how context influences the institutionalization of innovations in organizations. One of the objectives of this study is to explore the relationship of some of the contextual factors which significantly affect organizational innovativeness with the process of institutionalization of innovations.

2.2.1.2 Process Approach

The variance approach studies of organizational innovativeness have helped immensely in understanding the characteristics of innovative organizations. However, these studies had their limitations to, due to their cross-sectional nature and reliance on information aggregating quantitative analysis methodologies. These limitations were increasingly highlighted in some studies carried out in the 1970s where innovations were primarily communication technologies (Zaltman *et al.*, 1973). The innovation process for these innovations was a longitudinal activity and a key variable. The cross-sectional approach and quantitative data aggregation techniques used in the variance approach meant that process variance was lost in variance approach studies.

This led to the emergence of a process approach that emphasized the often unpredictable interactions between people in organizations and the environment. Innovation process studies identify the main sequence of decisions, actions, and events in organizations undergoing the process. The studies in this approach assume that people try to achieve their goals but acknowledge that outcomes are often different from those intended (sometimes better and sometimes worse). One of the strengths of the process studies is that they account for mutual influences between the organization and its environment. Two prominent weaknesses of process studies are that they are stronger in explanatory rather than predictive power, and they assign a prominent role to chance.

A common track within the process theory approach is to inductively develop stage models that identify a set of stages or phases, relatively fixed in number and sequence, through which organizations pass on their way to innovations. The studies in the process approach relied more on qualitative data collection and analysis techniques. Researchers propose many theoretical models (Table 2-1) that trace the innovation path from the adoption decision through investments and resource creation to the desired outputs of productivity increases, organizational performance improvements, realized business value, and the like (Dean Jr., 1986; Soh and Markus, 1995).

Innovation in the process approach is conceptualized as a decision-making process (Rogers, 1983) consisting of three broad phases of adoption (Rogers, 1962), implementation (Zaltman *et al.,* 1973; Pierce and Delbecq, 1977), and post-implementation (Kwon and Zmud, 1987; Cooper and Zmud, 1990; Soh and Markus, 1995). Initially, researchers focused primarily on the decision to adopt an innovation as innovations were assumed to be invariant in quality that did not change as they were diffused. It was only in the 1970s that diffusion scholars entertained

the idea that there was a certain degree of modification and customization involved in the implementation. For example, Zaltman *et al.* (1973) identified distinctive aspects of the innovation process when it was implemented in the adopting organizations. In such studies, the focus of the adoption process was expanded to include implementation activities. Diffusion scholars realized the importance of the post implementation activities much later. Only in the 1990s was the observation made that the most potential benefits of innovations were realized much later than implementation - only after the innovations were institutionalized by the organizations. Most of these studies are in the context of IT-based innovations where some prominent economists initiated a debate on productivity paradox (Strassman, 1990; Roach, 1991; Brynjolfsson and Hitt, 1998).

This debate prompted researchers to follow the innovation process beyond implementation and extend the process models. For example, Soh and Markus (1995) added a post-implementation phase to the innovation process model, stating the importance of the conversion of capabilities developed by innovation into business value. The Markus and Tanis model draws on the authors' experience with ERP systems based on the Soh and Markus model (Figure 2-5), providing a framework for the study of the ERP adoption process. We adopt the Markus and Tanis model in our study to delineate the ERP adoption process (Figure 2-6). The two models (Soh and Markus (1995) and Markus and Tanis (2000)) are discussed in the next two sections.

Table 2-1: Innovation Process Stage Models

Authors	Year	Phases
• Rogers	1962	Adoption
• Zaltman *et. al*	1973	Adoption and Implementation
• Pierce and Delbecq	1977	Initiation, Adoption, and Implementation
• Kwon and Zmud	1987	Initiation, Adoption, Adaptation, Acceptance, Use and Incorporation
• Cooper and Zmud	1990	Initiation, Adoption, Adaptation, Acceptance, Routinization and Infusion
• Kumar *et al.*	1994	Conceptualization, Development, Implementation, Program Monitoring, Qualification and Acceptance
• Soh and Markus	1995	IT expenditure (adoption), IT assets (implementation), Organizational impacts (post-implementation)
• Markus and Tanis	2000	Project Chartering, Project Configuration, Shakedown, Onwards and Upwards

Soh and Markus Model

Soh and Markus (1995) modeled the "IT investment to business value" process as a series of three linked models that corresponded to the phases of IT investment, system development, implementation, and ongoing operations. Their model is based on emergent process theory. Soh and Markus (1995) argued that there cannot be a necessary and sufficient relationship between IT spending and improved organizational performance. The reason was because some of the investment may be wasted through poor internal IT management processes such as failure to select the right IT projects to pursue or failure to manage them effectively. In the model, improved organizational performance due to IT investment is the outcome of organizational interest. The Soh and Markus (1995) model explicitly acknowledges the multidimensionality of

performance and also that a favorable outcome does not always occur. Their theory specifies the chain of events necessary for the outcome set at any point in the chain. Some events necessary for the outcome set may fail to occur, derailing all or some of the desired outcomes. Their model is sub-divided into three distinct processes based on the following key arguments:

1. The IT conversion process: organizational spending on IT subject to the varying degree of effectiveness during the IT management process results in IT assets.
2. The IT use process: quality IT assets combined with appropriate IT use yield favorable IT impacts.
3. The competitive process: favorable IT impacts, if not adversely affected during the competitive process, lead to improved organizational performance.

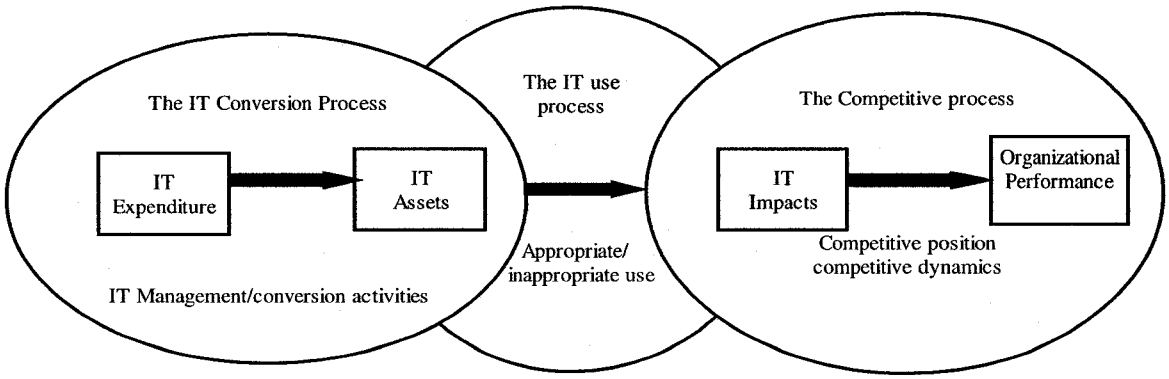

Figure 2-5: How IT creates Business Value (adopted from Soh and Markus (1995), p. 37)

This process model helps to explain why IT investment does not always lead to improved performance. It draws the research attention to how, when, and why IT investment is converted to favorable organizational performance.

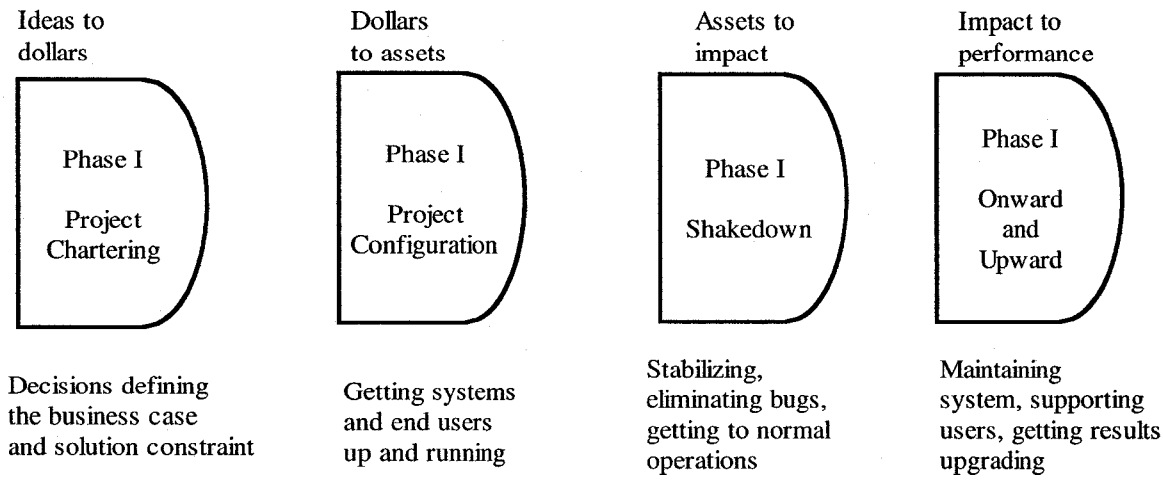

Figure 2-6: Enterprise systems experience cycle (adopted from Markus and Tanis (2000), p.189)

Markus and Tanis Model

Markus and Tanis (2000) built their "ERP Systems Experience Cycle" framework by incorporating their experience with enterprise systems in the Soh and Markus model. They described the organization's experience with the enterprise systems as moving thorough four main phases, characterized by key players, typical activities, characteristic problems, appropriate performance metrics, and a range of possible outcomes. Each enterprise system experience is unique, and the experiences may differ considerably depending, for example, on whether the adoption of the enterprise system is initiated by IS specialists or by business people, involves external consultants or is done largely in-house, follows a strategic IT business planning or business process re-engineering, or does not follow such a process. The later two phases describe the post-implementation phases of the ERP adoption process.

The phases can be briefly described as follows.

The **project-chartering** phase includes all the decisions and typical activities leading up to project approval and funding. One possible outcome of this phase might be that the idea is

abandoned as unlikely to provide business benefits. Or there might be a decision to develop the project within certain parameters with a sound or unsound business case. An example of an unsound adoption is a decision not to allocate sufficient resources for change management and training (Ross, 1999). Another example is the decision of a decentralized company to require more standardization of business processes than is necessary to achieve business benefits (Davenport, 1998). Successful project chartering is a necessary, but not sufficient, condition for successful innovation. Success may also depend on a successful implementation and post-implementation process.

The **project-configuration** phase comprises activities intended to get the system up and running in one or more organizational units. Key players include the project manager, project team members (including non-technical members of various business units and functional areas), internal IT specialists, vendors, and consultants. Again the composition of players may vary, depending on the decision to do the project in-house with outside assistance or totally outsource it. Key activities include software configuration, system integration, testing, data conversion, training, and rollout. Large number of errors and problems can occur. Project teams may be staffed with inadequate representation; teams may lack requisite knowledge and skills; teams may embark on extensive, unnecessary modifications; and data cleanup, testing, or training may be inadequate. In addition, the business conditions characterizing the chartering phase may have changed: the company may have fallen into financial distress, it may have merged with some other company, or it may have shifted its business model. Some projects are terminated owing to cost or schedule overruns or severe technical problems.

The **shakedown** phase is when the organization comes to grips with the enterprise system. The phase can be said to end when "normal operations" have been achieved. The project

(or consulting) team may continue its involvement or may pass control to operational managers and end users. Primarily, the new technology is stabilized in this phase. Activities include fixing bugs and rework tuning, system performance, retraining, and staffing up to handle temporary inefficiencies. Effects of errors made in previous phases are felt in this phase in the form of reduced productivity or business disruption, while new errors can also arise. The organization may come to rely heavily on knowledgeable project team members rather than building the enterprise knowledge and skills in all the relevant operational personnel.

The **onward and upward phase** continues from normal operations until the system is replaced with an upgrade of a different system. It is during this phase that the new systems are institutionalized and the organization is finally able to ascertain benefits (if any) of its investment. The changes are mastered by the organization, new competencies around technology and redefined processes are developed, and complimentary structure and norms evolve. Key players include operational managers, end users, and IT support personnel (internal and external). Vendor personnel and consultants may also be involved, particularly when deliberations about bolt-ins (additional software integrated to enhance system performance) and upgrades are concerned. Characteristic activities in this phase include continuous business improvement, additional user skill building, and post-implementation benefit assessment; these activities may not be performed at all in some cases. A common problem in this phase is the loss of knowledgeable personnel who understand the rationale of prior configuration choices and how to improve the business processes through the use of the system. Several ultimate outcomes are possible in this phase. Additionally, the organizations may be unwilling to undertake further improvements or upgrades.

2.2.2 Post-Implementation Phase of ERP Adoption

The works of Markus and Tanis (2000) and Soh and Markus (1995) highlight the theoretical need for a focus on the post-implementation phase of ERP adoption. This need is further confirmed empirically by a 1999 Deloitte consulting study of ERP-implementing companies that refers to post-ERP implementation activities as ERP's second wave. Quattrone and Hopper (2001) argue that availability of a new system marks a transformation in the IS and offers new possibilities to the organization for solving problems. However, no significant benefits can be realized unless organizations and their working styles change to use the new systems. Markus and Tanis (2000) identify the Shakedown and Onwards and Upwards stages in their "Enterprise System Experience Cycle" framework as the post-implementation stages. These stages are characterized by activities to realize business benefits from ERP systems. Institutionalization has been defined as an important process in the post innovation implementation phase wherein changes are mastered by the organization, technology is stabilized, new competencies around technology and redefined processes are developed, and complimentary structure and norms evolve. It is important to note that technological innovations are not purely physical artifacts. Their usage is conditioned by the cultural norms and values, and social roles and practices, in which they are found.

Institutionalization is treated in the literature as both a process and a property variable that is affected by both exogenous and endogenous factors. The institutionalization process is critical for the successful institutionalization of innovations, as it is during this process that the organization uses the innovation and comes to terms with the changes introduced by an innovation. New competencies, norms, and rules and regulations are developed in this process that translate into increased and more effective use of the new systems by the organization in its

unique value-creation process. Through the process of institutionalization, the socially created beliefs and cognitions assume a taken for granted characteristic and become the natural way to act (Zucker, 1983). Successful ERP institutionalization is important not only because it is where the benefits of ERP are realized, but also because it provides foundations for further innovations, e.g. ERP systems provide a backbone for e-government and e-business initiatives.

2.3 Institutional Theory

The institutional theory is one of several theories that developed in reaction to the prevailing conceptions of organizations as bounded, relatively autonomous, and constituted by rational actors. The earliest institutional arguments in economics are associated with the German historical school of economics. A number of scholars in this school led by Gustav Schmoller in the early 20th century argued that economic processes operated within a social framework that was in turn shaped by a set of cultural and historical forces (Scott, 1995). These scholars challenged the simplified and rationalized assumptions of classical economic theory.

Many of these ideas of the historical school were embraced and further developed by American institutional economists, e.g., Thorstein Veblen, John Commons, and Westley Mitchell. Veblen in his book *The Theory of Business Enterprise* published in 1904 was critical of underlying economic assumptions regarding individual behavior. He insisted that much behavior was governed by habit and convention. Veblen argued that "Not only is the individual's conduct hedged about and directed by his habitual relations to his fellows in the group, but these relations, being of an institutional character, vary as the institutional scene varies" (Veblen, 1909: pg.245, cf. Scott, 2001). Commons and Mitchell also challenged the conventional emphasis on individual choice behavior and rationality assumptions made by theorists who were

their contemporaries. Commons (1924) suggested that the more appropriate unit of economic analysis was the "transaction," i.e., two or more willing people giving, taking, persuading, coercing, defrauding, commanding, obeying, competing, and governing in a world of scarcity, mechanisms, and rules of conducts. "To Commons, the institutions existing at a specific time represent nothing more than imperfect and pragmatic solutions to reconcile past conflicts; they are solutions that consist of a set of rights and duties, an authority for enforcing them, and some degree of adherence to collective norms for prudent reasonable behavior" (Ven de Ven, 1993, pg. 142). Most of these early institutional economists were critical of rationalist assumptions made by their colleagues for not making its examination central to their mission. However, their criticisms did not prevail until the advent of neo-institutional theory in the 1970s which revived some of the old questions associated with rationalization.

The concept of institutions has also been a mainstay of some prominent sociological theories in organization studies (Parsons, 1951; Selznick, 1949, 1957; Simon, 1957). However, the idea that organizations are deeply embedded in wider institutional environments acquired greater prominence with works of neo-institutional theorists (e.g., Meyer and Rowan, 1977; Zucker, 1977; Zucker, 1983; DiMaggio and Powell 1983; Scott and Meyer, 1983). These theorists stressed that cultural and cognitive influences were equally important in decision making in the organizations, as opposed to earlier organizational theory that had only emphasized regulative and normative influences.

One of the earliest and most influential versions of institutional theory in organizations remains that associated with the work of Selznick and his students. They viewed organizational structure as an adaptive vehicle shaped in reaction to the characteristics and commitments of participants as well as to influences and constraints from the external environment. Selznick

(1949) argued that while organizations are conceived as rational mechanistic instruments designed to achieve specified goals, they are, over time, transformed into institutions that are adaptive organic systems and affected by the social characteristics of their participants as well as by varied environmental pressures.

Selznick (1957) refers to Institutionalization as an adaptive process. He states that "In what is perhaps its most significant meaning, 'to institutionalize' is to infuse with value beyond the technical requirements of the task at hand" (Selznick, 1957 pg. 17). Selznick laid the basis for a process model of institutionalization in particular organizations with his study of Tennessee Valley Authority. He noted how its original structures and goals were transformed over time by the commitments of its participants and the requirements imposed by the powerful constituencies in its environment (Selznick, 1949). Stinchcombe (1968) expanded upon Selznick's work by attempting to analyze how power holders in organizations are able to preserve their power, for example, by controlling the selection of their successors and general instruments of communication and socialization.

Parsons (1960), by contrast, developed his institutional arguments by analyzing the relation between an organization and its environment. He studied how value systems in organizations are legitimized as individual actors who internalize shared norms so that they become the basis of individual action (Parsons, 1960). Simon (1957) linked individual cognitive capacities to the development of organizational structures, which he said work to simplify and support decision making of individuals in organizations, allowing them to achieve a higher level of "bounded rational," but consistent behavior, than would otherwise be possible. Individuals joining organizations are, thus, expected to adopt organizational value premises in the form of rules, procedures, and routines (Simon, 1957).

Neo-institutional theorists argue that the building blocks of organizational action (e.g., actors and roles, structures and goals) are constituted as social entities by an evolving set of rationalized patterns, models, and cultural schemes (Meyer and Rowan, 1977). The emphasis on both normative and cognitive factors is a key factor that distinguishes institutional analysis from earlier theories formulated to account for organizational structure and action such as contingency theory, resource dependence, and population ecology approaches that gave primacy to materialist forces for shaping organizations. It holds that organizations, and the individuals who populate them, are suspended in a web of values, norms, beliefs, and assumptions that are taken for granted; these factors define their institutional environment.

Organizations are, thus, made possible as situated patterns of meaning and action by these wider instrumental beliefs and practices that neo-institutional theorists describe as a rationalized environment enforced by regulatory processes. This entails that pervasive processes, such as property rules, become increasingly codified above the level of the single nation state and the global entrenchment of particular systems of rationalized control in work organizations, such as hierarchy and the labor contract (Jepperson and Meyer, 1991). Although tremendous progress has been made in institutional analysis, the terms institution and institutionalization still have vague and variable meanings in most discussions. One plausible reason for this may be that contributions have been made to the development of institutional theory by researchers of different backgrounds and disciplines, such as economics, political science, and sociology. Further, researchers have analyzed institutions at different levels - intra-organizational, organizational, organization field, and societal - and focused upon different aspects and carriers of institutions. Scott (1995), in his review of contemporary institutional theory provides the following summary definition of institutions:

"Institutions consist of cognitive, normative, and regulative structures and activities that provide stability and meaning to social behavior. Institutions are transported by various carriers – cultures, structures, and routines – and they operate at multiple levels of jurisdiction (Scott, 1995: pg. 33)."

2.3.1 Pillars of Institutional Theory

Scott (1995) conceptualizes institutions as composed of regulative systems, normative systems, and cognitive systems and calls these the three "pillars" of institutional theory. Each of these pillars provides a basis for institutionalization of innovations. Institutionalized innovations are supported by shared meanings by the adopting organization's employees, social norms of usage, and rules. He argues that, even though all of these three pillars have been identified as vital components of institutions, various studies stressed one or the other as central.

Regulative: The regulative aspect of institutions emphasizes how institutions constrain and regularize behavior by rule setting, monitoring, and sanctioning activities. Regulative processes involve establishing rules, inspecting, or reviewing conformity to established rules, and executing sanctions - rewards or punishments - in an attempt to influence future behavior. Many researchers have viewed institutions as primarily dependent on the regulative pillar. However, a stable system of rules backed by surveillance and sanctioning power is only one of the prevailing views of institutions.

Normative: Studies focused on the normative aspects of institutions emphasize normatively developed rules that introduce a prescriptive, evaluative, and obligatory dimension into the social life of organizations (e.g., Selznick, 1957; Parsons, 1960). Normative systems include both values and norms. Values are conceptions of the preferred or the desirable behavior to which the behavior of the actors will be compared and assessed, while norms specify how things should be done. Norms also define legitimate means to pursue organizational values. Most early

institutional theorists regarded norms and values are as the basis of a stable social order. However, later institutionalists emphasized the effects of different sets of cultural rules: shared definitions of social reality for stability.

Cognitive: Studies focused on the cognitive aspects emphasize how cognitive elements constitute the nature of organizational reality and the frames through which meaning is made (e.g., Geertz, 1973; Zucker, 1987). Meanings arise through interaction in organizations. They are maintained and transformed as they are employed to make sense of the ongoing activities by organizational actors (Scott, 1995). The cognitive view insists that much of the coherence of social life is due to the creation of categories of social actors, both individual and collective, and their associated ways of acting (DiMaggio and Powell, 1983).

2.3.2 Institutionalization: A Change Process

Institutional theory has risen to prominence as a powerful explanation for both individual and organizational action (Dacin *et al.*, 2002). In spite of growing interest in the institutional perspective, there are still gaps in our understanding of institutional processes (Scott, 1995; Barley and Tolbert, 1997). An often-neglected area of enquiry is the question of how institutional practices evolve and change: "we need an enhanced understanding of both the heterogeneity in institutional environments and the processes that generate institutional change (Powell, 1991, p.183)." As currently practiced, neo-institutionalism bypasses the central issue of the social construction of rationalization, which it treats in terms of structural isomorphism, i.e. diffusion of the same or similar structural patterns across populations of organizations.

Until recently, the studies on institutions have largely focused on persistence and homogeneity of institutions (Dacin *et al.,* 2002). However, institutions change over time, and they cannot be uniformly taken for granted. The topic of institutional change has emerged as a

central focus in many recent studies where researchers have tried to find out how institutions are created, transformed, and distinguished, and the way in which institutional processes affect institutional change.

Berger and Luckman (1967) identified institutionalization as a core process of creating and perpetuating social reality between organizational actors through externalization, objectification, and internalization. The process is enacted as "Individuals take action (externalization), and when other individuals interpret these actions as having a meaning beyond the idiosyncratic action, objectification takes place. Institutions are the outcome or the end state of institutionalization process, which leads to reciprocal typification of habitualized action" (Berger and Luckman, 1967). Habitualized action here refers to behaviors that have been developed empirically and adopted by an actor or set of actors in order to solve recurring problems. Such behaviors are habitualized to the degree that they are evoked with a minimum decision making effort by actors in response to particular stimuli.

Tolbert and Zucker, in their (1996) review article on the status of institutional theory, argue that even though there is widespread recognition that institutionalization is both a process and property variable (Zucker, 1977), a process-based approach to institutionalization has not been followed in most organizational analyses. Most review articles on institutional theory concur that little attention has been given to conceptualizing and specifying the processes of institutionalization (Tolbert and Zucker, 1996; DiMaggio and Powell, 1991; Strang and Meyer, 1993). "Instead, institutionalization is treated as a qualitative state, i.e., structures are institutionalized or they are not. Consequently, important questions of the determinants of variations in levels of institutionalization, and of how such variations might affect the degree of

similarity among sets of organizations, have been largely neglected (Tolbert and Zucker, 1996 pg. 175)."

In organizational analysis, there are two main strands of thought related to institutional theory. One is at the macro sociological level focusing on how institutional pressures on organizations influence organizational forms (DiMaggio and Powell, 1983). The second is at the micro level, dealing primarily with the idea of how organizational members make sense of new initiatives in the existing institutional realm (Meyer and Rowan, 1977; Meyer and Scott, 1983). The focus of this study lies more in the micro-social sense-making process in the organization. More specifically, we can define institutionalized innovations as relatively widely diffused practices, technologies, or rules that have become normatively and cognitively entrenched so that it is costly to choose other practices, technologies, or rules.

The micro-social process of institutionalization of new initiatives has become of significant interest to management research, as in the last few decades several new initiatives have been undertaken by organizations to remain ahead of their competitors. However, few of these initiatives become institutionalized. Lawrence *et al.* (2002) defines the practices, technologies, and rules that are narrowly diffused and only weakly entrenched, but have the potential to become widely institutionalized as proto-institutions. These new practices, technologies, and rules are institutions in-the-making; they have the potential to become full fledged institutions if social processes develop that entrench them and they are diffused throughout the institutional field. A number of authors also introduce agency theory into institutional analysis in the context of proto-institutions. For example, DiMaggio (1988, pg.14) argues that new institutions arise when organized actors with sufficient resources (institutional entrepreneurs) see in them an opportunity to realize interests that they highly value. However,

most of the studies that look into the relationship of action and institutions are focused at the societal or industry levels. Very few studies have tried to trace the institutional change process in the organization (e.g., Leblebici *et al.*, 1991; Van de Van and Garud, 1989) and studied the efforts to establish new governance structures and procedures in the organization.

2.3.3 Temporal Dynamics of Institutionalization Process

Institutionalization of an innovation is a dynamic process: new practices, rules, and technologies emerge, diffuse, and become legitimated over time at varying rates (Leblebici, *et al.*, 1991; Meyer and Rowan, 1977). Once established, they endure with greater or lesser degrees of stability (Christensen, 1997; Fligstein, 1991). Institutional theory has been criticized for not giving enough attention to understanding the dynamics of the institutional process. In this study, we focus on two primary dimensions: time taken and the extent of institutionalization.

Few researchers have studied the dynamics of the institutionalization process and none have considered both the time and extent of institutionalization elements. Also, past studies are not supported by empirical evidence. Lawrence *et al.* (2002) stress the importance of the temporal dynamics of the institutionalization process. They identify two temporal variables pace and stability, in their conceptual model of the institutional process. They argue that the traditional model of institutionalization, as typified by the S-shaped diffusion curve, masks a variety of temporal patterns in institutionalization (Figure 2-7). These authors believe that the mechanisms of institutionalization prevalent in organizations can affect the temporal variables and, thus, affect the shape of the individual organization's S-curve for institutionalization.

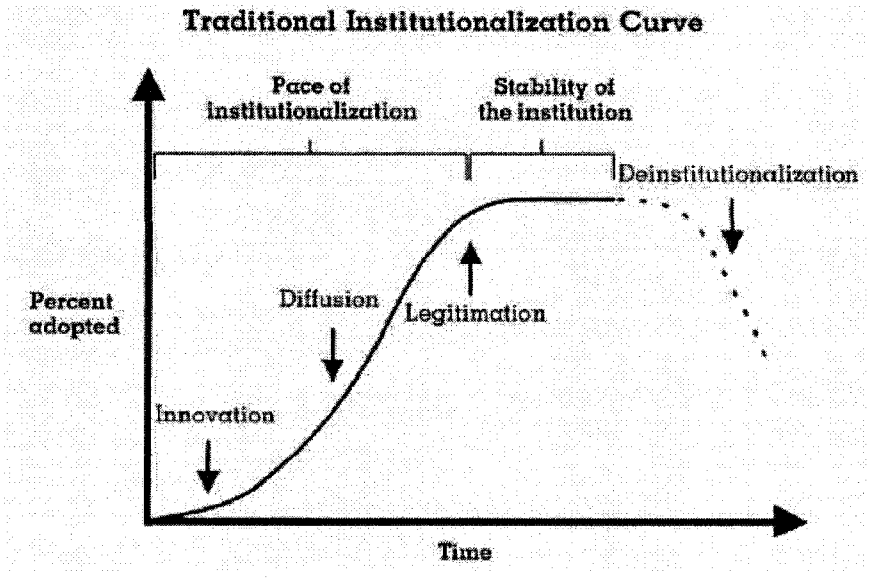

Figure 2-7: Institutionalization Curve (adopted from Lawrence *et al.* (2001), pg.626)

Institutional theorists have not tried to study the extent of institutionalization. Only indirect reference to institutions is made in some of the stages of growth models such as those in the field of information systems (Anthony, 1965; Gibson and Nolan, 1974; Venkatraman, 1994). We take these works as background to develop the stages of ERP institutionalization, whereby an analysis of organization can be undertaken using several constructs to benchmark and categorize the level of systems evolution.

Considering that ERP systems began to have a real presence in organizations only in the late 1990's, most organizations are now realizing the need to focus on the effective use of ERP systems. And, thus, perhaps it is an appropriate time for researchers to contribute to the issue of ERP institutionalization. Some authors argue that the models developed for institutionalization of information systems must stand true for ERP systems (Holland and Light, 2001). Unfortunately, researchers have paid scant attention to differences between ERP packages and traditional software systems.

In the context of this study, ERP institutionalization has been defined as a continuous adaptation process in the post-implementation phase wherein changes are mastered by the organization, technology is stabilized, new competencies around new technology and redefined work processes are developed, and complimentary structure and norms evolve. It is during the institutionalization process that the organization uses the innovation and comes to terms with the changes introduced by an innovation.

2.4 Concluding Remarks

The study of innovation diffusion has a long and diverse history as a multidisciplinary field with contributions from sociologists, economists, organizational theorists, technology management, IS/IT management, and many other fields (Rogers, 2003). However, most of the research available focuses on the adoption and implementation of innovations. The literature reviewed in this chapter highlighted that very few researchers have explored the post-implementation use and assimilation of ERP systems. Management research on ERP systems lacks the understanding of how these systems are institutionalized in the post-implementation phase.

Institutional theory has risen to prominence as a powerful explanation for both individual and organizational action (Dacin *et al.*, 2002). Institutional theory extends an excellent means of explaining how innovations are used, routinized, and assimilated in the organization in the post-implementation phase. However, institutional theory contains little work on the process of institutionalizing innovations. This research on ERP Institutionalization, thus, offers an excellent opportunity for filling a gap in the existing literature by providing insight into the process of institutionalizing innovations in adopting organizations.

Chapter 3 Research Design

This chapter describes the research design used in this study. Research design is a critical component that provides the blueprint of the research project and explains how the research has been conducted. It can be defined as the process of selection of methods, procedures, protocols, sampling plans, and analysis techniques appropriate for the research (Cooper and Schindler, 1998). The chapter is organized into six subsections that discuss the key components of the research design used in this study. The first section describes the case study research approach, which is used in this study in general and explains why this approach was deemed suitable. The second section delineates the research design adopted for this study and describes its three phases. Section three provides information on criteria used for selecting cases and section four describes the measures taken to enhance the rigor and reliability of the case study research design used in this research. Section five focuses on introducing the data analysis techniques used for the study, and concluding remarks are provided in the last section.

3.1 Case Study Approach

We employed the case study as the research approach in this research. Case studies over the past decades have gained considerable acceptance in business research, particularly as a method of choice for holistically examining complex phenomena in real life settings (Benbasat *et al.* 1987; Yin 1994). This method has been consistently gaining popularity in IS research as it allows for a great deal of flexibility and individual variation (Cavaye, 1996). It not only combines several qualitative data collection methods - such as interviews, documentation, and observations - but it can also include quantitative data, such as questionnaires and time series to

provide richness and flexibility to the research process. Dube and Pare (2003) report modest progress in both the rigorousness and popularity of case study methodology in IS research.

Our interest in studying the process of institutionalizing ERP systems in the post-implementation phase clearly justifies the case study research approach, since it is quite difficult to separate the ERP experience of organizations from their context. Each organizational instance of ERP systems is as unique as the organization configuring these systems to support its business practices and policies. We also found, early in the research process, that not much literature was available to understand this complex socio-technical phenomenon, which made the case study a better approach for this study.

Case study design can vary significantly, given the scope and objective of the research (exploratory, descriptive, or explanatory). For example, the decision to include one or several cases in the design is closely linked to the design objectives. Single case studies have been the basis of most exploratory qualitative research. They can be very vivid and illuminating, especially if they are chosen to be unique or revelatory (Yin, 1984). Multiple case studies offer researchers an added ability to enhance their understanding of the processes and outcomes of cases by allowing them to do cross-case analysis. They provide an opportunity to test (not just develop) hypotheses, and also provide a good picture of locally grounded causality (Miles and Huberman, 1994). Multiple case studies have distinct advantages and disadvantages in comparison to single case studies. They add confidence in the findings by allowing the researchers to look at a range of similar and contrasting cases. However, multiple case studies can require extensive resources and time. Multiple case studies require an extended design phase that includes detailed planning and development of detailed case study protocol.

The objectives of this study stipulated both individual and cross case analysis for delineating the institutionalization process and finding theoretical explanations for the association of success of institutionalization with organizational characteristics. Multiple case studies were adopted, as they allowed us to conduct a cross case comparative analysis for understanding similarities and differences in the institutionalization process in organizations. The multiple case study methodology also gave us more confidence in our findings by allowing us to look at a wide range of similar and contrasting cases.

While the relevance and potential value of case study research is very well accepted, it has been criticized for being unsystematic and lacking the rigor of surveys or experiments. Many researchers have suggested that methodological rigor should be added to case studies. They have made useful recommendations for improving the design, data collection, and data analysis in case studies leading to a significant advancement of scientific rigor in case study methodology (e.g., Benbasat *et al.*, 1987; Eisendhardt, 1989; Lee, 1989; Yin, 1994; Miles and Huberman, 1994). We have used several of these recommendations in the research design to enhance the reliability and validity of the research. The multiphase research design described in the next section was also motivated by the need to introduce more rigor into the methodology.

3.2 Research Phases

We adopted a three-phase research design to gradually introduce structure into this research project. The constructs were carefully delineated and pre-tested in the initial two phases as not enough previous literature exists. The third phase was designed to refine and validate the model. This strategy enabled us to formulate a tighter and efficient research design for the third phase. The three research phases are described in the following sections.

3.2.1 Phase I

Phase I of this research was focused on developing the research questions and the *a priori* research model. We conducted three pilot case studies that were used to develop the *a priori* model conceived through the review of ERP, innovation management, and organizational theory literature. We identified several activities and key issues that were faced in the process of ERP institutionalization in the three ERP adopting organizations. The case studies also helped us in formulating the hypotheses for the variance component of this research, as they significantly contributed in enhancing our understanding of the ERP institutionalization process and its relationship to organizational characteristics.

The case studies in this phase were loosely structured and participatory in nature, as the researcher joined, on a part-time basis, the ERP support teams of the organizations studied. The case studies in Phase I were also used to develop the research protocol for the study which consists of several research instruments including the interview probe, check sheets, and questionnaire. Research instruments were found to be instrumental in preventing data overload and lack of comparability across cases in multiple case studies in the later phases. Case study details and outcomes of Phase I are discussed in Chapter 4.

3.2.2 Phase II

The second phase of the research was used to pretest the efficacy, reliability, and validity of the research protocol, which was comprised of several instruments such as charts, check sheets, probes, and a questionnaire. We were able to get good estimates of respondents' time for participating in the research, which was important in planning an efficient data collection process. We found that ERP managers were among the highest paid, but overworked, employees

in organizations. Getting these managers from multiple organizations to participate in the research was the biggest challenge for us.

The second phase helped greatly in improving the structure of the research. It helped us in pre-testing and refining the research tools. ERP managers in six organizations were interviewed in this phase. The main focus of this exercise was to improve the understandability of the questionnaire from the responding manager's perspective and check the validity of the questions. It was important to pretest the instruments as we found out that some of the academic terms were not understood well in practice. Several questions were reworded to increase clarity and understandability. A few questions that were not found to add much value were deleted from the interview probe and questionnaire. Details of the case studies and the results of pre-testing are discussed in Chapter 5.

3.2.3 Phase III

The third phase of this research focused on getting information to test and validate the *a priori* model. This phase focused on collecting data to test the hypothesis formulated in this study and to explain the relationships between organizational characteristics and institutionalization success. Field work in the third phase included data collection from 21 new organizations. While additional data was provided by some of the organizations which participated in the previous phases to fulfill the data needs of third phase. The research in the third phase was structured to minimize the respondents' time. We used the research protocol that we had extensively refined and pre-tested in the second phase of the research to ensure the validity and reliability of the data.

Each executive was interviewed for 50 to 60 minutes in the third phase and interviews were recorded and transcribed for analysis using N-Vivo. SPSS was used in the transcription and

analysis of quantitative data. The results and details of the third phase of the study are discussed in Chapter 6. We also conducted three review interviews with respondents from three organizations within our sample to discuss the results of our analysis in this phase. These interviews helped us in getting enhanced understanding of some interesting correlations observed in the study.

3.3 Case Selection

Careful selection of research subjects is crucial for any study as it places limits on the conclusions that can be drawn from the research as well as on the confidence level with which the results can be stated. Case study research is driven more by research objectives, such as theoretical replication of results, than by achieving a random selection and representation of a population. The sampling of case studies is conceptually driven and sequential (Miles and Huberman, 1994). Usually it cannot be wholly specified, but evolves as the fieldwork begins and is within the preset boundaries of theoretical framework and the limits of means and time. The theoretical framework helps in uncovering, confirming, and qualifying the basic processes or constructs that bind the study and also provides the criteria for case selections.

The primary unit of analysis in this research is the organization. Multiple case studies were conducted in three phases for this study, as stipulated by the research design. Both qualitative and quantitative data was collected by means of in-person and/or telephone interviews. We used a convenient sample which was sieved through the conceptual filters provided by the research model. Large Canadian organizations (more than 500 employees) in the post-implementation phase of ERP adoption were requested to participate in the research.

The replication logic used in this study is analogous to that used in multiple experiments (Yin, 1994). Each site was therefore carefully selected so that it either predicted similar results or produced contrasting results but for predictable reasons. Given our interest in observing the differences in the institutionalization process across two moderating variables size (large and very large) and sector (public and private), organizations with more than 500 employees in both public and private sectors that had implemented ERP systems were contacted. All these organizations represented fairly unique domains and mandates, giving us a good insight into the variance of challenges faced in institutionalizing ERP systems. The public sector organizations included federal, provincial, and municipal government departments; crown corporations; and publicly funded organizations, such as universities and hospitals.

Out of the 75 organizations contacted, 30 organizations participated in the study: three in the first phase, six in the second phase, and 21in the third phase. The respondents differed widely in their operations, businesses, strategies, and their time of initiation of adoption and experience with ERP. All the participating organizations are described in Table 6.1 in chapter 6. Names of the organizations are not disclosed because of the confidentiality concerns of the respondents.

3.4 Rigor and Reliability

While the relevance and potential value of case study research is very well accepted, it has been criticized for being unsystematic and lacking the rigor of surveys or experiments. Many researchers have called for adding methodological rigor to case studies and have made useful recommendations for improving the design, data collection, and data analysis in case studies (e.g., Benbasat *et al.*, 1987; Eisendhardt, 1989; Lee, 1989; Yin, 1994; Miles and Huberman,

1994). We use several of these recommendations in the research design to enhance the reliability and validity of this research. In particular, the guidelines for case study research provided by authors Eisenhardt (1989), Yin (1994), and Miles and Huberman (1994) were followed to enhance the rigor and reliability of this research.

A detailed case study protocol was designed, pre-tested, and used effectively in this research. The protocol includes multiple instruments, field procedures, and research design and analysis details that were used extensively to guide the research process. Numerous texts have recommended the case study protocol as a major tactic that helps structure the research, improve the data quality and completeness, and increase the external validity and reliability of the data collection process (Yin, 2003; Miles and Huberman, 1994). To achieve variance and greater understanding, organizations of different types were requested to participate in the study. For example, in the public sector our sample included publicly funded institutions such as universities and hospitals, and government departments and agencies at federal, provincial, and municipal levels.

3.4.1 Case Study Protocol

Case study research involves the systematic collection of relevant information about the phenomenon being studied followed by analysis of the collected information to answer the research questions. The case study protocol is a prime method used by researchers for increasing the reliability of case study research and is intended to guide the investigator in carrying out the study (Dube and Pare, 2003). Developing a case study protocol is considered an essential component for ensuring methodological rigor, particularly in multiple case studies. The case study protocol is more than an instrument or a questionnaire. A number of data gathering instruments, procedures, and rules can be incorporated into a case study protocol in the design

stage to make the case study research systematic and structured (Yin, 2003). It is a fairly detailed plan of the total research process. A higher level of operational details in the research protocol can help in better streamlining and controlling the research process. It keeps the research targeted on the subject of the study.

The case study protocol designed for this research included the following four main components: Overview, Field procedures, Instruments, Planned Interim Analysis, and Outline of Case Study Report.

3.4.1.1 An Overview of the Case Study Project

The overview concisely documents the background (theoretical and contextual) information of the project. It is identified as an important component of the case study protocol as it provides a handy theoretical reference for the researchers and aligns their efforts to the theoretical framework. In this case, the overview was very helpful in providing the research information asked by respondents seeking clarity on the purpose and value of research. The overview contained primarily the following components:

a. Case study objectives and research questions
b. Theoretical framework, hypotheses, and propositions
c. Role of protocol in guiding the case study investigator

3.4.1.2 Field Procedures

Properly designed and documented field procedures are essential for multiple case studies. The data in the case study research is collected in the field and in work situations primarily through interviews and observations. The data collection process in case studies, unlike laboratory experiments or surveys, is much less controlled. The nature of the interviews is much

more open-ended; researchers must cater to interviewees' availability and willingness to cooperate. As a result, in case study research, it is the behavior of the interviewer (researcher) that can be constrained for improving reliability and quality of data. This leads to a need to have explicit and well-planned field procedures. Documented and well designed field procedures not only help to constrain and standardize the behavior of interviewers but they also help the researchers in optimally utilizing the respondents' time and getting better quality and more reliable data. The field procedures in the protocol emphasize how to carry out major activities in the process of data collection. The major procedures used in this study include:

a) Gaining Access to Organizations and Interviewees

Gaining access to organizations was a prime concern. This made having explicit and well planned procedures for identifying the organizations of interest, approaching them, and soliciting data from them critical for the success of the research effort. In business research, this activity relies heavily on the ability of the researchers to communicate clearly and precisely with the key executives. They need to know precisely what the research is about and how they can contribute to it. The first step in this process was identifying sites for research based on the criteria dictated by the research model and subject requirements. The criteria used in this research for identifying research sites have already been discussed in the previous section. We scrutinized and searched several secondary data sources to evolve a shortlist of research sites. The results of this process also led us to several fields of information about the potential sites such as names, addresses, contact persons, and other details required to contact the respondents. Systematically listing the data sources and the key information fields about the sites is considered important by most texts on case study research as this information may often be needed at various stages of the project

(Miles and Huberman, 1994). A contact summary sheet illustrated in Appendix I, was used to consolidate and store information about each site in a systematic manner.

b) Research Introduction and Participation Request

Once the potential sites were identified, the researcher requested his contact person in the organization for reference to the ERP Managers. Subsequently, a formal request for participation was made through a formal email to the concerned managers in the short-listed organizations. This email was followed by a phone call to the concerned executive in the organization. Interviews were scheduled at the convenience of the respondents, once their consent for participation in the study was received. We preferred an in-person interview, but a telephone interview was scheduled in a few cases if an in-person interview was not possible.

c) Having sufficient resources while in field

All of the hard work done for getting access to the organization can be wasted if the researchers do not have the necessary resources to collect and store data when in the field. These may include recording devices, personnel computers, spare batteries, notepads, and several checklists or templates that can be devised to systematically store the data in a format easy for future retrieval.

In order to optimally utilize the respondents' time, researchers need to focus on an efficient and effective interviewing process. All the necessary information that can be assembled through secondary data sources must be compiled beforehand. For example, prior to the interview session with the ERP managers on the organization we used secondary data sources, including the website to gather background information of the organization and put it on a pre-

designed check sheet. This information included its line of business, financial overview, senior officers, major competitors, key products, and organizational structure.

3.4.1.3 Instruments

The research instruments form the heart of the protocol. In this study we relied on multiple research instruments as both qualitative and quantitative data was collected from both primary and secondary sources. We used an interview probe and a questionnaire for collecting primary data for the study in conjunction with a context chart, which was used to organize the context data that was collected from secondary sources.

3.4.1.4 Interview Probe

The interview probe consisted of substantive questions that reflected the actual enquiry. Several characteristics distinguish an interview probe from a survey questionnaire. First, the questions in the probe are posed to the investigator, not to a respondent. The questions were developed to serve as reminders regarding what information needs to be collected and why. In some instances, specific questions were developed as prompts in asking questions during a case study interview; however, the main objective of the questions in the probe developed for this study was to keep the researcher on track as the interview proceeded. The interview probe provided a linked list of questions of interest, notes, and the likely sources of evidence which was reviewed before and during each interview. The interview probe and questionnaire developed for this study is included in Appendix II. This probe was provided to each interviewee by email before the interview was scheduled.

3.4.1.5 Ethics Documents

Ethical research policies at Carleton University require each research project at Carleton to follow the tri-council ethics guidelines and get clearance from the university's ethics council before collecting any primary data. Each respondent was informed about the ethical code of conduct stipulated by the tri-council policy and was required to sign an informed consent form included in Appendix III. The informed consent was designed as part of Carleton's ethics committee clearance application package and was approved by the committee.

3.4.1.6 Context Chart

The meaning of complex organizational phenomenon is often embedded in the context and cannot be understood independently. Organizational efforts to institutionalize ERP systems have to be understood in the specific context of the ERP-adopting organizations, which cannot be ignored or held constant. A context chart was used to capture organizational context information from secondary data sources such as the website. To maximize the efficacy of the respondent time, we first gathered all of the contextual information about the organization was available through secondary data sources.

3.4.1.7 Questionnaire

The prime purpose of the questionnaire in this research was to gather the perceptions of the respondents as a quantitative measure of the independent variables for the variance aspects of the study. A self-administered questionnaire was used to measure the independent variables of the study on a seven point Likert-type scale. Measures for all the variables were developed based on existing instruments in the innovation diffusion literature, our review of the extensive literature

on ERP systems, and input from ERP experts. Table 4-4 in chapter 4 defines the constructs used in the study and lists their respective survey items.

3.4.1.8 Early Data Analysis

The final component of the case study protocol is the plan for early data analysis. Early data analysis has been recommended especially for case study research for several reasons (Miles and Huberman, 1994). It allows researchers to question their biases and assumptions which are highlighted in the process of analyzing the data. It allows the researchers to collect new data if gaps are observed or new information is required to test alternate hypotheses. Early analysis also facilitates production of interim reports that can be communicated as feedback to the various stakeholders in the research such as sponsors.

In early analysis, it is important that the researchers formulate the process of analysis before the data collection. At least some key methods must be identified beforehand that can guide the researchers in organizing the data and formulating interim reports. Data analysis techniques to be used in this study are discussed in the next chapter of this proposal. This element is generally neglected in most case study plans, as investigators do not think about the reporting format or audience until after the data is collected. Although there cannot be a fixed style for a case study report, most texts on case study research argue that the basic outline of at least the interim case study report should be part of the protocol as it facilitates the collection of relevant data in the appropriate format and reduces the possibility of a return visit to the case study site (Yin, 2003; Miles and Huberman, 1994). The early completion of an interim case report for each site is especially important methodologically for multiple case studies, as there might be a significant time difference between the completion of the first and last of the case studies being conducted. The researchers may find it difficult to recollect some of the

unstructured data of the earlier completed case studies if the report is written only at the completion of all the studies.

The data collected through the various instruments discussed in this chapter was used to develop the interim case report. The outline of the interim case study reports of this study consist of the following key components.

a. Case study organization's context pertaining to ERP institutionalization.
b. Status of ERP in the organization
c. Brief chronology and the description of the main events in the institutionalization process.
d. Detailed description of the major issues identified in the ERP institutionalization process of the organization.
e. Innovativeness of ERP institutionalization process in the organization.
f. Outcomes of the institutionalization process.
g. Attachments: Data Displays such as chronology, role and conceptually ordered matrices, specific logical models, references to relevant documents, and list of persons interviewed.

As the anonymity of the responding organizations in this study needs to be maintained for ethics considerations, organizations studied are referred by pseudonyms in the thesis. A sample interim case report is provided in Appendix V.

3.5 Data Analysis

The final component of the research design is the detailed plan of how the data will be analyzed. Most of the data generated by case studies is in qualitative form. However, the research objectives for this study stipulate the use of both qualitative and quantitative techniques

for analyses. Several authors have stated the importance of linking qualitative and quantitative data for enhancing the understanding of a phenomenon (e.g., Salomon, 1991; Miller and Fredericks, 1991; Miles and Huberman, 1994). Data analysis, both qualitative and quantitative, consists primarily of three major activities: data preparation, data examination and display, and analysis (Yin, 2003a; Schwab, 1999).

3.5.1 Qualitative Data Analysis

Qualitative data formed a prominent component of this study. Several interrelated procedures were performed to summarize and re-arrange the raw data and make it amenable for analysis in the data preparation activity. The first step involved transcribing the data which primarily included recordings of interviews with the ERP managers. The data was then coded and entered into the N-Vivo application.

Data examination and display was the next crucial step in the data analysis process. It involved two key processes: a) examining the key assumptions, and b) drawing descriptive conclusions from the data as the data is displayed during the examination process. Data examination may lead researchers to carry out certain transformations for making the data amenable to certain analytical techniques if some of the assumptions for those techniques are not observed in the examined data.

Data displays are primarily description-oriented qualitative analysis techniques that supply the basic material for explanatory analysis and allow researchers/readers to draw valid conclusions from the data displayed. We used the process of displaying data mainly for breaking it down, inspecting, formatting, standardizing, and rearranging it to start the search for meaningful descriptions, patterns, and relationships. The following three displays (partially

ordered displays, conceptually ordered displays, and case ordered displays) were found to be particularly useful in this research.

Partially ordered displays, as the name suggests, do not have too much order built into them by design. Minimal conceptual structure is imposed on these displays as the aim of these displays is to uncover and describe what is happening in a local setting (Miles and Huberman, 1994). One partially ordered display was used in this research: a context chart. It has been described in the previous chapter as a sub-section of case study protocol as it was used in the data collection process itself.

Conceptually ordered displays are described by Miles and Huberman (1994) as arrangements that bring together items that belong together conceptually. The rows and columns are arranged into either conceptually or empirically devised classes. In viewing case study data, conceptually ordered displays are very helpful in answering the research questions. They, cluster information in an orderly fashion, and facilitate comparing and contrasting information to generate meaningful understanding of the concepts as they occur in the field. Reading across a conceptually clustered matrix gives the researcher a brief profile of each case and provides the initial test of relationship between different variables. Reading down the conceptually clustered matrix allows comparison across cases. (Table 4-1) in Chapter 4 is an example of a conceptually ordered display that gives a comparative view of the three pilot case study organizations across several variables.

Case ordered displays provide a powerful way to understand the differences across cases. They are a type of conceptually ordered display that arrange data case by case, but the cases are ordered according to some variable of interest, so that the researcher can see the differences among high, medium, and low occurrences of the variable across cases (Miles and

Huberman, 1994). Table 6-2 in chapter 6 is also an example of a case ordered display where some of the characteristics of individual cases are tabularized. Several qualitative data analysis techniques were used for making inferences pertinent to the meaning and implications of the research investigation and for drawing conclusions about the managerial implications. The three techniques mainly used for analysis in this study are the following:

Content analysis is one of the primary and most popular techniques where the semantic content of the data is analyzed for the what aspect of a message. It can be broadly defined as a "technique for making inferences by systematically and objectively identifying special characteristics of the message" (Holsti, 1968, pg.608). Content analysis aids in exploring for patterns, explanations, and relationships among variables of interest.

Pattern matching is considered one of the most popular case study data analysis techniques (Dube and Pare, 2003). It employs a comparison of empirically based patterns across cases. If the patterns coincide across cases, the observed theoretical replication can help strengthen the internal validity of the case study (Yin, 2003a). In explanatory case studies, the patterns may be related to the dependent and/or independent variables of the study. Researcher may often find alternative situations in matching patterns in multiple case studies due to non-equivalent dependent variables and/or equivalent dependent variables but different independent variables. The strength of analysis in these cases lies in identifying all the reasonable threats to the validity of the explanatory logic.

Explanation building is a specific type of pattern matching that is used to generate hypotheses. It stipulates forming a presumed set of causal links to explain a phenomenon. These causal links are similar to the independent variables in pattern matching discussed in the previous section. However, these links are not stipulated *a priori* as in pattern matching. Yin (2003)

describes explanation building as an iterative process, which involves making an initial theoretical statement about the observed phenomenon and then comparing other details in the case so the proposition can be revised. This process is repeated as more information is added and the chain of evidence is expanded with new details. The process entails a gradual refining of ideas.

3.5.2 Quantitative Data Analysis

Quantitative data analytical techniques have been frequently applied to test theoretical models and propositions. These techniques have been widely used to draw statistical inferences, using probability theory to reach conclusions that transcend the relationships between variables in both natural and social sciences. Quantitative data was gathered using Likert-type scales and a self-administered questionnaire to measure the key determinants of organizational innovativeness that are used as independent variables in the variance model of this study. The data was coded into SPSS and examined for the accuracy and validity of some of the key assumptions such as normality, absence of outliers, and internal consistence. The accuracy of any research outcome is highly dependent on the quality of the data and sampling. In essence, all statistical techniques rely on some basic assumptions, such as absence of outliers, normal distribution of the residuals, non-correlation between the residuals, and no complete mutlicollinearity among predictors (Jaccard and Wan, 1996). Since the accuracy of the statistical testing techniques proposed to be used in this research relies heavily on some of these basic assumptions, it is imperative to ensure that those assumptions are complied by the sample prior to analysis. The relationship of organizational characteristics (independent variables) with organizational success in institutionalizing ERP systems (dependent variable) was then examined using quantitative data analysis. In the following subsections, some of the common data quality

issues - such as outliers, normality, and internal consistency - are discussed. The last subsection provides a brief discussion of correlation analysis.

3.5.2.1 Absence of Outliers

Outliers are data points that are very different from the rest of the data. Statistical procedures, particularly multivariate techniques, can be quite sensitive to outliers and the occurrence of outliers can significantly distort the research outcome and diminish the research contribution. They occur primarily due to data entry errors or subjects that are different from the rest. The outliers due to data entry errors can be identified by listing the data and checking to make sure that it has been read accurately. If the variable is approximately normally distributed, then z scores around three in absolute value could be considered as potential outliers, because in an approximate normal distribution about 99 percent of the scores should lie within three standard deviations of the mean.

3.5.2.2 Normality

Normality is a fundamental assumption in many popular statistical techniques that refers to the normal distribution of the sample data. In general, independent observations tend to approach normal distribution when sample sizes are large as stated by the central limit theorem. However, in cases of moderately high sample sizes, a test of normality becomes necessary prior to analysis. A number of data transformation methods have also been suggested in the literature that could be used to treat serious cases of non-normal data distributions (Cohen, 2001). For example, the square root or logarithm of the variable could be taken to reduce skewness.

3.5.2.3 Internal Consistency

Testing internal consistency is critical in social science research as most studies involve latent variables. Internal consistency is a measure of the degree to which the respondent's answer

is consistent across the measure items (Schwab, 1999). There are several ways to measure internal consistency, including test-retest in the same respondent, parallel testing using the different items to test the same knowledge domain, and test of the coefficient Cronbach's Alpha. As this research uses multiple point items as measurement constructs, the coefficient of Cronbach's Alpha can be applied as a test of internal consistency of latent variables where a higher score suggests a higher degree of internal consistency. The coefficient of Cronbach's Alpha can range between 0 and 1; if the coefficient of Cronbach's Alpha is above 0.6, it is considered as an indicator that the latent variable is internally consistent (Stevens, 1996).

3.5.2.4 Correlation Analysis

The data analytical techniques that were considered for the testing relationship of variables considered in this research include multiple regression and correlation analysis, path analysis, partial least squares, and structural equation modeling. All these techniques are frequently used in the social sciences for explaining relationships between latent variables and structuring theoretical models. However, some of these techniques are subject to the availability of a large sample size and could not be applied to this research since the sample size sought is not very large. This research, however, seeks to explore evidence of an interaction effect, if any, between the variables. Simple correlation analysis was used to determine the relation between the organizational characteristics and the success of organizations in institutionalizing ERP systems.

3.6 Concluding Remarks

In this chapter, we presented the research methodology used in this research. The multiple research objectives (process and variance) dictated a mixed methodological approach where multiple case studies were adopted. Our literature reviews also suggested the increasing

popularity of case study research; this is evident from an increasing percentage of case study based papers in the leading IS journals (Dube and Pare, 2003). Several studies were, therefore, available which provided methodological guidance for carrying out this research.

Chapter 4 Results Phase I: Research Questions and A priori Model Development

This chapter presents the results of Phase I of this study. In this phase, pilot case studies of three very large ERP-adopting organizations were conducted to: a) develop the broader research objectives into more specific research questions and b) develop the *a priori* model for this study. The pilot case studies were also useful in developing the research protocol and instruments used in the later stages of the study. This chapter is organized into four sections. In order to provide a background of case studies, the first section of this chapter describes the organizations, their ERP systems, and some highlights of the individual cases. The second section discusses the research questions. The third section presents and discusses the *a priori* model. Concluding remarks are provided in the last section.

4.1 Case Study Organizations

Three very large Canadian organizations (more than 10,000 employees) were identified for case studies in this phase. We studied their experience in institutionalizing ERP systems in the post-implementation phase. The main objective of these case studies was to explore and understand the phenomenon as it is enacted in its original settings. We used the grounded theory approach as described by Glaser and Straus (1967) in conducting the case studies in this phase of the study to develop the *a priori* process model. The data was collected through on-site interviews of six-eight managers in each site, and a review of available ERP documentation. These case studies were participatory in nature because the author joined the ERP support teams of these three organizations as a research student. Some highlights of these case studies are

discussed in this section and Table 4.1 provides the summarized profiles of these three organizations. The case studies contributed significantly to enhancing our understanding of the ERP institutionalization process and its relation to the organizational attributes. We have used the understanding to develop the research questions and the *a priori* model in the proceeding sections of this chapter.

Table 4-1: Profiles of Case Study Organizations

	Organization A	Organization B	Organization C
Type	Government Agency	Crown Corporation	Private Sector Corporation
No. Of Employees	More than 10,000	More than 10,000	More than 10,000
ERP Software	SAP	SAP	SAP
Why ERP?	Better Administration and Y2K	Process Organization	Integrating Enterprise Systems
Facilities Location	Across Canada	Across Canada	Across North America and Europe
Mandate	Governance and Implementation of Federal and Provincial Programs	Physical and Electronic Delivery Services	Research, Development, Manufacturing and Sales of Telecommunication Equipment

4.1.1 Organization A

The subject organization of this case study is one of the largest government organizations in Canada with more than 10,000 employees across Canada. This organization was created through restructuring efforts made by the Canadian federal government in the early 1990s. Like many other government organizations, it is the sole supplier of critical services to Canadians. The organization adopted SAP's R/3[4] software in 1998 to replace numerous legacy systems in the key administrative functions of HR, Finance, Materials Management, Procurement, and Estate Management. ERP adoption was motivated by a decision to replace aging legacy systems which were not Y2K compliant with advanced corporate systems that could not only extend some of the best business practices built within them for providing better administration, but were also Y2K compliant.

[4] SAP is a Germany based ERP vendor which currently leads the market for ERP systems.

The organization faced several problems in institutionalizing the ERP systems. The organization took several months to tweak and improve the system configuration and their IT infrastructure after going-live, before the systems could be technically stabilized. Even after technical stability was achieved, the new systems and their implications were not understood very well by the end users and several more months were taken until the ERP systems were semantically stable and routinely used.

We found that the ERP initiative was championed and supported by the IS function of the organization, but it received little support from the prime business units in the agency. Change management efforts were poorly planned and executed. The organization faced serious problems as employees lacked proper training on go-live and continued to use shadow systems based on Access databases and Excel spreadsheets for several months even when the systems were technically stable and working properly.

Some of the key initiatives taken by the organization to enhance technical stability included extending the contract of the system integration vendor (consulting company) for an initial operations period until the capabilities for support within the organizations were developed. The organization also instituted a center of excellence on ERP systems. Employees from the functional units were seconded to this center for an annual term. These employees brought functional expertise to the center of excellence and were developed as power users who consequently provided coaching to their colleagues in the functional areas when they went back to their respective functional areas. Eventually, as many of the respondents acknowledged, several benefits were realized and the systems were stabilized, but the process of institutionalization of ERP in this organization was a long and strenuous. The organization had failed to plan ahead for many difficulties it faced in making this major change.

4.1.2 Organization B

The subject of this case study was one of the largest crown corporations in Canada with more than 10,000 employees. This organization also provides critical services to Canadians and enjoys a sole service provider status for some of the services it provides. ERP adoption in this organization was motivated by a decision to replace multiple legacy systems with a single integrated enterprise system and a desire to transform the organization.

The organization embraced ERP systems as a way to introduce process orientation and a more effective business structure. The project stage was kicked off in the organization with a workshop on process orientation by a world leading business expert on process re-engineering that was presented to all its executive and senior managers. The organization adopted SAP's R/3 software in 2001 to replace numerous legacy systems in the key administrative functions of Sales, HR, Finance, Procurement, Materials Management, and Estate Management with an integrated enterprise-wide system that supported its key business processes end to end. The project was supported with a well-defined business case that included adequate support from the board for changing the organizational processes to achieve e-business and business transformation objectives.

The organization did well in learning from previous ERP adopters and achieved both technical and semantic stability within a planned period. Wherever possible, plain vanilla implementation was followed as a policy. Changes were made to the business processes with support from senior management, instead of customizing the software. The organization also budgeted adequately for change management and training. Some of the key initiatives taken by the organization to enhance technical stability included building advanced technical capabilities

for ERP support by forming a long-term strategic partnership with two major technology companies and the ERP vendor.

The organization also developed an ERP center of excellence where new modules were tried and tested before being introduced within the organization. The center also developed in-house training programs that were frequently extended to employees on request or when a new module was introduced. The organization also used the functional employees on the project team to provide support within their departments. These employees were developed as power users who were used as coaches when they went back to their functions. Institutionalization of ERP in organization B was a challenging process but good planning and management support made a shift to the new systems relatively easy for such a large organization.

4.1.3 Organization C

The subject of this case study was a large private sector corporation in the High-tech sector with more than 10,000 employees worldwide. ERP adoption in the company was motivated by a decision to replace aging legacy systems in the key administrative functions of HR, Finance, Materials Management, Sales, and Production Planning with advanced corporate systems that could support the growth while enhancing supply chain efficiencies. The industry was going through a phase of very high growth at the time the ERP adoption project was initiated in 2000. The company adopted SAP's R/3 software. However, the go-live in 2001 coincided with the start of a deep depression in the industry. While the go-live was smooth and the organization achieved technical stability quickly, it faced several problems in achieving semantic stability due to a severe resource crunch caused by the industry downturn. More than 50 percent of the employees were laid off in the downturn and several projects were cancelled.

We found that the ERP was supported by a well-trained team of IS and functional professionals in the organization during the post go-live period, with very little support from outside contractors. The organization did exceptionally well in managing the systems, given the resource constraints. End-user training suffered as several trainers and trained employees were either laid off or decided to leave due to the uncertain employment situation in the organization. Institutionalization of ERP in the organization was a strenuous process since the organization could not have planned for changes in the environment. Some of the key initiatives taken by the organization to enhance semantic stability included lunch-and-learn training sessions followed by point-of-use support. In addition to the lunch time presentations made to the employees, information resources, such as SAP iTutor[5] scripts (screenshots) were posted out on the company intranet for self-learning. End users were encouraged to call the well-trained power users to guide them through their problems.

4.2 Research Questions

We used the understanding gained through the case studies to develop more specific research questions from the study's two broad research objectives. The first objective of the study -"To explore and delineate the process of ERP institutionalization in ERP adopting organizations during the post implementation phase"- led to the following two broad research questions. These questions were identified during the case studies based on their pertinence in enhancing the understanding of the ERP institutionalization process.

1. How are ERP systems institutionalized in ERP-adopting organizations?
2. What are the challenges in ERP institutionalization and what strategies do ERP-adopting organizations employ in meeting these challenges?

[5] Simulation software provided by SAP to develop training material

We found that these questions were of significant interest to ERP managers. There was little research available that documented the ERP institutionalization process. The managers we interviewed were very interested in understanding the challenges faced by organizations in institutionalizing ERP systems. There was little guidance available on strategies that could be employed by organizations to cope with these challenges. As one of our respondents put it:

"The whole ERP methodology is to get you live. There is nothing in the books on how to pick it up from there. How to survive and how to grow your ERP implementation? No handbook provides us with information on going forward with the new system."

The second objective of the study -"To explore the relationship between organizational characteristics that are normally considered as determinants of a firm's innovativeness with the ERP adopting organization's success in institutionalizing ERP systems"- led to the following two broad research questions. These questions were also identified based on their pertinence in enhancing the understanding of why some organizations were more successful in institutionalizing their ERP systems in the post-implementation phase.

3. How do organizational characteristics (that are considered as determinants of a firm's innovativeness) relate to the success of institutionalizing ERP Systems in the post-implementation phase?

4. How do other contextual variables such as an organization's sector and size affect these relationships?

We found during the case studies that organizational characteristics and context significantly influenced the informational needs and the configuration of an organization's ERP systems. The information needs and system specifications varied depending on the organization's environment, form, size, culture, objectives, and activities. The effects of some of these organizational characteristics on organizational innovativeness and adoption of innovations are evident from the literature (Rogers, 1995; Damanpour, 1991; Kwon and Zmud, 1987).

However, the affect of organizational attributes on institutionalization of innovations in the post implementation phase has not been explored.

These questions were also of significant interest to ERP managers who were often puzzled when some of the reported ERP management best practices failed to work for their organizations. For example, managers in the organizations we studied showed keen interest in knowing "how the ERP institutionalization process in other organizations differed from their organization." Public sector managers were particularly interested in understanding how private sector organizations fared. All the three organizations studied in this phase were very large organizations (more than 10,000 employees) but ERP systems are also popularly used by medium-and-large-sized organizations. We added the size moderating variable as we were interested in exploring whether the effect of characteristics differed across relatively smaller organizations.

4.3 A Priori Model

The *a priori* model developed for this study consisted of two related but distinct components: a process model and a variance model. These components, which were driven by the two study objectives, were reconciled to develop the ERP institutionalization model that provides enhanced insight and understanding of ERP Institutionalization. The model provides a basis for further detailed exploration, refinement, and validation through data collected from surveying the experiences of more organizations in the course of this study.

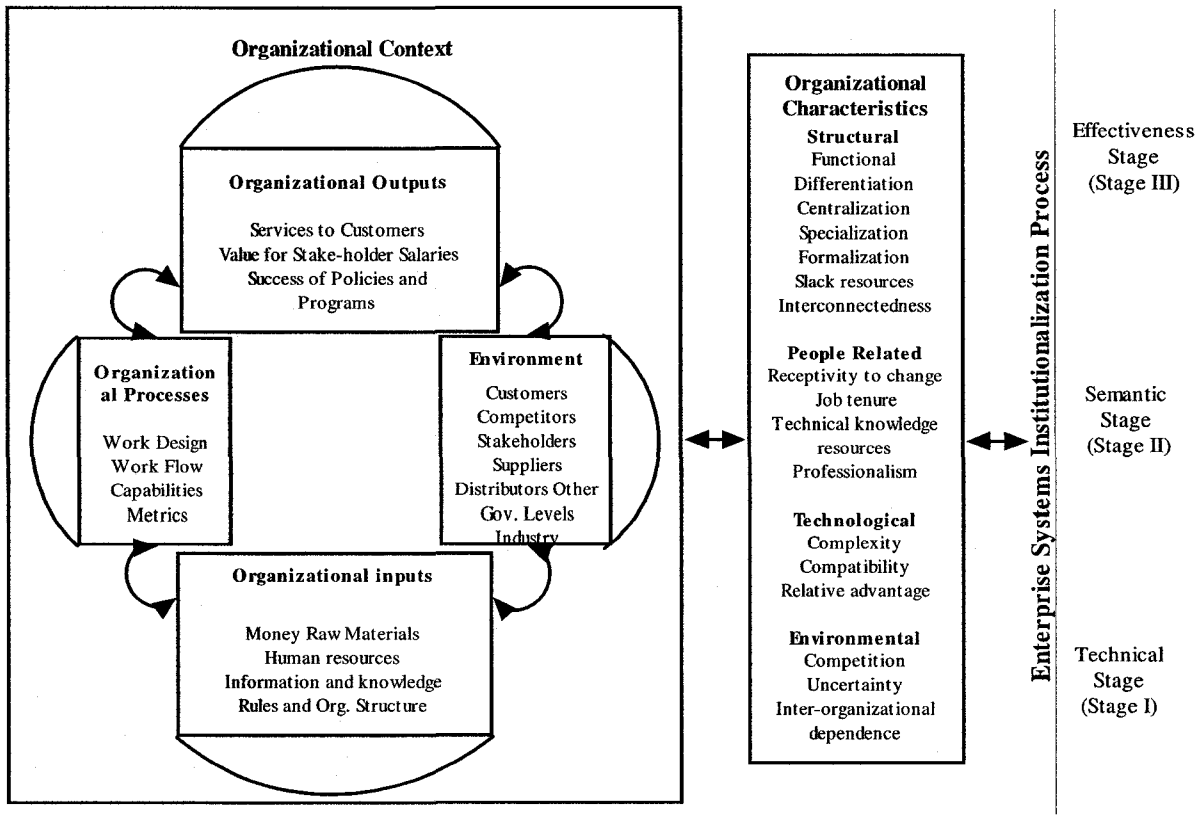

Figure 4-1: ERP Institutionalization Model

4.3.1 A Priori Process Model

Analyzing the data collected from the three case studies, we found that the ERP-institutionalization process in the case study organizations could be mapped into three broad stages: Technical, Semantic, and Effectiveness (Figure 4-1). These stages were literally in line with the three phases coined in communication theory by Shannon and Weaver (1948) and could be demarked by distinct ERP events: First Go-live (first instance when ERP software is used in the organization), Technical stability (a state after go-live when major technical issues have subsided), Semantic Stability (a state after achievement of technical stability when adequate understanding of ERP systems in the organization is developed and routine usage is achieved),

and Decline/replacement (when the systems start to lose their value proposition and are gradually replaced). The four ERP events identified to demark the stages were further qualified and described with the help of the respondents in the second phase.

4.3.1.1 Technical Stage

The technical stage was identified as the initial period in an organization's post-implementation experience occurring between first go-live and the achievement of technical stability. First go-live was the instance when ERP software was put to use in the organization for the first time. Technical stability was the state when a majority of the high-risk technical problems, which hindered the use of the systems, were resolved.

Managers in all the three cases associated the first go-live with the initiation of the post-implementation phase of ERP systems in their organization as systems were switched on for use in the organization. The organizations having undergone a major change saw continuance of several challenges and problems associated with the move to the ERP environment after go-live. These issues, both technical and organizational, posed significant risks to the working of the organization and created an environment of uncertainty. However, in the period occurring immediately after go-live, organizations were focused first on resolving the major technical issues and assuring that at least the basic functionality of the systems was available to the users.

ERP support teams in the organizations were stretched with a very high number of technical problems and a heavy backlog of work. As one of the ERP support managers in the organization C commented

"Our elation of going-live on time and within budget was soon drowned with more than 3000 technical issues being raised in the first week itself."

The predominance of technical problems prompted us to call this stage the technical stage. Managers in all three case study organizations identified this period as crucial and challenging. Major problems in this early phase were mainly related to the conversion of organizational processes from legacy systems to the new system. The focus of the organization was on overcoming these problems by resolving bugs, fine-tuning the new systems, establishing a system-infrastructure fit, and enhancing the new systems wherever absolutely necessary. The goal was primarily to provide a running system and to minimize business disruption by resolving the major issues that were primarily technical in nature.

Table 4-1: Technical Stage Summary

Stage Description	Major Challenges	Key Coping Strategies
Critical period immediately after go-live. The systems are new to the organization and high technical disorder exists. It ends with achievement of technical stability. High business and technical disorder persists Organizational focus is on resolving major technical issues	High number of technical issues	Providing additional resources
	Communication and change management	Communication through multiple modes
	User training and support	User handholding and coaching, point of use support

Major Challenges and Coping Strategies

Both the ERP users and the support staff in all three organizations were awakened to a new organizational reality as they are now required to work with new systems and modified

processes. The support staff faced a barrage of technical issues along with many calls from users just finding it difficult to navigate their way through the new system. Several technical challenges were uncovered post go-live. For example, in organization A, which had offices spread across Canada the response time for the system was very slow. The employees had to wait for several minutes after giving a command. The organization faced this challenge because much of its IT infrastructure, though theoretically compatible with the new systems could not provide the service level that was expected. Organization C found that many of its business processes were not supported by the new systems at that time; for example, the systems could not allow sales of products until the bill of materials was qualified. However, in this organization's industry the prevalent practice was to sell products that were still in the Beta stages of development.

The turnover of key project employees complicated the situation of the support team further in all the three organizations. There was a prevalent ERP skill shortage at the time these organizations implemented their systems. All of these employees were hard to replace and took valuable contextual knowledge with them. Both positive and negative stories about the new systems emerged about the system. Managers found that several of the negative stories about the system not working had very little basis in fact. Managing the rumor mill was difficult, but curtailing the negative stories was important as they affected end user morale. End user training and support provided prior to go-live was found inadequate in all three organizations, as a major percentage of support calls were found to be from users not able to navigate their way through the systems.

All system development activities were put on the back burner; only in critical situations were any changes made into the system. The workload of both users and the core project team in

Stage I increased, which gave managers a significant challenge to motivate them. Particularly, in organization C, employees were concerned by ongoing layoffs as part of organizational cost cutting measures. The comparatively lower pay structure of the public sector organizations A and B compared with the private sector caused a lot of turnover of skilled employees. A number of skilled employees were retained by the public sector organizations as independent contractors and these employees could extract a higher remuneration, as the position was no longer subject to limits posed by old job classifications.

Communication to the organization about changes and promoting positive aspects of the systems is important in this stage of institutionalization. We found that it is important that communication should also include what action people should be taking and the implications of those actions. It is important to document the changes made to the processes at all ERP stages as inadequate documentation became a problem for the support team at a later when a bug appeared or a new release was implemented. In complex organizations where information abounds on many critical issues, the use of all lines of communication becomes important. The end users in all three organizations valued direct communication with ERP experts in the organization as the best means of communication. However, the difficulty in establishing direct communication varied between the three organizations. It was more challenging in Organization A than B and C, where the less bureaucratic corporate structure provided relatively more flexibility in moving people across departments.

Organization B created ERP champions in all functional teams who were not only critical in interpreting and personalizing ERP related information for their team members, but also provided a direct link for the team to ERP-related resources. Various functions - such as engineering, manufacturing, finance, purchasing, and customer service - were separately located

and also had significantly different perspectives. The role of ERP functional area team champions was found to be significant due to the advanced specialization existing in the organization. As the general manager responsible for change management commented: "These champions provided a one-to-one and personalized communication link."

Organization C used key or super users who were the functional representatives on the project configuration team as their direct link of one-to-one communication with the system end users. These key users also acted as coaches and helped the end users become comfortable with the system when the system went live. Organization A used ERP consultants who were embedded in the organization to help end users; however, as these were outsiders to the organization they were not very familiar with organizational processes and the organization faced significant communication problems. Later, the organization created an ERP excellence and resource center where employees were seconded from their department to the IT group for a term. These employees were expected to champion ERP in their respective departments after their term with the IT group was over.

Training in Stage I was largely focused on developing the capability of users to use the systems; handholding and coaching was often required to expedite the process. Not enough time was budgeted for training before going live, and training was carried out without organizational data. As a result, users found significant differences in their work environment from the environment they were trained on. All the organizations realized that training was extremely important for institutionalization and made efforts to provide more funding then initially budgeted in the business plan. Organization A found significant difficulties in getting additional resources for training, which were not budgeted. Organization C found difficulties in scheduling training. Due to the cost-cutting efforts in the organization a number of positions were

eliminated, which made it difficult for employees to get away from their routine activities and attend training.

4.3.1.2 Semantic Stage

The predominance of understanding-related and organizational problems in this stage prompted us to call it stage semantic stage. We found that several problems persisted even after the systems were technically stabilized. Most of these problems were related to an inadequate understanding of the systems, developing a support structure, unsupported processes, and changes that were not properly enforced. It took the organizations some time to develop an adequate understanding of the systems so that the new systems functioned smoothly. The state when adequate understanding was developed within the organization is known as semantic stability. The semantic stage was identified as the period of an organization's post-implementation experience, occurring between the achievement of technical stability and the achievement of semantic stability.

In this stage, the systems have largely lost their imported-from-outside character. The technology has stabilized and the core team faces fewer technical issues. The new systems and their concepts have become clearer to the organization's members, but there is still a high level of organizational disorder due to inadequate understanding about the new systems and their support policies. The organization largely faces semantic problems, related to the clarification of roles, misunderstandings, and inappropriate distribution of resources. Stable arrangements are made as the ERP systems get embedded into the organizational structure and resources are re-allocated to balance new processes. Restructuring or redefining of some processes is taking place as the inefficiencies in new processes are identified. Some new roles or sometimes even new

departments are created. Organization in this stage experiments with the new systems to explore the permissible degrees of freedom.

The organization tries to generate a fit with the systems, and build and leverage process expertise. New rules are made and new norms emerge. Users master basic ERP skills and a need for advanced training to develop skills such as reporting is seen. Organizations need specific research in this stage on how to reduce the organizational disorder induced by ERP implementation. Efforts are made to teach the organization members the optimal use of the new capabilities. Using role-specific training and creating job aids is important for increasing an individual's effectiveness in performing a role. Some benefits of the new systems are realized in this phase, e.g. the visibility of processes across the organization is improved, tighter financial control is exercised, and disputes on payment with vendors and customers are reduced.

Table 4-2: Semantic Stage Summary

Stage Description	**Major Issues**	**Key Coping Strategies**
Period between achievement of technical stability and achievement of semantic stability Organizational focus in on establishing a better understanding of the systems to provide semantic stability.	Organization-system fit	Developing matching skills through retraining.
	Process re-engineering	Build process expertise
	Enforcing new rules and norms	Leadership and change management

This stage was found to be critical in realizing the effectiveness of ERP by matching human skills and software system capabilities. The organizational acceptability of the systems initiatives has increased as employees and managers came to understand and know the systems better. This was also evident from some of the comments from the organizational members interviewed. One of the HR managers in Organization A responsible for employee motivational initiatives in the organization, such as commending employees with gifts on completing 15 years of service, found that this component of her job has become highly simplified. She could now be automatically reminded through the workflow program when an employee was completing the 15 years, where the employee was located, and what category of gift the employee was eligible to get. She could also order the gifts through pre-configured vendors and notify the people concerned, such as the employee's supervisor and colleagues for the commendation ceremony. Previously, she would need to collect the employee information from the payroll department, which was often not adequate as employees receiving a salary from one department could be working in another location. Further she would need to order the gifts. This particular manager, much of whose time was spent in this one activity, could now initiate other motivational programs.

Major Challenges and Coping strategies

However, there was still continued resistance to adopting the new systems from various pockets in organization A. A number of key managers in the functional units continued to use their preferred shadow databases and systems, which lead to a number of instances of data integrity losses in the ERP system. Organization A conducted a series of focus group interviews of managers and employees where system capabilities were presented and participants were

asked to provide feedback on the problems of utilizing those capabilities. The observations in the focus group interviews, which provided several examples of how the new systems were improving the work flow and business processes, were then shared with the employees in all departments.

Organization A also brought in a senior executive from industry, who had significant experience in IT and change management, to lead the project and institutionalize ERP. This person was responsible for introducing programs such as focus group interviews for identifying skill gaps, system gaps, and increasing user buy-in. We found that there were less instances of organizational resistance in the semantic phase in Organization B, which could be attributed to continued senior management commitment to the success of the program and more centralized authority in the organization with the senior management. There were also some examples of improved productivity in organization B. One of the managers responsible for making sales calls commented that his team could now make more sales calls, since the time needed to input and retrieve data was significantly reduced and the employees had enough time to make more sales calls. Efforts were also made in all three organizations to synchronize their systems with those of their suppliers and customers. While a number of intangible gains were obvious in terms of information visibility, the performance metrics used in the organizations were not sufficient to capture direct gains due to ERP adoption. Organization B, the organization of the three organizations studied that had made maximum funding commitments to the ERP initiative, was also the most pressed by their management to account for business benefits derived from the initiative. Organization B had begun the process of developing a balanced scorecard for managing the tangible and intangible business benefits from ERP adoption.

Organization C had its own share of challenges, which could be mostly attributed to some of its processes not being directly supported by the system and the scarcity of resources due to a general downtrend in the industry. The organizational drive for cost cutting left the core team strained for resources, allowing little space for pro-active development; most of the team's activities were focused on critical issues. Given the highly centralized nature of the organization, it was relatively easier for organization C to overcome any resistance to change with the intervention of senior executives who formed the steering committee. Some of the processes in organization C could not be directly matched to the ERP system. For example, the organization, being in the high technology sector, often sold its products to customers in the beta stage of development. However, the ERP system could not invoice the products until the bill of materials had been qualified. The organization found this was a significant challenge, as beta product sales had to be accounted separately in the legacy environment until ERP experts helped worked out a solution to accommodate accounting for beta products in the new environment.

Some serious gaps in both software system capabilities and human skills were identified in all three organizations in Stage II. Efforts were made to enhance both these key ingredients of ERP systems effectiveness. A number of system enhancement projects were also taken up in both organizations. Several such happened when Organization A initiated the employee HR portal, where all employees could manage their HR information through a web-based user friendly interface, and Organization B introduced data-warehousing tools for advanced analytical applications. Additional training was provided in both organizations to enhance employee skills.

In Organization A, the first set of people seconded to the ERP excellence center went back to their department to coach other employees while they were replaced by new people in the excellence center. Organization B enhanced their employees' skills by introducing training of

advanced analytical capabilities and reporting where required. Organization C, which was strained for resources, used the expertise of their key users and project team members effectively by developing job aids and tutorials on various processes using simulation tools to help employees. These tutorials and job aids[6] could be easily accessed from the company intranet and were regularly updated by the key users to reflect any changes made in the system. Specific problems were addressed in one-to-one communication and the new learning developed in this process was incorporated in the job aids and tutorials.

4.3.1.3 Effectiveness Stage

The effectiveness stage was identified as the period in an organization post-implementation experience occurring after semantic stability had been achieved. In this stage, the ERP systems were incorporated into all the projected activities of the organization. The organization focus is on achieving effectiveness of the new systems by using them to improve their value creation process. The stage ends with replacement/decline of systems.

The new competencies are developed, and, with the help of redefined business processes, the organization is able to improve its performance on various operational and customer measures. ERP benefits are reflected in its competitive positioning. The organization is able to increasingly use the system for decision-making, and the effect of ERP implementation in improving the outputs or reducing the inputs can be measured if the appropriate metrics are developed by the organization. The technical issues are reduced to general and routine maintenance or evaluating complimentary systems or issues with upgrades or ERP patches provided by the vendor to resolve bugs identified in the system. Efforts are made to extend the ERP capabilities as users become more competent and complementary systems and technologies

[6] Check lists, routines, process flows etc. were developed to help users in executing their jobs efficiently.

are added. Technical and organizational disorder is reduced as technological issues have been resolved, the organization has been restructured, and new roles have emerged with new norms and rules for governing the organization. The organization finds synergies in its activities with new systems and achieves value in use.

Some impacts on outputs were observable in the semantic phase such as the ability of the HR manager in Organization A, who was mentioned above to perform better or the ability of the sales team in Organization B to make more sales calls. For example, Organization C found savings in lowered inventory costs and improved processes as the new system allowed direct consignment of outsourced materials from suppliers to customers while previously these materials had to be unnecessarily shipped to its premises and then shipped to the customer. However, very few of these indicators of impending transition of the organization into Stage III were observed in all three of the organizations at the time of data collection. Organizations were still dealing predominantly with the issues of enhancing the system and human capabilities to better realize potential benefits. Hence, we could conclude that the effectiveness stage was yet to be achieved in all the organizations.

Table 4-3: Effectiveness Stage Summary

Stage Description	Major Issues	Coping Strategies
Period after semantic stability is achieved until decline/replacement Most potential benefits are realized in this stage Organizational focus is on enhancing the effectiveness of the systems	Managing upgrades	Testing for integration
	Enhancements and add-ons	Prioritizing
	Continuous improvement	Introducing self-serve portals, Changes made in the organizational structure

Major Challenges and Coping Strategies

While the major technical problems and understanding issues that were prominent in earlier stages had subsided, organization faced several challenges in the effectiveness phase. Handling upgrades was a prominent issue, which was highlighted by managers in all three case study organizations. The upgrade handling was a particularly difficult issue for Organization A, which had introduced several customizations in the software to meet some of its specific needs. Each time an upgrade was implemented, the organization had to undergo a tedious process of testing to ensure that its customized changes were not impacted.

Managing enhancements was the next big challenge for ERP managers. We found that organizations had staged their implementations in multiple phases, which implied that additions and enhancements were made to the implementation in later stages. Enhancement projects needed to be prioritized and resourced. Organization C, in particular faced significant difficulties in managing enhancements due to severe resource constraints. Managers in Organization B particularly found that getting resource commitments from the functional managers, in terms of their employee time, was very difficult and enhancement projects were frequently delayed due to the unavailability of functional employees.

Continuous improvement of the systems and infrastructure, and the support provided by the organization was another major challenge faced by the organization in this phase. Improving the support was a major issue. As the organizations moved to regular operations, ERP managers were required to reduce costs of operations while improving support quality and service levels. We found that the organizations having lived through the turbulent technical and semantic

phases had, over time, considerably developed their skill-sets and support infrastructure. They tried to manage the frequency and time of applying upgrades so that the risk of disruption was minimized. Organization A, which was most affected due to its initial customization strategy, gradually got rid of several of the customized features so that integration testing after upgrades was minimized.

Enhancements were approached with better planning and buy-in from business leaders. Senior management was involved and apprised about the time commitment of functional employees. Functional managers were required to free the key employees for their assignments related to system testing as the requirements were placed in the formal process of resource allocation in the organization. All three organizations undertook a periodic review of their systems and the support management policies. Continuous improvement initiatives were governed through these periodic reviews that were undertaken by a senior management committee.

4.3.2 A priori Variance Model

The case studies also provided support to our proposition that organizational characteristics affected the institutionalization process in respective organizations. Variances in the organizations, ERP systems, and their institutionalization process can be explained as due to the variance in their distinctive value creation process and the context in which they operate. The organizational context in which the ERP systems are institutionalized includes the level of investment needed in change management, learning curves, opportunity costs, and so on. For example, there was a gradual and difficult learning process in Organization A which had a high degree of formalization and faced high resistance to change. A core implementation team

member responsible for change management in Organization A also expressed her frustration on less interconnectedness:

> "Business units are like independent kingdoms with their own ways of carrying out a process and command structure: each one would like to amend the practices supported by the system to their existing ways."

Both organizations A and B had highly unionized environments where any potential management decision leading to change in the work environment or job loss for the members was resisted. The organizations could lay off employees only in extreme cases due to strict contractual clauses in the agreement with the unions. Organization B's union was generally regarded to be one of the toughest in the country as one of the senior executives in the organization stated, "We can but only take a path to natural attrition as a method towards leaner organization." On the other hand, Organization C, which was less formalized, also faced challenges in learning new processes. However, their difficulties could be attributed more to the complexity of the new systems and its associated learning. In this section we develop the *a priori* variance model by adapting the classification of organizational characteristics given by Tornatzky and Fleisher (1990) for this study. We add another category (people related attributes) to Tornatzky and Fleisher's framework to take into account its importance as observed in the case studies. As well, only those variables that were considered theoretically significant in the context of ERP systems are included in the model (Figure 4.2).

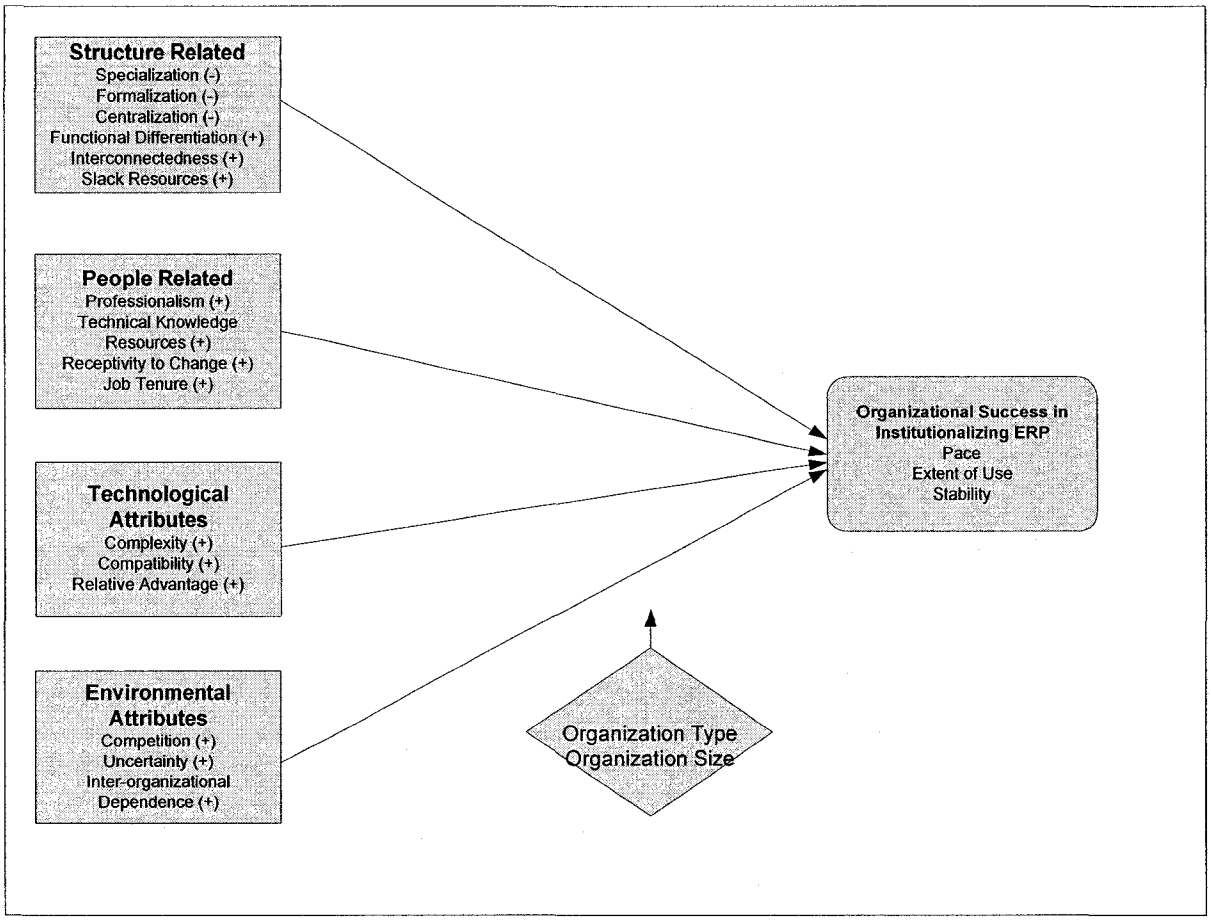

Figure 4-2: ***A priori*** **Variance Model**

4.3.3 Dependent Variables

Most organizations adopting ERP systems have business transformation objectives associated with their ERP programs. As a result, the success of ERP systems is often tied to achieving larger business benefits through transformation. However, as Quattrone and Hopper (2001) argue, the implementation of ERP systems signifies a change in the systems but not in the organization. Organizations change when they transform their structure and operations using the adopted systems. Institutional theory (DiMaggio and Powell, 1983) suggests that institutional environments impose pressures on organizations to appear legitimate and conform to prevailing

social norms. The institutional environment imposes structure on individual organizations either because of being taken for granted or because it is considered the proper way to organize for normative approbation or necessary in order to obtain resources. Applying this theory in the business context, institutional pressures presumably motivate firms to pursue activities that will increase their legitimacy and cause them to appear in agreement with the norms of their business environments (Oliver, 1990; Scott and Meyer, 1983).

ERP institutionalization, thus, occurs when the organization changes through the enactment of new rules, norms, and routines. The organization acquires new knowledge and the behavior of its actors complies with socially negotiated organizational reality. For instance, institutionalizing an ERP system may transform the way payables and receivables are treated in the adopting organization. As they become more visible, managers are forced to treat them with more urgency, thus leading to more efficient financial processes.

We adopted the success of an organization in institutionalizing the new systems as the dependent variable of this research. However, terms such as success and failure are always debated in the literature as they are multi-dimensional and relative concepts. It is very difficult to define them comprehensively. People can legitimately use a number of different definitions of success. For example, one can define success in terms of budgeted costs and time (did the organization succeed in institutionalizing ERP systems within estimated time and costs?). Or one can look in terms of business results (did the organization succeed in realizing its business goals for the initiatives?). Success may also look very different when examined at different points in time, on different dimensions, or from different points of view.

The success of an organization in institutionalizing ERP systems is clearly a multidimensional and relative concept. It is relative to the time at which it is assessed and the

organization's unique objectives. Two organizations with identical improvements in inventory carrying costs can be judged at two different levels of success with respect to ERP institutionalization if the first organization's goals for the ERP systems were to improve only its inventory carrying costs, and the second organization's were to achieve an increase in market share. At the same time, an organization's goals, taken alone, make a poor standard against which to judge success. An organization's goals may be insufficiently ambitious if they are compared to the inherent capabilities and how well the organization needs to perform considering its competitive position. For example, a business organization that is losing its market-share because it cannot promise the availability of its products to its customers in time would be short cutting its objectives if it adopted ERP systems solely to solve the inventory management problems. It would need to integrate its internal and supply chain processes so that shortening the product development lifecycle is also possible with concurrent product development activities and early involvement of suppliers.

The argument is not that one definition of success is inherently superior to another but it is not possible to achieve all facets of success. We stress that it is the job of the executive leadership to define success selectively and estimate it by using a set of key questions that are based on the perspective of their organizations and ERP objectives. To accommodate the multidimensionality and relativity of success in the organizational initiative from the adopting organization's perspective, we operationalize *organization's success in institutionalizing ERP systems using* three dimensions to take multidimensionality and relativity of the organizational success in institutionalizing ERP systems: Pace of Institutionalization, Stability of Institutionalization, and Extent of Institutionalization. These dimensions are discussed below.

Institutionalization is presumed by most researchers to occur along the S-shaped curve that depicts the diffusion path (see Figure 2-7 in chapter 2.). Time scales represent a critical element on the institutionalization curve. Lawrence *et al.* (2002) use Pace of Institutionalization and Stability of Institutionalization to represent the two temporal dimensions of the institutionalization process. They map the time dimensions to percentage adoption in their paper and argue that the institutionalization process can vary in different organizations based on the approach and mechanisms used for institutionalizing innovations. However, the wide variance in the realization of potential benefits of the same underlying technology makes a focus on the extent of institutionalization important for assessing benefit realization. We add the extent of institutionalization as the third dimension of institutionalization success. The three dimensions of institutionalization success are depicted on the ERP Institutionalization curve (

Figure 4-3).

4.3.3.1 Pace of Institutionalization

The variance in the rate at which innovations institutionalize makes a focus on the pace of an institutionalization process important. We use the definition given by Lawrence *et al.* (2002) and define the pace of ERP institutionalization as the length of time taken for ERP systems to become institutionalized in the organization.

4.3.3.2 Stability of Institutionalization

Once institutionalization has been achieved, the length of time it will remain in effect is known as the stability of institutionalization. We use the definition given by Lawrence *et al.* (2002) and define the stability of ERP institutionalization as the estimated time firms expect the ERP systems to remain in service for them.

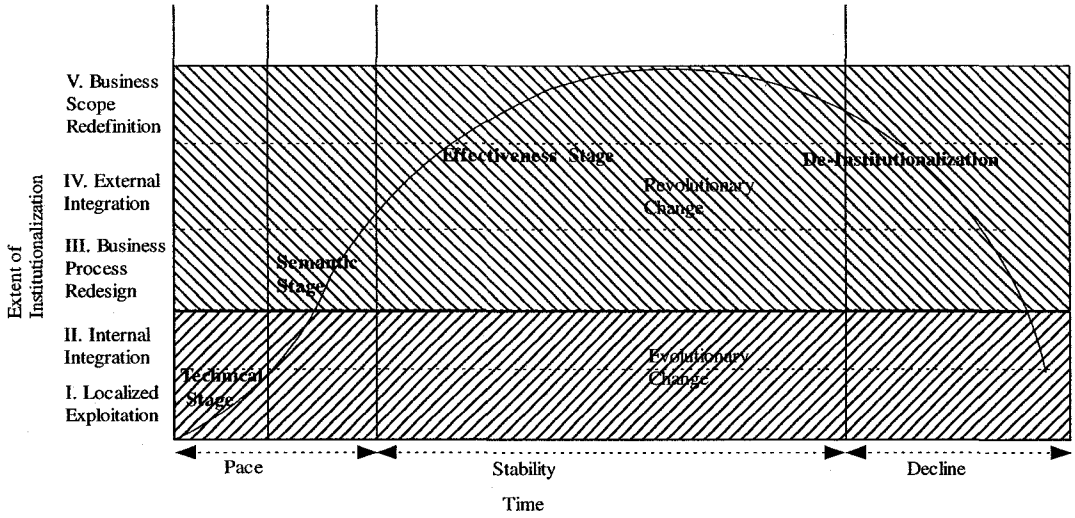

Figure 4-3: ERP Institutionalization Curve

4.3.3.3 Extent of Institutionalization

We define the extent of institutionalization considering the outcome of ERP systems in terms of business transformations using the IT-enabled business transformation framework suggested by Venkatraman (1994). Firms adopting ERP systems can improve their existing business processes by realizing the efficiencies and improved technical functionalities of the new systems. However, ERP systems offer more opportunities than just technical improvement. Organizations adopting ERP can significantly change their business practices by integrating their supply chains or by offering improved services to customers. While the higher levels of transformation indicate potentially greater benefits, they also require a correspondingly higher degree of effort in terms of institutionalizing the new systems and associated changes in organizational routines, such as logic of structuring, reporting relationships, performance assessment criteria, and informational flow.

Figure 4-3 represents the extent of institutionalization in five broad levels represented by horizontal lines. The five levels are further categorized into two groups based on whether the transformational effect of ERP systems on the organization's business is evolutionary or revolutionary.

Group 1: Evolutionary

Level I Localized Exploitation: The first level is the basic one for leveraging ERP functionality within an organization. The systems in this level are deployed in isolation and are not integrated. The result is minimal learning and change as the ERP systems are partially deployed primarily to replace and/or enhance legacy systems in response to operational problems and challenges in the functions.

Level II Internal Integration: The second level is the logical extension of the first. It reflects relatively more systematic efforts by organizations to leverage ERP system capabilities. This type involves the increasing interdependence of organizational roles by introducing interconnectivity, interoperability, and integration of processes. Organizations adopt more than one module of ERP and integrate them.

Group 2: Revolutionary

Level III Process Redesign: The third level reflects the view that benefits of ERP functionality are not realized if superimposed on existing business processes. ERP adoption can significantly alter some of the basic principles underlying many of the existing business processes in the organization and may require significant process redesign and re-engineering. The third level represents a systematic response to leverage potential of ERP system capabilities

throughout the entire business process by changing business processes for potential ERP benefits. This involves a redesign of business processes as mandated by the ERP best practices.

Level IV External Integration: The first three levels focus on evolving the business systems in the organization by employing new advanced technologies and associated changes in the internal routines. These levels assume that the boundaries of the focal organization are given. Even when there is a technical functionality extended by the new systems for integrating systems with those of external organizations - such as suppliers, customers, and other intermediaries - the business activities across these different entities are not altered. The fourth level not only subsumes the lower three levels, but also includes the redesign and change in the organization's exchange with multiple participants in its business network leading to integration of inter-organizational systems.

Level V Business Scope Redefinition: The fifth level of transformation is achieved when firms redefine their business scope significantly and create a more flexible and effective business organization by exploiting and leveraging the information processing capability of the ERP systems. Organizations achieving this level are able to change their business models by leveraging the new system capabilities and thus generate additional revenues and increased profit margins.

4.3.4 Moderating Variables

We propose the use of two moderating variables, organization type and size of the organization, to identify if there are any differences in the effect of independent variables on dependant variable across organizations of different types and sizes. Organizations of all types have adopted ERP systems to respond to changes in their information processing needs and

environment. However, organizational factors may unequally influence the institutionalization of innovations in organizations of different types, as the inter-organizational context and the industry or sector in which the organization is located influence its needs (Van de Ven, 1986). We can distinguish mainly based on contextual variables such as: sector, inputs, outputs, culture, and environment. However, for this research we will look for the differences across public and private sector organizations.

Similarly, the size of the organization may also influence its ERP needs. Organizations adopting ERP systems range from those with a few million dollars in annual revenues to those with billions of dollars. However, studies indicate that organizations with different sizes approach ERP implementations differently across a range of issues (Mabert *et al.,* 2003). We will investigate how organization size influences the relationship of the independent variables in the study with the dependent variables.

4.3.5 Independent Variables

Organizations adopt innovations, such as ERP systems, in order to respond to changes in their internal and external working environment (Damanpour, 1991). Despite similarities in underlying technology, the ERP instances in organizations can differ significantly due to differences in the adopting organizations. Organizations have evolved into many forms - such as business enterprises, state-owned companies, government departments and agencies, charities and voluntary bodies, mutual societies, clubs, and trade unions. Organization theory literature provides many ways of classifying organizations according to purpose, structure, stages in the life cycle, management style, and task complexity (Jones, 1999). While there may be commonality in activities - such as statutory account reporting, human resource management, and procurement - there may be many differences in the way these activities are executed in

different organizations. For example, an organization's business processes may vary depending on whether it makes discrete products or it provides services. Similarly, variances in organizations may be observed with respect to the business environment. In the public sector, where one of the prime objectives is maximizing the value of tax dollars spent while being citizen-focused, there are many distinctive processes that could be attributed to the organization's value creation process.

A number of contextual factors have been identified by both empirical and non-empirical studies on innovation and IS adoption that affect the successful adoption of innovation in organizations and/or predict organizational innovativeness. We selected some of those factors identified in previous research as determinants of innovation adoption to explore their affect on the success of ERP institutionalization in organizations. The organizational factors (characteristics) affecting institutionalization of ERP are grouped into four categories in the *a priori* model: structural attributes, people related attributes, technological attributes, and environmental attributes (

Figure 4-2). We relied on previous work by Rogers (1995), Damanpour (1991), Tornatzky and Klein (1982), Kwon and Zmud (1987), and Tornatzky and Fleisher (1990) in the selection of independent variables for this study.

While there is agreement on names and operationalization of some of the variables used across these studies, there are many differences in the naming and operationalization of other variables. Also, there is some overlap in the meanings of variables used across different studies. For example, Damanpour (1991) include specialization and professionalism as two independent variables. On the other hand, Rogers (1995) used organizational complexity as an attribute that is operationalized as the degree to which an organization's members posses a relatively high level

of knowledge and expertise, usually measured by the members' range of occupational specialties and their degree of professionalism (expressed by formal training). We avoided the overlap in meanings of the variables by carefully selecting the variables and operationalizing them to suit the specific context of the study, i.e., ERP systems. Organizations are typically characterized by the quality of their human and management resources, culture, work processes, and structure. Several early studies on organizational innovation have examined the relationship between these broad characteristics and innovation (e.g., Burns and Stalker, 1961; Aiken and Hage, 1971). Subsequently, authors have tried to disaggregate these gross concepts used to characterize organizations in early studies. For example, most of the early studies considered organizational structure as two broad types, organic or mechanistic. In later studies it has been broken into constituent variables such as centralization, formalization, inter-connectedness, complexity, and availability of slack resources to examine the impact of those variables on a firm's innovativeness (Kwon and Zmud, 1987).

Tornatzky and Fleisher (1990) provide a unifying framework based on their review of the vast literature of innovation adoption. They categorize attributes that characterize organizations and have been found to determine organizational innovativeness in the literature into three broad categories: organizational, technological, and environmental. We adapt the classification given by Tornatzky and Fleisher (1990) by dividing the organizational attributes in two categories: structural and people related attributes. We thus categorize the organizational characteristics into for types: 1) structural, 2) people related, 3) (perceived) technological, and 4) environmental attributes (see

Table 4-4).

Table 4-4: Determinants of Innovation

Variable	Definition	References
1. Structural		
Specialization	The diversity of specialists in the organization	Damanpour, 1991; Kimberly and Evanisko, 1981; Kwon and Zmud, 1987
Centralization	The degree to which power and control in a system are concentrated in the hands of few individuals	Damanpour, 1991; Kimberly and Evanisko, 1981; Kwon and Zmud, 1987
Interconnected-ness	The degree to which the units in the social system are linked by interpersonal network	Zaltman *et al.*, 1973; Rogers 2003; Damanpour, 1991
Formalization	The degree to which the organization emphasizes its members' following rules and procedures.	Damanpour, 1991; Kimberly and Evanisko, 1981; Kwon and Zmud, 1987
Functional Differentiation	Coalition of professionals forms in differentiated units	Damanpour, 1991; Rogers, 2003; Cooper and Zmud, 1990
Slack Resources	The degree to which un-deployed resources are available to the organization	Damanpour, 1991; Kimberly and Evanisko, 1981; Grover *et al.*, 1997; Fichman and Kemerer, 1997, Swanson, 1994
2. People Related		
Professionalism	Professionalism is related to the occupational training and education of employees.	Damanpour, 1991; Kimberly and Evanisko, 1981; Grover *et al.*, 1997; Fichman and Kemerer, 1997, Swanson, 1994
Organizational receptivity to change	Organizational receptivity to change relates to the organizational willingness to accept change.	Miller and Friesen, 1982; Swanson, 1994

Job tenure	Job tenure is related to average length of association of employees with the organization.	Damanpour, 1991; Kimberly and Evanisko, 1981; Grover *et al.*, 1997; Fichman and Kemerer, 1997, Swanson, 1994
Technical knowledge resources	The degree to which individuals in the organization can understand and work with technology.	Damanpour, 1991; Kimberly and Evanisko, 1981; Cohen and Levinthal, 1990
3. Technological		
Complexity	Complexity is related to the degree of difficulty users experience in understanding and using an innovation	Brancheau and Wetherbe, 1990; Moore and Benbasat, 1991; Rogers, 1995; Lai, 1997
Compatibility	Compatibility is related to the innovation's organizational fit as well as its impact on individuals' attitudes regarding change, convenience of change, power shifts etc.	Brancheau and Wetherbe, 1990; Moore and Benbasat, 1991; Rogers, 1995; Lai, 1997
Relative Advantage	The degree to which the innovation is perceived as providing greater benefits that either other innovations or status quo.	Brancheau and Wetherbe, 1990; Moore and Benbasat, 1991; Rogers, 1995; Lai, 1997
4. Environment		
Uncertainty	Uncertainty is related to variability in organizational environment. It encompasses both instability and turbulence	Ostlund, 1974; Holak *et al.*, 1987; Nooteboom, 1989; Venkatraman, 1991
Competition	Competition is related to environmental capacity and population density	Tornatzky and Klein, 1982; Kamien and Schwartz, 1982; Robertson and Gatignon, 1986; Baldwin and Scott, 1987; Gatignon and Robertson, 1989
Inter-organizational Dependence	The degree to which the organization has a program of sharing resources or exchanging ideas with other organizations.	Tornatzky and Klein, 1982; Markus, 1990; Katz and Shapiro, 1994

4.3.5.1 Structural Attributes

We include the following six structural variables in this study to explore their relationship with institutionalization success: Specialization, Formalization, Centralization, Functional Differentiation, Availability of Slack Resources, and Interconnectedness.

Specialization refers to the presence of a greater number of occupational specialists in the organization who possess a high level of knowledge and expertise, thus providing a broader knowledge base to the organization (Kimberly and Evanisko, 1981). Specialization has been associated positively to innovativeness by previous studies. However, specialization may add to the organization's specific needs for the ERP systems, which ERP vendors may not be providing for in their generic products. Specialized organizations may need more time and resources for instituting the change. We argue that institutionalizing ERP systems will be more difficult in organizations that are more specialized. We measure specialization by asking the respondents about the range of occupational specialties in the organization.

H1: Specialization and the Institutionalization of ERP are negatively correlated.

Formalization denotes the extent to which rules, procedures, and instructions are explicit in the organization. The degree to which an organization is bureaucratic is measured by its formalization. Formalization has been, thus, negatively related to adoption of innovations in firms, because it inhibits the consideration of innovation by its members. However, it has been found to aid implementation. ERP systems may aid formalization as rules and processes must be explicit in ERP-adopting organizations before the systems can be configured. However, more formalized organizations may still find institutionalizing ERP systems challenging as they may have to unlearn many of the formalized rules and procedures, and relearn the new ways of operations with ERP systems.

H2: Formalization and the Institutionalization of ERP are negatively correlated.

Centralization refers to the concentration of decision-making authority in the hands of relatively few individuals. Centralization is considered negatively related to the adoption of innovations as the range of new ideas considered by the organizations is restricted when only a

few strong leaders dominate the organization. However, centralization can encourage the implementation of ERP systems, given their cross-functional and organization-wide scope, as centralization may facilitate quicker access to organization-wide resources. However, as more participatory work environments facilitate institutionalization of innovation by increasing organizational members' awareness, commitment, and involvement, institutionalization of innovation may still be more difficult in more centralized organizations.

H3: Centralization and the Institutionalization of ERP are negatively correlated.

Functional Differentiation has been positively associated with adoption of innovations in previous studies. Functions are referred to as coalitions of professional forms in differentiated organizational units. However, greater functional differentiation in the organization will make institutionalizing ERP systems more challenging as the organization will have to institute integrated processes that cut across functional boundaries. More functionally differentiated organizations may find institutionalizing ERP systems more difficult than less functionally differentiated organizations.

H4: Functional Differentiation and the Institutionalization of ERP are negatively correlated.

Slack Resources are those resources that have not been optimally deployed, but which allow an organization to adapt to environmental change, by providing the means to pursue opportunities. Slack resources allow an organization to afford to pursue innovations, absorb failure, and exploit, new ideas in advance of an actual need (Rosner, 1968). The availability of slack resources may aid institutionalization of ERP systems also because organizations may be able to use the slack resources in building ERP-supporting infrastructure and capabilities.

H5: Availability of Slack Resources and the Institutionalization of ERP are positively correlated.

Interconnectedness is the degree to which the units in the organizational social system are linked by formal and informal networks. It facilitates dispersion of ideas within an organization and increases their number and diversity, which results in cross-fertilization of ideas. Interconnectedness is positively related to the adoption of innovations. It also creates an internal environment favorable to the survival of new ideas as it aids information exchange and greater interaction among functions of organizational members. More interconnected organizations may find institutionalizing ERP systems relatively easier than less interconnected organizations

H6: Interconnectedness and the Institutionalization are positively correlated.

4.3.5.2 People Related Attributes

We include the following four people related variables in this study to explore their relationship with institutionalization success: Professionalism, Technical knowledge resources, Organizational receptivity to change, and Job tenure.

Professionalism of organizational employees is one of the measures of organizational complexity. However, professionalism of employees is also associated with increased boundary-spanning activity, self-confidence, and a commitment to move beyond the status quo and, thus, an openness to adopting innovations (Pierce and Delbecq, 1977). The membership of professional associations also aids the cognitive development of employees, as they are one of the prime places where employees are introduced to new knowledge and innovations (Greenwood *et al.*, 2002). Professionally qualified employees are also expected to be more

motivated in learning high demand skills such as ERP. We believe that organizations with a greater percentage of professionally qualified employees will be more successful in institutionalizing ERP systems than those with a lower number of such employees.

H7: Professionalism and the Institutionalization of ERP are positively correlated.

Technical Knowledge Resources in the organization have been positively associated with adoption of technological innovations as they increase the ability of organizations to understand new technical ideas more easily and aid the development and implementation of those ideas in the organization (Dewar and Dutton, 1986). Interestingly, ERP adoption signifies a move from proprietary systems to vendor-managed systems. Most ERP-adopting organizations have outsourced technical activities leading to reduction in technical support staff employed by these organizations. On the other hand, an advent of ERP systems and applications that are supported by fourth generation programming languages extend the self-support ability to employees. While organizations still maintain some technical staff to support these systems, they are also trying to build technical knowledge resources among the users to self-support the systems with outsourced technology support. We believe that, due to the socially adaptive nature of the institutionalization process, organizations with employees with greater technical knowledge resources may be more successful in institutionalizing ERP systems.

H8: Technical Knowledge Resources and the Institutionalization of ERP are positively correlated.

Organizational Receptivity to Change if positive leads to an internal climate conducive to adoption of innovations. Miller and Friesen (1982) found that organizations with an entrepreneurial culture were more receptive to innovations than those with a conservative culture. Continued organizational support for innovation is required for institutionalization of

innovation in the post-implementation stage. While continued managerial support is essential for achieving higher levels of usage, coordination, and conflict resolution among individuals and functional units, managerial support for innovation when aided by positive reception by employees in the organization can further boost the success of institutionalization of innovations.

H9: Greater Organizational Receptivity towards Change and the Institutionalization are positively correlated.

Job Tenure provides legitimacy and knowledge of how to accomplish tasks, manage political processes, and obtain desired outcomes in the organization (Kimberly and Evanisko. 1981). The longevity of managers and employees in their jobs has been positively related to the adoption of innovations in the organization. Both managers and employees would have a perspective and motivation towards developing systems for longer-term success if they were to be associated with the organization longer. Frequent change in managers may make ERP institutionalization more challenging as an additional process of acclimatization of the new manager to the organization may be involved.

H10: Job tenure and the Institutionalization are positively correlated.

4.3.5.3 Perceived Technological Attributes

Technological factors, however, play an obvious and important role in determining the organizational adoption activity. Aiken *et al.* (1980) found that an organization's current technology sets broad limits on the extent of subsequent technological change as the organization has to ensure the compatibility of new technology with its current technological assets and capabilities. A number of studies have examined the relation between perceived technological attributes and adoption. Rogers (1995) list five perceived attributes of innovations as significant

determinants of adoption: Relative Advantage, Compatibility, Complexity, Trialability, and Observability. Tornatzky and Klein (1982), in their meta-analysis of literature on innovation characteristic research identify three innovation characteristics that have been found to have a consistent association with innovation activity in organizations: compatibility, relative advantage, and complexity. We include these three variables in our study.

Complexity is related to the degree of difficulty users experience in understanding and using an innovation. Lack of skill and knowledge is believed to be the primary factor behind the efforts to resist organizational innovations. However, organizations with greater technical knowledge resources and understanding of the integrated processes may find the ERP systems less complex than those that have less technical knowledge resources and integrated process. Thus, complexity is likely to add to difficulties in institutionalizing innovations.

H11: Perceived ERP Complexity and the Institutionalization are negatively correlated.

Compatibility is the degree to which an innovation is perceived as consistent with existing values, past experiences, and the needs of adopting organizations. Compatibility is related to an innovation's organizational fit as well as its impact on individuals' attitudes regarding change, convenience of change, power shifts, etc. For example, accumulated prior knowledge by individuals, when related to the innovation enhances learning because new knowledge is developed with relative ease by associative learning in which events are recorded into memory by establishing linkages with pre-existing concepts.

H12: Compatibility and the Institutionalization are positively correlated.

Relative Advantage reflects the degree to which an innovation is perceived as providing greater organizational benefits than either other innovations or the status quo. The degree of relative advantage is often conveyed as economic profitability, as conveying social prestige or in

other ways. The organizations perceiving higher relative advantages are more likely to have less difficulty in institutionalizing ERP systems.

H13: Higher Relative Advantage and the Institutionalization are positively correlated.

4.3.5.4 Environmental Attributes

Environmental context is the arena in which the organization operates. Environment is seen as both a source of information and as a stock of resources (Aldrich, 1979; Scott, 1981). Competition, heterogeneity, inter-organizational interdependence, and uncertainty are some of the key environmental attributes that have been studied in the literature for their impact on the innovativeness of an organization. A number of studies find that organizations often adopt technological innovations in response to the pressures from the business environment in which they operate; as well, they depend heavily on the environment to provide supporting infrastructure and resources to sustain the innovation (Tornatzky and Fleisher, 1990). DiMaggio and Powell (1983) suggest that coercive, mimetic, or normative processes may lead to positive associations between environmental attributes and institutionalization.

Competition is related to environmental capacity (scarcity of resources) and population density. Greater competition is likely to aid institutionalization of ERP systems by motivating organizations to make more efforts to realize the benefits of ERP systems.

H14: Competition and the Institutionalization are positively correlated.

Uncertainty is related to the variability of organizational environments. This definition encompasses both instability and turbulence. Uncertainty is believed to stimulate adoption of innovations through an organization's efforts to survive and grow. Uncertainty is likely to enhance the extent of ERP institutionalization as organizations are more likely to use the

advanced functionality of ERP systems on a regular basis to improve the quality of information available and thus reduce uncertainty.

H15: Uncertainty and the Institutionalization are positively correlated.

Inter-organizational Dependence refers to the degree to which the organization has a program of sharing resources or exchanging ideas with other organizations. Outside sources of knowledge have been found to be critical for an organization's innovativeness (Cohen and Levinthal, 2001). Innovative organizations exchange information with their environment effectively. Environmental scanning and inter-organizational professional activities of the members can bring new innovative ideas. Greater inter-organizational dependence encourages the exchange of information with other firms and, thus, may aid in the institutionalization of an ERP system.

H16: Inter-organizational Dependence and the Institutionalization are positively correlated.

4.4 Concluding Remarks

The study objectives in Phase I were primarily exploratory, as not much empirically supported research was available. The main outcomes of Phase I were the development of the *a priori* model and a set of research questions. The case studies in this phase also helped us to develop a case study protocol that was critical for conducting multiple case studies. A reasonably representative sample of large organizations provided valuable insight into the ERP-institutionalization process and allowed us to documents some of the critical post ERP-implementation issues in government organizations.

We identified a number of critical challenges facing post ERP implementation activities such as additional training, and upgrading system functionality. Given their organizational characteristics - such as high formalization, less interconnectedness, high complexity, low centrality, and slack - organizations may need to focus on behavioral issues of ERP implementation - such as buy-in from the organization, early involvement of systems key users and frontline managers, and increased communication about expected changes. Organizations may also need to focus on improving their processes more than just modifying new systems to fit the requirements of their existing processes. A key component of process improvement is developing the capability of the people managing the processes by providing them with training around new and efficient ways of executing their responsibilities with new systems. Integration benefits promised by ERP cannot be realized without integrating mechanisms such as standardization of work processes, and an output and supervision structure that promotes co-ordination between departments towards the end goals of optimizing all the cross-functional business processes. Government organizations may find greater difficulties in changing structures in comparison to the private sector, as their structures are often legislated and cannot be changed without changing the legislation. Nonetheless, conscientious efforts should be made towards implementing complementary supervision structures and performance measures to realizing the benefits of integration.

Chapter 5 Results Phase II: Pretest of the A priori Model

This chapter presents the outcomes of the second phase of this study. In this phase, we focused on pre-testing the research tools and instruments developed during the first phase. Six case studies were conducted to pretest the efficacy and validity of the research protocol and get additional insights into the phenomenon of ERP institutionalization. Several improvements were made into the research protocol based on the findings of the case studies and suggestions of the interviewees. The first section of this chapter describes the case study organizations, their ERP systems and some highlights of the individual case analyses. Section 2 discusses the key additions made to the *a priori* model and the changes made to the research protocol and tools based on lessons learned in Phase II. Concluding remarks on the chapter are provided in the last section.

5.1 Sample Description

We included a varied sample of large and very large organizations for the purpose of on-site interviews, observation, and data collection in this phase. Table 5-1 summarizes the profiles of the six organizations that participated in Phase II. All of the six organizations were unique in terms of their needs and approach to ERP systems and they provided us with several insights in the ERP institutionalization process. These insights were very useful in enhancing the *a priori* model. Some highlights and observations of these cases are provided in this section.

5.1.1 Organization D

The subject organization of this case study was a medium-sized privately owned corporation in the oil and gas sector with more than 750 employees in North America. ERP adoption in this company was motivated by a decision to replace its legacy systems with

advanced integrated systems that could accommodate growth. The organization went live with SAP's R/3 software in November 2000 to provide for its informational needs in the key functional areas of Finance, Sales and distribution, HR, Procurement, Materials Management, and Plant Management.

Table 5-1: Profiles of Phase II Case Studies

	Organization D	Organization E	Organization F	Organization G	Organization H	Organization I
Type	Private Sector Corporation	Government Department	Non for Profit Charitable Organization	Publicly Funded University	Private Sector Corporation	Government Department
No. Of Employees	More than 1000	More than 10000	More than 3,000	More than 1,000	More than 750	More than 5000
ERP Software	SAP	SAP	SAP	Other	SAP	SAP
Why ERP?	Accommodating Growth and replacing Legacy Systems	Replacing Legacy Systems and Y2K	Replacing Legacy Systems	Replace Aging Legacy Systems	Accommodating Growth	Y2K, Replacing Legacy Systems
Facilities Location	Multiple Locations in North America	Across Canada	Across Canada	Single Location	Multiple Locations in North America and Europe	Across Canada
Mandate	Oil and Gas	Governance and Implementation of Financial Information Strategy and Departmental Operations	Medical Related Manufacturing and Essential services	Education and services to more than 20,000 students	Manufacturing and Design of Telecommunication Equipment	Governance and Implementation of Financial Information Strategy and Departmental Operations

The organization adopted a plain vanilla configuration of the software version specific to the oil and gas sector. Implementation was smooth and was supported in the post implementation phase by a small internal team of well trained IS employees. Technical stability was achieved within six months as the organization made very few changes to the SAP's industry blue print and made no changes to the configuration to suit the business. Instead, business processes were changed wherever there was a misfit.

Functional expertise was provided by the super users who were not collocated with the IS team as we found in many other cases. These super users also provided the first level of system

support in these functions to their colleagues and the requisite training in their function to new employees. However, both the IS team and the super users were largely overburdened in the technical and semantic stages. The organization, thus, had difficulties in using these people for enhancements and improvements activities which ERP research studies found to be critical for realizing the benefits of ERP systems. Institutionalization of ERP in organization D was a relatively smooth process and achieved in relatively short period of time. However, the organization could not realize some of the potential benefits extended by the ERP system because it did not use the system extensively for decision making or improving its supply chain performance.

5.1.2 Organization E

The subject organization of this case study was a large government department with more than 10,000 employees. ERP adoption in this government department was motivated by a decision to replace aging legacy systems with advanced corporate systems that were Y2K compliant. The organization adopted SAP's R/3 software in 1998. This software was one of the Treasury Board's recommended financial information systems as replacement for numerous legacy systems in the key administrative functions of Finance, Purchasing and Materials Management, and Estate Management. The organization however, continued to use some legacy systems and PeopleSoft for HR.

The organization faced several problems in achieving technical stability. The ERP (SAP) system was not integrated with HR (PeopleSoft) and other legacy systems, which it continued to use. The organization developed point to point interfaces for exchange of data. This created a multitude of problems for the technical support organization because every change made to any

of the systems in the organization affected each interface and they had to be updated. The department maintained a large IS organization which was divided into sub units along the lines of systems they supported. Communication across these units, which supported different systems was infrequent and difficult; this added further challenges to the task of changing the ERP systems in the technical stage. We found that the ERP program was owned by the centralized IS function in the organization and it lacked support from the prime business units. Consequently, the organization faced several challenges in managing the change as the users were rarely part of the early decision making process. This had implications on the efforts required and time taken in achieving semantic stability.

Overall, institutionalization of ERP in the organization E was a challenging process because the existing bureaucratic structure had to be changed significantly to address some of the challenges in institutionalizing ERP systems. However, organization managers had a good view of their limitations and strengths and were initiating several changes to improve the situation. One of these limitations was the relatively slow change process of a highly bureaucratic government organization. To mitigate these limitations they had planned to work with the contractor in the initial stages of ERP institutionalization while the organization made a transition to the new support environment. At the time of the interview the organization was undergoing a structural change in the IS department. Integrated functional and technical support of all ERP systems under one senior officer was being designed to improve communication channels across the system support units. Employees in the organization were encouraged to participate in external networking events such as seminars and user group meetings to enhance their ERP capabilities. The organization was working closely with the government's shared services organization to develop a common government-wide foot print of SAP and extend

avenues for sharing technical resources with other departments. Efforts were being made to get early buy-in and participation with future ERP projects from the senior officers of the business units.

5.1.3 Organization F

The subject of this case study was a large public sector organization with more than 4000 employees across Canada. The organization adopted SAP's R/3 software in the year 1998 to replace numerous legacy systems in the key administrative functions of HR, Finance, Materials Management, Sales and Production Planning functions before Y2K. Driven by its needs to have Y2K compliant systems the organization adopted a rapid implementation approach putting the ERP systems in place in 93 days. However, this strategy resulted in a very high reliance on external consultants and configurations that did not represent the business reality. In many instances processes were configured with very little input from the business. Consequently, the organization's work was badly affected and constrained in the post go-live period. For example, the system could not handle several requirements in place from union collective agreements. People could not be paid without a large number of manual work-arounds, which lead to a high number of errors and user dissatisfaction. To make matters worse, the organization faced heavy turnover of trained ERP support personnel and was left reeling with inadequate technological capabilities to carry out the difficult task of improving the configuration.

Business units had enjoyed significant autonomy until this change and they resisted the standardization and reengineering required for this enterprise system. The organization had to go through a long process of cleaning up the configuration before the systems could be technically stabilized and effectively used to support the organization. The ERP manager summarized the

institutionalization process as "a long, expensive, and painful experience." Apparently, the organization had grossly misjudged the importance of business process input in configuring the ERP systems and vice versa. It was not until a more recent upgrade to the ERP systems that the organization was able to incorporate a process to ensure the input of functional employees in systems design and the input of systems employees in process design. Any request for a system change in the organization has to be signed by the functional director and approved by a functional employee/manager, who would be responsible for providing the functional input to the change project at various stages. On the other hand, bringing systems people into the negotiation of collective agreements to determine the complexity of what was being negotiated was an interesting example of ensuring systems input in process design.

Semantic stability was also delayed since it took several months for the ERP support organization to restore the confidence of the users in the effectiveness of the ERP system. In the words of the ERP (IS) manager in the organization:

> "It is only now that we have beaten through the problems we had in supporting the business. Business folks also now understand what they have to do to work with the ERP systems."

The ERP support organization pushed back a lot more responsibility on the users, which was a significant shift from the ways system support was provided in the legacy system era. The functional user organization was responsible for deciding within their function what were their top priorities for changes they wanted to pursue before approaching the ERP/IS support organization. Earlier, this discipline was not enforced and the organization would carry out projects that had been agreed upon between the IS employees and their functional clients in an ad-hoc manner. That approach was not consistent with ERP systems as things were integrated in the new environment and also the organizational ERP resources were constrained and expensive.

This also aided in creating an increased understanding of the ERP systems and their nature since, while deciding on what projects to pursue, the employees in the different functions were required to do their own homework to support their projects.

5.1.4 Organization G

The subject of this case study was a medium-sized university with more than 1,000 employees catering to the educational needs of more than 23000 students. The organization adopted SCT's banner software in the year 2000 to replace its numerous homegrown systems in the Finance, HR, Student support, and Alumni departments. The project however was troubled and delayed by a year due to several reasons, including scope changes, and it missed the educational year deadline for the student system.

Like organization F, this organization also faced several severe challenges post go-live. Users were unable to carry out many of their system-dependent day-to-day activities. In some cases, what had been a simple five minute process with the legacy system became an hour long struggle for employees as the incomplete configuration of the process in the ERP system meant that they had adopt manual work-arounds to get the work done. The end-users were not only frustrated by the learning curve and the efforts required to change to the new systems, but also due to the inability of the support team to respond to their help requests. The support team, as well, was agitated and felt stressed due to their inability to handle too many complaints. However, the organization gradually resolved both technical and semantic issues with continued support from its project leadership and senior management.

The organization introduced an advanced methodology based on project management for organizing initiatives to improve the technical issues. It initiated several change management

initiatives along with efforts to improve and fix the systems so end users could regain confidence in the ERP systems and the project team. For example, to improve the communication between the project team and the functions, the organizations introduced a cross-functional issues sub-committee that met regularly to prioritize and monitor progress made by the support team in resolving technical and semantic issues. The institutionalization process in this organization was an interesting example of regrouping low morale project team and frustrated end users to bring a delayed, over budget, and out-of-control implementation project gradually back on track.

5.1.5 Organization H

The subject of this case study was a medium-sized private sector corporation in the high technology sector with more than 750 employees in North America and Europe. The corporation has gone through phases of very high growth followed by a deep depression in the industry coinciding with the dot com bubble burst. The corporation inherited an instance of SAP in one of the companies it acquired and decided to extend it to its other division. The main motivation for the adoption was a decision to replace aging legacy systems with advanced Y2K compliant corporate systems that could support the growth and could enhance supply chain efficiencies.

While the go-live was smooth and the organization achieved technical stability within the planned period, it faced several problems in achieving semantic stability due to a severe downturn in the industry that created a severe resource crunch. More than 60 percent of the employees were laid off in response to the downturn, including some key people from the ERP program in the post go-live period. The organization had a liberal training policy with a large supporting budget that gave training to the employees during the project. However, most of the employees with advanced ERP skills left the organization during the downturn. The ERP

systems in the organization were maintained at a bare minimum level of functionality; they mostly served the transaction processing needs of the organization as the organization could not afford to invest in ERP skill-sets or enhancements.

The organization managed to ride the downturn and make resurgence by managing to work well within resource constraints. Interestingly, the organization devised innovative ways for extracting the data from its SAP system and running the cubes in a homegrown data warehouse. At the time of the interview, the organization was back to profitability and back on track for investing and renewing its ERP systems and supporting organization. End user training was badly affected in the post go-live period in the organization as several trainers and end users were laid off. Institutionalization of ERP in the organization was a strenuous process, as the organizational could not have planned for difficulties in making a shift to the new systems that changed the way the organization worked in an environment severely constrained for resources.

5.1.6 Organization I

The subject of this case study was a large government department with more than 5,000 employees across Canada. ERP adoption in the department was motivated by a decision to replace aging legacy systems with advanced corporate systems that were Y2K compliant. The agency adopted SAP's R/3 software in 1998 to replace numerous legacy systems in the key administrative functions of Finance, Materials Management, and Procurement. The organization was already running Peoplesoft software for its HR function.

The organization initially treated the ERP systems adoption as a technical project for replacing legacy financial system with an advanced Y2K compliant system. The following comments by the director of ERP systems highlighted an interesting dilemma faced by

government organizations that have deeply institutionalized functional boundaries. These boundaries are often etched and demarked by requirements placed by legislation, such as the financial administration act (FAA).

"Government departments are expected to have a financial system not an ERP. We need to have a system which can allow us to follow the FAA. I would even say that we don't even use SAP as an ERP as we don't use the whole realm of its services. Even if we want to extend it to other functions such as HR, and real estate, it is perceived as a financial and materials management system. There is a lot of reluctance in using this system; they (users) always view it as something that will encumber the financial processes not realizing how well it is integrated."

The organization faced several challenges in achieving technical and semantic stability post go-live. Like many other government organizations in this study it faced challenges in holding on to trained employees in the initial years when there was a shortage of people with ERP skills. As the ERP manager pointed, the organization retained some highly paid consultants on a long-term basis to ensure that the systems were not affected in case of a resignation by a key employee in the ERP support organization. Not much guidance was available on ways to manage the ERP systems, as one of our respondents commented

"...the whole ERP methodology was to get you live. There was nothing in the book on how to pick it up from there."

Some of the challenges were attributed by one respondent to a deficient definition of go-live. Go-live was defined in the organization as having a system that allowed them to run financial transactions, and they were able to run transactions such as paying a bill - when they went live with the system. However, as system and process performance was not specified, the systems performed poorly. The amount of time required to perform transactions was, in many cases, ten times longer than required to do the same transactions with the legacy systems. The users, in some cases, required to navigate through 8-10 screens to complete a transaction that

was available on a single screen in the legacy system. The organization that took over from the project team had to go to their superiors to get funding to fix the systems. It took up to two years to achieve normal performance in some of the business processes.

Semantic stability was also delayed as the organization resorted to manual work-arounds for a significant period of time after go-live as technical stability was delayed. Staff was not sufficiently trained to handle the systems and consultants were expensive and in short supply. Not many business processes were standardized, as the Treasury Board did not push for standardization in those initial years. Only in the last few years efforts have been undertaken to standardize process.

5.2 Learning from Pre-Test

The case studies conducted in this phase significantly contributed to our understanding of the phenomenon. Better qualification of the four defining events of the ERP institutionalization model was a significant improvement made in the *a priori* process model with the help of respondents we interviewed in this phase. Pre-test case studies also helped us to improve the *a priori* variance model in several ways that are discussed later in this section. Several changes were made in the research protocol-; for example, we were able to structure the research protocol so that each interview in the third phase could be completed in 60 minutes. Some of the prominent lessons learned and changes made to the research protocol are in the following text.

5.2.1 ERP Institutionalization Events

Mintzberg *et al.* (1976) describe process theories as important means for providing structure to unstructured and abstract phenomenon by breaking them into simpler components (stages) and describing their elements, supportive routines and factors that influence them. In this

phase of research we use the data to develop the model further by identifying some of the key events that were used to demark the three stages in the proposed institutionalization process model. Events are a critical component of a process theory as they provide the researchers with anchor points to construct and follow the phenomenon until it reaches the desired state. We identified and used four key events to demark the three stages in the institutionalization process. The four events were qualified and described with the help of the respondents as follows:

Event 1: First Go-live

Going live is a significant event in the organizational experience with ERP systems; it marks the first instance when ERP systems are switched on. It marks the beginning of the post implementation stage where the organization as a whole comes to terms with the new system. It is a widely anticipated event in the ERP lifecycle, often referred to by ERP scholars as "the beginning of an end." It not only marks the end of the ERP implementation project, but also a new beginning as the organization puts the ERP systems to use for the first time. Until go-live, only a few executives and functional managers, along with the project team are the only people directly involved with the ERP system. Most organizational members in general have very little awareness of the new systems which they have received through formal and informal communications about the implementation project from the members of the implementation project team. Some members have attended ERP training programs but training, in many cases, does not provide a sufficient idea of the organization's instance of ERP systems, since organizations mostly run training on generic training configurations provided by the vendor. In most cases the system with which members of the organization eventually work at go-live is substantially different from what they have seen in the training environment.

Event 2: Technical Stability

A high level of technological disorder persists at go-live when systems are new, even for the support staff. The organization faces several problems, many of which are leftovers from the implementation project when they either were not recognized or not successfully resolved. At go-live, there are severe technical challenges that often affect customer and suppliers, and result in significant slowdown of business processes. The organization is heavily reliant on manual processes, workarounds, and increased staffing to barely manage its operations. Technical issues, particularly ones related to interfacing with legacy and other systems, abound to an extent that the organization's confidence in the technology is very low.

Technical stability is important for the sustenance of the ERP systems in the organizations and is achieved when the support staff is able to resolve the major issues and get a better understanding of the continued technical support needed for the systems. Systems are technically stable when the persistent problems left are low risk in nature and are reduced to an acceptable level. One example of the indicators of technical stability was that configuration changes to the ERP systems to suit the business and infrastructure were no longer required on a regular basis. Technical stability marks the end of the technical stage and the beginning of the semantic stage.

Event 3: Semantic Stability

Unlike the previous experience of most organizations in building and maintaining legacy systems, managing ERP systems is a fairly different experience. ERP adoption marks a major paradigm shift in the organizational strategy for information systems from home grown to

vendor-developed systems. Skill-sets, technological infrastructure, and management processes needed to introduce and maintain ERP systems are quite different from those needed to maintain older and established technologies (Applegate *et al.*, 2006). Cross-functional integration and heavy reliance on the vendor for system development introduced through ERP systems in the organization are new concepts for most organizations. Therefore, even when technical stability is achieved, a large amount of disorder remains in the organization due to lack of understanding and confusion about using and supporting the systems.

Several problems persist, which are primarily due to lack of user understanding, mismatched assumptions, and cultural resonance. The organization, without realizing, continues to use several mental models that were developed for working with the legacy environment. Semantic stability is therefore important for smooth functioning of the new systems in the organization. Semantic stability is achieved when the understanding of the new environment is developed within the organization. Systems are semantically stable when the persistent problems left are low risk in nature and are reduced to an acceptable level. One of the indicators of semantic stability is that the average user understanding and interaction with ERP for information access reaches a stable point. Support from super users is rarely required for carrying out day-to-day activities. Users are comfortable with the new system and available support. They can employ the system features effortlessly in their routine activities. Semantic stability marks the end of the semantic stage and the beginning of the effectiveness stage.

Event 4: Decline/Replacement

Decline represents a future state when the ERP systems are no longer able to serve the organizational needs. The systems are gradually replaced with more advanced contemporary systems in this state. It marks the end of the effectiveness stage.

5.2.2 Changes Made In the A priori Variance Model

The case studies also helped us in improving the operationalization of our variance model. In our scale for measuring the dependant variable "extent of use," we removed business scope redefinition which was the original fifth and highest category. The category was not understood very well by the respondents. As one of the respondents pointed out, for their organization, even though they have barely integrated the processes and much more needed to be done in terms of business integration, there were pronounced benefits that could be said to have redefined the business scope.

A new moderating variable Y2K was introduced. In the beginning of the study, we proposed the use of two moderating variables; organization type and size of the organization, to identify whether there were any differences in the effect of independent variables across organization of different types and sizes. We found that getting a system that complied with Y2K requirements was a significant motivator for several organizations. Organizations adopting ERP systems for Y2K compliances were often stressed by non-negotiable deadlines and a shortage of skilled ERP professionals. Thus, we included the year 2000 as the third moderating variable to study differences between organizations that went live with ERP before and after the year 2000.

As well, changes were made in the operationalization of another moderating variable – "size." While we initially planned to study the differences between large- and medium-sized organizations, we decided to focus on organizations with more than 500 employees after pretest. This decision was prompted by the experience we had in the pretest phase where several organizations with less than 500 employees reported that they did not use a system that could be called an ERP. This observation should not be interpreted to mean that an organization with less

than 500 cannot use an ERP system. However, we found focusing on organizations with more than 500 employees more appropriate for the purpose of this research because it allowed us focus our resources on contacting organizations and get a better response rate.

An independent variable in the *a priori* model technical knowledge resources was changed to knowledge resources and two manifest variables - technical knowledge resources and process knowledge resources - were used to reflect the field reality of knowledge relevant for managing ERP systems. Most of the respondents said that both technical ERP knowledge and detailed knowledge about the organizational business processes were important for successful institutionalization of ERP systems.

5.2.3 Improving the Research Protocol

Several changes were also made in the research protocol. For example, we were able to structure the research protocol so that each interview in the third phase could be completed in 60 minutes. We changed the order of appearance and the wording of several questions. The respondents helped us to adding qualifiers and examples to explain the meaning of a question and how that question could be re-worded to align with the language in the field. The responding managers were asked to comment on the understandability of each question and suggest and how it could be improved.

The quantitative questions asked on the Likert-type scale were regrouped and explanations were provided to inform the respondents why a particular group of questions was being asked. Some of the questions were deleted as they did not add any new information. Phase II case studies also helped us to decide to focus on only one respondent in the organizations in the third phase. Data was collected by means of personal interviews with two to three key people involved in ERP implementation at each site in the second phase. However, we found that the

key manager from the IS side had the most insights and an experience of the challenges faced by both business and IS teams. Moreover, most of the organizations pointed to the ERP champion (who was in most cases the ERP director/manager) as the key source of knowledge.

5.3 Concluding Remarks

In this chapter, we presented the outcomes of the second phase of this research. Overall, we added several new insights and details to the ERP institutionalization process delineated in this phase of the research. It became apparent that the success of the organization in completely and correctly implementing ERP systems had a direct effect on the length of both technical and semantic phases. Some of the case studies revealed that the organizations with incomplete and incorrect conversions/configurations of processes during implementation had to work hard to complete/correct these processes post go-live, thus extending the duration of the technical phase. The lengthy technical phase also delayed and undermined the activities required to develop the cognition and skill-sets of end users in the organization. Many of the system capabilities were not available for use, even after go-live in organizations where technical stability was delayed. In some cases, there was a significant delay between training offered for a particular process and/or capability and when it was available for actual use. The delay in actual use of the skill-sets developed during training often led to a need for retraining or considerable difficulties in achieving semantic stability when the firm did not, or was not able to, provide training again.

Chapter 6 Results Phase III: A priori Model Validation Results

This chapter focuses on the outcomes of the third phase of this research. Both quantitative and qualitative data was collected from organizations participating in this phase of research to achieve the two broad research objectives of the study a) Improving our understanding of the ERP institutionalization process and b) Exploring the relationship between organizational characteristics and the organization's success in institutionalizing ERP systems. We present the results of data analysis in this chapter, which is organized into four sections. In the first section, we discuss the profiles of the organizations that participated in the study. Organization profiles are an important component of the data analyses in any management research as they provide interesting insights in to the organizations where the research phenomenon is being studied. In the second section, we focus on the analysis of the qualitative data collected to answer the research questions related to the process research objective of this study. In the third section, we focus on an analysis of quantitative data collected to answer research questions related to the variance research objectives of the study. Finally, the last section contains concluding remarks for this chapter.

6.1 Description of Case Study Organizations

The focus of this section is to summarily describe the case study organizations and present a set of descriptive statistics on background information about their ERP programs. Organizations with more than 500 employees in both the private and public sectors, who had already implemented an ERP system, were contacted to participate in the study. A convenient sample was used as the broader research objectives in this study focused on understanding institutionalization issues in a wider and varied set of organization. Of the 75 organizations

contacted, 30 organizations participated in the study: three in the first phase, six in the second phase, and 21 in the third phase. Some organizations participating in the first and second phase also participated in the third phase by providing us the additional data required for the third phase.

The organizations participating in the study could be broadly grouped using three moderating variables of interest for data analysis: first go-live (Table 6-1 a), the sector in which the responding organization belongs (Table 6-1 b), and the size of the organization (Table 6-1d). Organization size and type were the two moderating variables originally used in the *a priori* model to facilitate analysis of differences between large (500-3,000 employees) and very large organizations (more than 3,000 employees), and between private and public sector organizations. Y2K was added as the third moderating variable in the pretest phase. We found that getting a system that complied with Y2K requirements was a significant motivator for several organizations. There were significant observable differences in the organizational ERP programs of organizations that adopted ERP before and those that adopted ERP after Y2K. Organizations adopting ERP systems for Y2K compliances were often stressed by non-negotiable deadlines and shortage of skilled ERP professionals.

Table 6-1: Sample Description (n=30)

a) First Go-live	**No. of Org.**	**b) Sector**	**No. of Org.**
• Before Y2K • After Y2K	14 16	• Public • Private	18 12
c) Vendor		**d) Size**	
• SAP • Oracle • Others	19 6 5	• Large (Between 500 and 3000 employees) • Very Large (More than 3000 employees)	13 17

An equal number of public and private sector organizations were requested to participate because of our interest to observe the difference across these two sectors: a) Public Sector, (Government departments, Crown Corporations[7], and Government-funded not-for-profit organizations[8] and b) Private Sector Corporations. The variety in participating case study organizations allowed us to observe the phenomenon from a much wider perspective for the process component of the study. Interestingly, each organization's approach to ERP was unique, and, even within the broad groupings made for analysis, they represented a unique flavor. For example, within the public sector organizations there were large government and very large government departments, but these organizations represented different government levels: federal, provincial, and municipal. Each level was influenced by several requirements placed on them by the environment in which they operated. For example, the federal government organizations were mandated to follow the directions of the Treasury Board and the Financial Administration Act, which often determined several decisions they made with respect to their ERP systems. Similarly, in the private sector we had a wide representation from modern to traditional businesses such as telecommunications, manufacturing, retail, forestry, and utility distribution.

As per design, the organizations we studied also differed widely with respect to their business objectives, task environment, system strategies, time of ERP adoption, support capabilities, employee skill-sets, and experience with ERP. This wide variance in the case study organizations was necessary to get a broader perspective on the institutionalization process

[7] Organizations wholly or partially owned, either directly or indirectly, by the government but managed by their respective boards of directors. The enabling legislation for each Crown Corporation sets out the corporation's mandate, powers, and objectives.

[8] Government funded organizations such as hospitals, universities, and essential services, which are legally distinct entities,

activities, challenges, and coping strategies employed by organizations. A summarized description of individual case study organizations is provided in Table 6-2. The names of the organizations are not disclosed to maintain the anonymity and confidentiality promised to the respondents.

Table 6-2: Case Study Organization Profiles

Organization Identifier	Organization Description	Sector	Size	System	Adoption Cohort (Y2K)	Extent of use
	Phase I					
A	Federal government agency	Public	Very Large	SAP	Pre-Y2K	Level 2
B	A federal crown corporation	Public	Very Large	SAP	Post-Y2K	Level 4
C	Optical network design and manufacturing Company	Private	Very Large	SAP	Post-Y2K	Level 3
	Phase II					
D	Federal government department	Public	Large	SAP	Pre-Y2K	Level 1
E	Federal government department	Public	Very Large	SAP	Pre-Y2K	Level 3
F	Oil and gas sector company	Private	Large	SAP	Post-Y2K	Level 2
G	Telecom manufacturing and design company	Private	Large	SAP	Pre-Y2K	Level 2
H	Publicly funded mid size university	Public	Large	Other	Post-Y2K	Level 3
I	Publicly funded health service sector organization	Public	Very Large	SAP	Pre-Y2K	Level 3

Organization Identifier	Organization Description	Sector	Size	System	Adoption Cohort (Y2K)	Extent of use
	Phase III					
J	Federal government department	Public	Very Large	SAP	Pre-Y2K	Level 3
K	Communications company	Private	Very Large	SAP	Post-Y2K	Level 4
L	Crown corporation	Public	Very Large	Other	Pre-Y2K	Level 3
M	Software company	Private	Medium	Oracle	Post-Y2K	Level 4
N	Forest products manufacturing company	Private	Very Large	Oracle	Post-Y2K	Level 3
O	Semiconductor Manufacturing	Private	Large	SAP	Post-Y2K	Level 3
P	Communications company	Private	Very Large	SAP	Post-Y2K	Level 4
Q	Federal government agency	Public	Very Large	SAP	Pre-Y2K	Level 3
R	Municipal Government	Public	Very Large	SAP	Post-Y2K	Level 3
S	Utility company	Public	Large	Oracle	Post-Y2K	Level 4
T	Publicly funded health sector organization	Public	Large	Other	Post-Y2K	Level 3
U	Federal government agency	Public	Large	Other	Pre-Y2K	Level 2
V	Publicly funded mid size university	Public	Large	Other	Post-Y2K	Level 2
W	Federal government agency	Public	Very Large	SAP	Pre-Y2K	Level 2
X	Federal government department	Public	Very Large	SAP	Pre-Y2K	Level 2
Y	Software company	Private	Large	Oracle	Post-Y2K	Level 3
Z	Federal government department	Public	Very Large	Oracle	Pre-Y2K	Level 3
AA	Provincial government agency	Public	Very Large	SAP	Pre-Y2K	Level 3
AB	Aerospace services management company	Private	Large	Oracle	Post-Y2K	Level 2
AC	Retail company	Private	Large	SAP	Post-Y2K	Level 3

AD	Telecom company	Private	Large	SAP	Post-Y2K	Level 4

We further analyzed the comparable background information collected from case study organizations. It was particularly important to note and take into account the differences in the organizations with respect to the following six points, to understand how the ERP institutionalization process unfolds in the organization:

- Systems strategies in the organization
- The ERP bandwagon effect within the task environment of the organization
- The ERP skill-sets in the organization
- The ERP support in the organization
- The ERP value realization in the organization, and
- The entrenchment of ERP systems in the organization.

6.1.1 System Strategy

The ERP experience of an organization can only be assessed in the context of the implementing organization, its systems strategy, and its objectives for the system (Markus and Tanis, 2000). Interestingly, organizations have adopted ERP systems to varying extents. Not all organizations pursue ERP systems aggressively; some choose to adopt only core modules, while others may interface several best-of-breed systems. It was, thus, important to determine the status of ERP in the organizations, their systems strategies, and their IS infrastructure. Several federal government organizations we studied used SAP as their prime system for Finance, Materials Management, and some other activities. At the same time they continued to use Peoplesoft (now Oracle) as their HR system with point-to-point interfaces for transferring data to the Finance system. Interestingly, as one of the managers commented:

"It is relatively easier to move your finance/accounting data to a new system than moving your HR information. In our organization while we moved our financial systems to SAP, we continued to use our HR systems and build them as SAP did not offer porting our data to the new system. The organization could not afford to lose all that data which was still active and required to determine the salaries and pensions of our employees."

Financial accounting, being more structured and standardized as a function, could also be one of the reasons, which makes the shift relatively easier. The practices in the accounting function are more regulated by legislation and the profession, which provides a body of best practices. The financial practices across organizations are more homogeneous than practices in functions such as HR, where the profession is not as organized as Financial Accounting and the laws do not dictate practices as closely.

6.1.2 ERP Bandwagon Effect

Mimetic forces have been addressed in the institutionalization literature as prominent reason that drives widespread diffusion of practices across an inter-organizational field (DiMaggio and Powell, 1983; Galaskiewics and Wasserman, 1989). To understand the impact of mimetic forces on the case study organization, we asked the respondents to rank, on a scale of 1-7 (1 stands for low and 7 stands for high), the extent to which organizations in similar task environments are likely to have an ERP system. Interestingly, most of our respondent said that the organizations in the task environments in which their organization operates are highly likely to have an ERP system. The data collected suggested an observable ERP bandwagon effect across industries and task environments. ERP systems have emerged as the dominant systems strategy for most large organizations, irrespective of the sector and task environment.

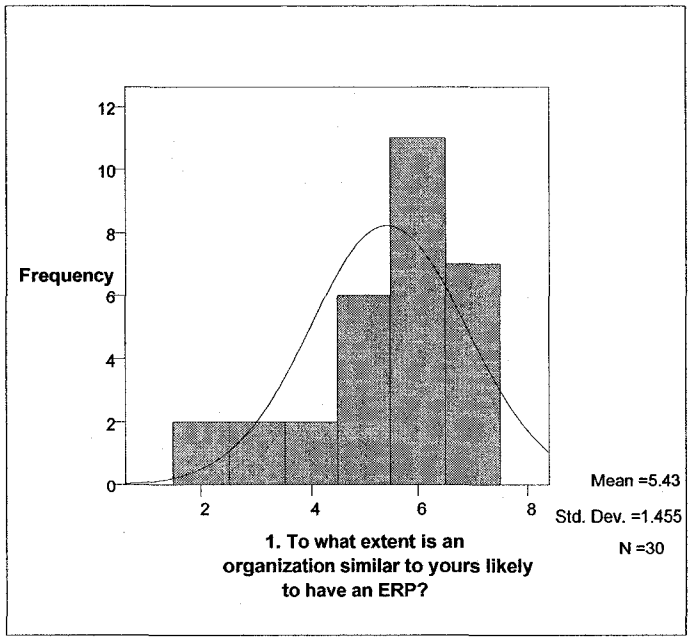

Figure 6-1: Likelihood of Having an ERP System in the Organization

Interestingly, few of the organizations who reported less likelihood of having an ERP were in the public sector. Analysis revealed a difference in opinion and facts; while a large number of organizations in the public sector have adopted ERP systems, some managers still thought there was no need. By asking the managers in the government to explain their viewpoint, we found that this view was rooted in the fact that administrative processes in government departments and agencies are guided by legislated regulations such as the Financial Administrative Act, which encourages a functional separation of the processes.

"Government departments are expected to have a financial system and a human resources system. There is no expectation for them to have an ERP. I would say to a large extent we do not use the systems we have as an ERP. We have not configured the whole realm of services which the system provides." (Manager Case E)

Similarly, another manager from a relatively smaller public sector organization (Manager Case AB) commented that their operations were not very complex, and even though they were running an ERP system many other organizations in similar task environments do not.

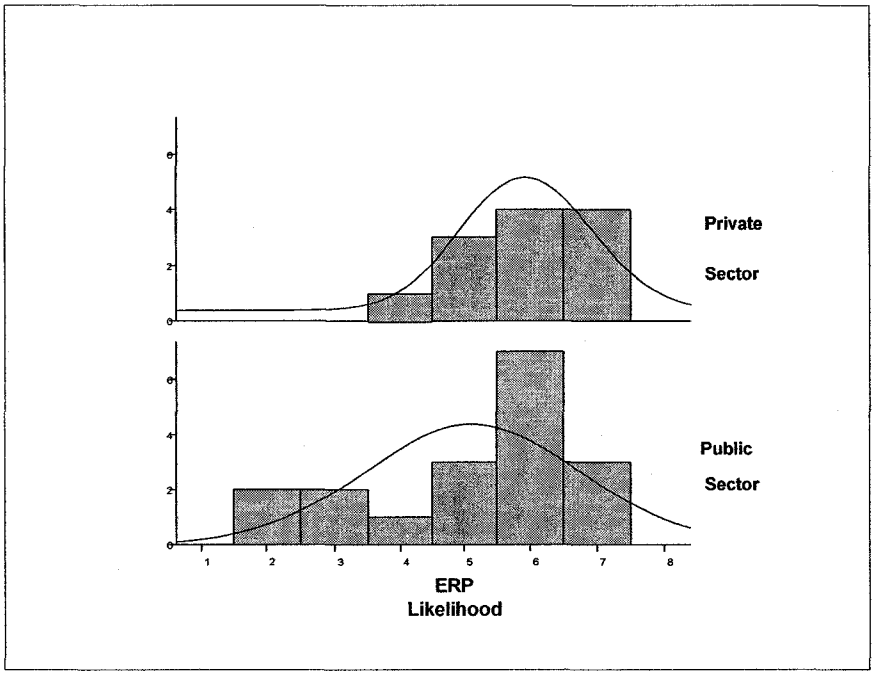

Figure 6-2: Likelihood of Having an ERP System in the Organization by Sector

6.1.3 ERP Skill-sets

Respondents were asked about the extent to which ERP users and their skill-sets were developed for the effective use of ERP in their organizations (again on a scale of 1 (low)-7 (high)). Interestingly, the responses were fairly dispersed as the responses ranged from 2 to 7 with a mean value of 4.4. Some of the organizations said that they were still struggling with the issue of developing the user skill-sets that are important for facilitating effective ERP use.

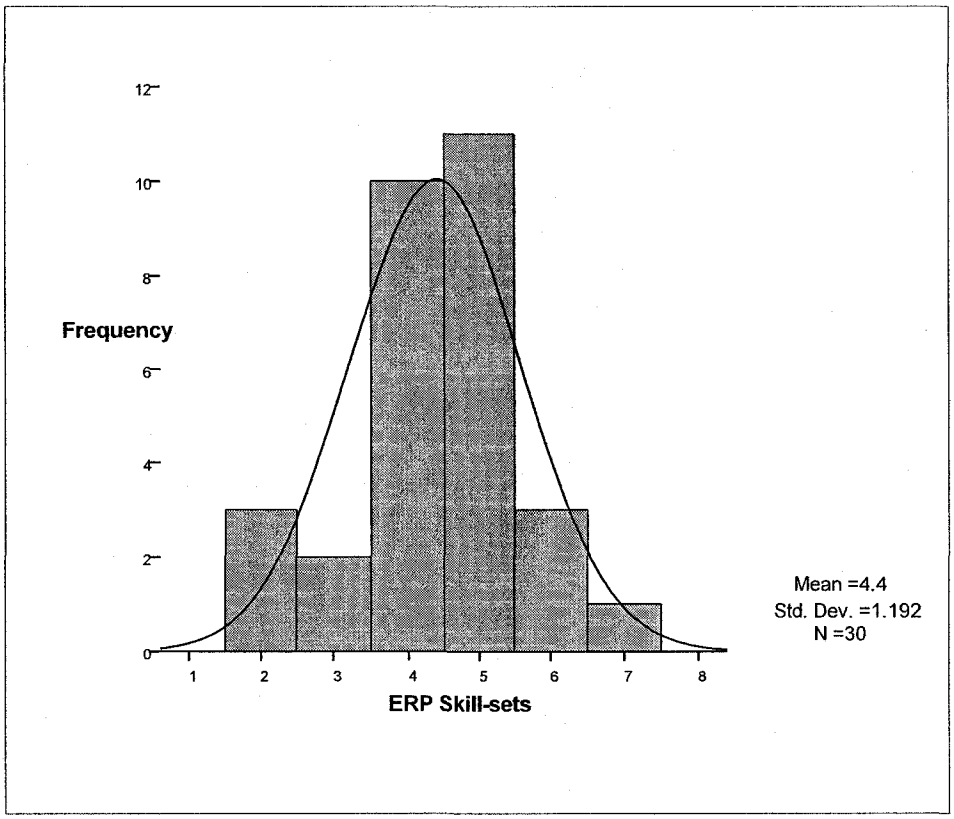

Figure 6-3: ERP Skill-sets of the Users in the Organizations

Interestingly, as evident from Figure 6-4, developing user skill-sets for effective ERP use was a bigger concern in public sector organizations than in private sector organizations. As one of the ERP manager (from Case Study X) explained:

"Our ERP system is still perceived in the government as a financial and materials management system. There is still a lot of reluctance in using it while we have expanded it to other functions such as HR and real estate management. Employees in those functions still view it as a way to encumber financial processes, not realizing how well it is integrated."

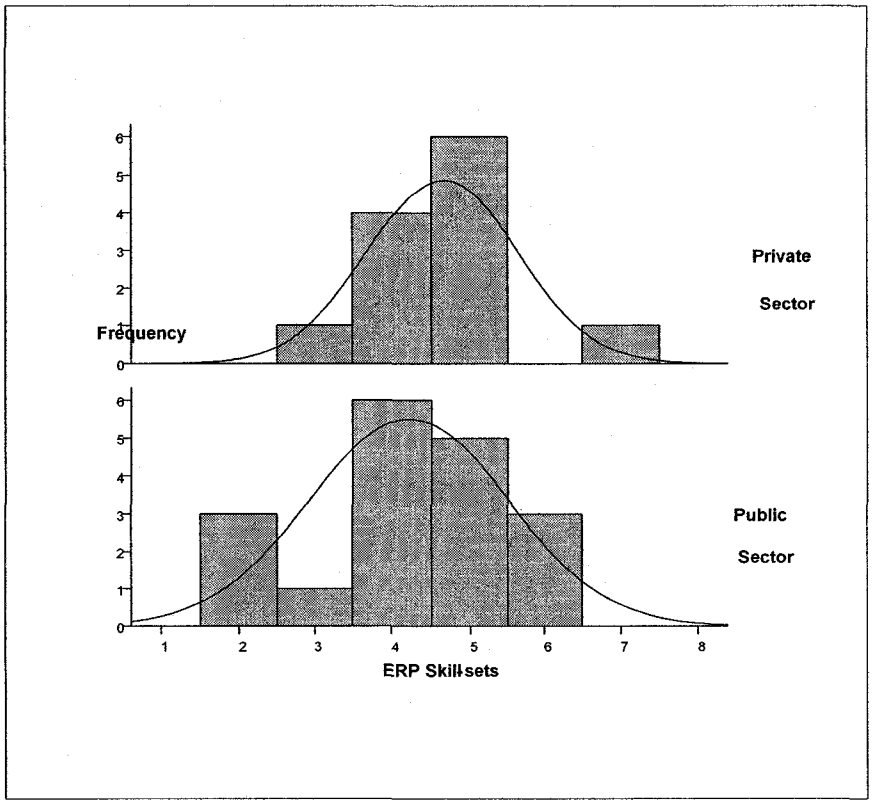

Figure 6-4: ERP Skill-sets of the Users in the Organizations by Sector

6.1.4 ERP Support

Institutionalization of an innovation fundamentally depends on the creation and continuation of structures that sustain the innovation. Technical and ERP support infrastructure is a structure that plays a key role in the institutionalization process as it helps the new innovation become established in the organization by creating a fit and balance with the organization's resources and information needs. Respondents were asked to rank on a scale of 1-7 (1 stands for low and 7 stands for high) the extent to which their organization has developed its technical and ERP support infrastructure to facilitate the effective use of ERP. Interestingly,

most respondents rated support for ERP systems in their organization as high. The mean value for support was 5.33.

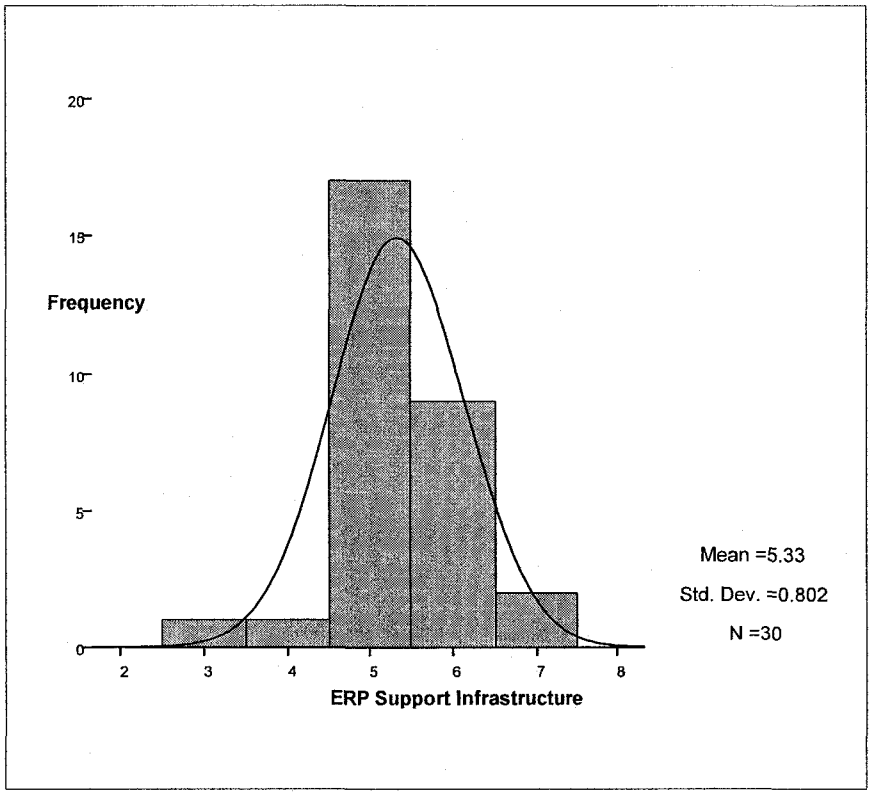

Figure 6-5: ERP Support Infrastructure Developed in the Organization

Interestingly, most organizations that gave a low value for the variable ERP support were organizations with 500-3,000 employees. Further investigation of these organizations revealed that these organizations faced significant challenges retaining skilled ERP support employees. Some of these organizations also faced difficulties in providing the adequate resources needed for running the ERP program. For example, one organization in the private sector said that its financial situation had changed drastically, due to the market downturn, since it had implemented ERP systems, and consequently, the available organizational resources to support the ERP program were also reduced. Similarly, another organization in the public sector said that it has

not been able to retain some key ERP support people, and as a result the support organization suffered.

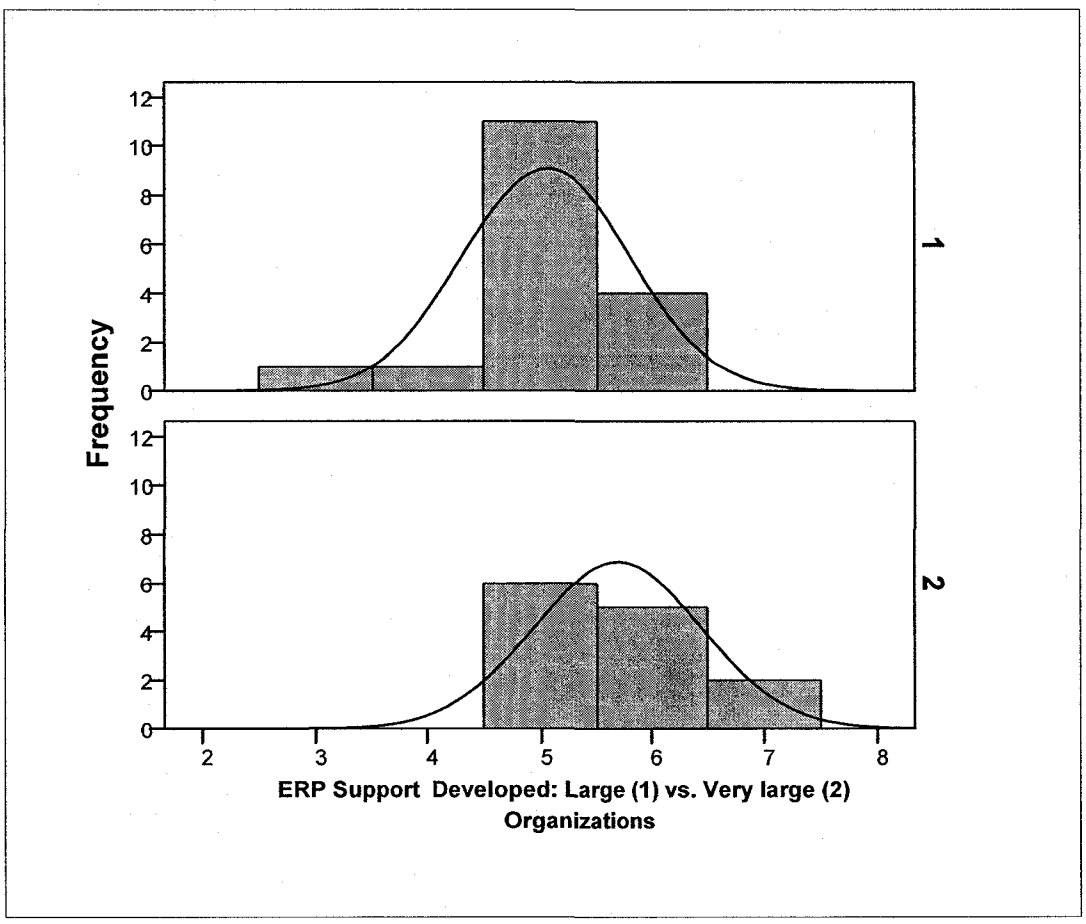

Figure 6-6: ERP Support Developed by Size

6.1.5 ERP Value Realization

Respondents were asked to rank, on a scale of 1-7 (1 stands for low and 7 stands for high), the extent to which their organization's implementation of ERP systems has enhanced its service delivery and value proposition to its customers. A high mean value 4.97 suggested that most organizations realized some value from ERP systems. Interestingly, the organizations that

could not realize the value were those that were not able to develop an adequate support infrastructure and/or were not able to provide adequate resources to their ERP program. This observation is interesting because the availability of slack resources discussed later, did not show significant correlations with the dependent variables of institutionalization success. The inability of the firms to develop an adequate support infrastructure affected value realization.

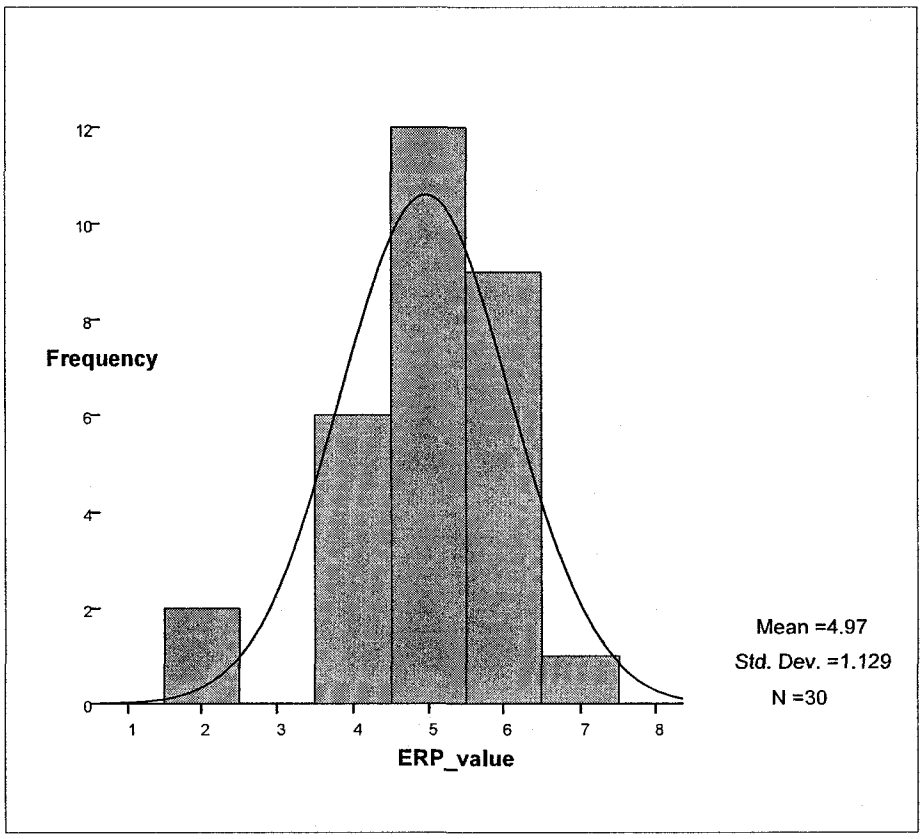

Figure 6-7: ERP Value Realized in the Organization

6.1.6 Entrenchment of ERP Systems

Respondents were asked to rank, on a scale of 1-7 (1 stands for low and 7 stands for high), about the extent to which the use of ERP system was taken for granted/entrenched in the

routine functioning of their organization. A high percentage of organizations reported that ERP systems were entrenched in their organizations. Some organizations that reported less entrenchment were those that have implemented ERP systems more recently and were going through the process. Interestingly, a few organizations in the public sector that did not have recent implementations also reported a lower level of ERP entrenchment in their organizations. Further investigation of these organizations revealed that these organizations had faced severe challenges during implementation, and the technical and semantic stability was delayed.

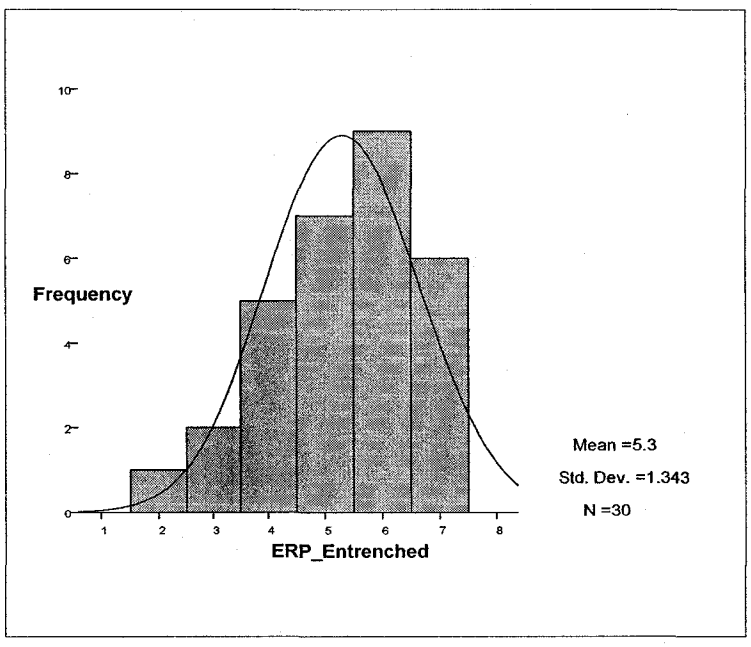

Figure 6-8: Entrenchment of ERP Systems in the Organization

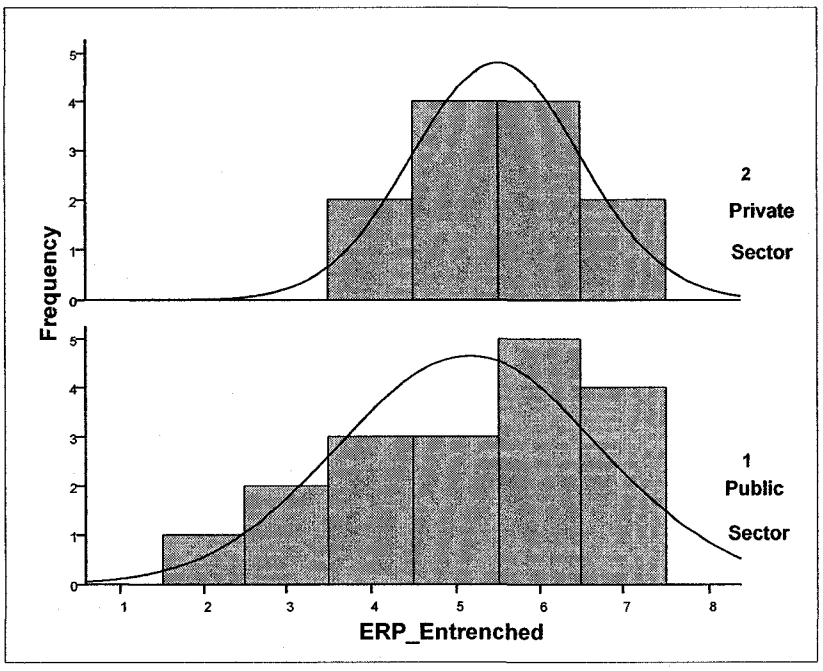

Figure 6-9: Entrenchment of ERP Systems in the Organization by Sector

6.2 Qualitative Data Analysis: ERP Institutionalization Model

In this section we discuss the analysis of the qualitative data collected in the third phase of this research. Additional information provided by the respondents in this phase helped us in delineating the institutionalization process in greater detail. The information was analyzed and assimilated with that collected in the previous two phases to enhance our understanding of the ERP institutionalization process. The enhanced understanding was used to refine the *a priori* process model, and several contextual details on activities, challenges, and coping strategies were added. The following subsections discuss and describe the detailed components of the process model.

We developed the *a priori* model using a grounded theory approach on the basis of data collected from three pilot case studies conducted during first phase of this research. In the *a*

priori model, we identified three broad and linear phases of the ERP Institutionalization process: Technical, Semantic, and Effectiveness. More structure and details are added to the model in the subsequent phases. The data collected in the second phase was also devoted to pretest and validating the research tool for efficient data gathering in the third phase. The third phase included significantly more cases studies and was devoted to gathering data from multiple organizations in different sectors and of different sizes to get a wider perspective of the phenomenon.

We found abundant support for the proposed model and its value proposition. Most respondents viewed this research exercise to delineate this complex phenomenon in greater details as valuable. However, one respondent raised some valid issues on the appropriateness of a process model, which she saw as a very simplified abstraction of this complex process. The discussion that followed was important in clarifying the process and highlighting its complexity. We use the following subsection of the qualitative data analysis to discuss some of those issues on the usefulness of process model raised by both this respondent and in the literature. The third subsection focuses on describing the key events that were used in this model to define the beginning and end of the three stages. The fourth subsection is devoted to describing the revisions and additions made to the model. The remaining three subsections focus on the three stages of the ERP institutionalization process, major activities in those stages, the major challenges in those activities, and corresponding coping strategies, which were also identified.

6.2.1 Applicability of the Process Model

The efficacy of modeling a complex phenomenon by a simple staged linear process is well debated in the literature. Several authors in the innovation management literature have criticized the linear process models as being too simple to denote the complexities of the

innovation process which is iterative and interlinked (Kline, 1989; Kumar *et al.*, 1996). Kline (1989) also proposed an activity chain linked process model to show linkages between various activities in different stages of the process. However, several other authors have maintained that even while being a simple representation of reality, linear process models are important and very helpful to managers in sorting the complexities of the innovation process and putting things into the right perspective (Markus and Tanis, 2000). Qualitative process theories are also extremely useful as they extend a language for intuitively characterizing a dynamic and complex phenomenon as a process. They provide researchers and practitioners alike with a simple language to describe dynamic theories and move beyond the static analysis of the final stage. We found ample support from leading researchers in both innovation management and institutional theory areas who advocated the need for process theory studies to establish the understanding of the phenomenon in general.

When we applied the process theory approach to study ERP institutionalization in this research, the debate was re-ignited during fieldwork. Interestingly, one respondent, who was a key player in her organization's ERP program and a senior functional manager, argued that, "Technological stability and semantic stability go hand in hand; you cannot achieve one without the other." We agree with the respondent and do not deny the cyclical nature of the ERP institutionalization process, as these ERP systems are implemented in several releases and go through several cycles of stabilization. However, by focusing on the initial cycle of stabilization that unfolds after first go-live, we are able to get a good view of the process that follows in the organization.

The efficacy of our model, and our selection of four key events that mark the transition of three stages in our model, was vetted by most of the respondents. They were also asked to

qualify the following four transition events used to identify the three stages in the model: First go-live, technical stability, semantic stability, and decline. Most respondents agreed that technical stability was needed before semantic stability could be established, and semantic stability was important before ERP systems could be effective.

6.2.2 Further Improvements to the A priori Process Model

The information collected in the third phase of this research was used in many ways to refine the *a priori* model. Several components of the model were added and/or described in greater detail. To develop this model, we relied upon the recommendations of several previous researchers, those who have provided guidelines for developing a process theory and those who have developed the institutional theory, along with information and insight provided by the respondents.

Forbus (1984) argues that a qualitative process theory model must explicitly specify the direct effects of the process and specify the means by which these effects are propagated in time. Previous research on institutional theory identifies the stability and entrenchment of the innovation in the organization as the direct effect of progress in the institutionalization process. This progress is propagated and sustained in the adopting organizations through the following three means: New Regulations and Structure; New Norms and Practices; and Changes in Cognition and Culture (Scott, 1995).

We found that these three means described by Scott (1995) as pillars of institutionalization clearly evolve through the three stages identified in our model. A distinct shift in focus was observed in each stage. For example, the focus of the organization in the technical stage was to develop regulations and structures to reduce disorder created by the introduction of new systems. These regulations and structures were often temporary creations

and were abandoned when the systems were stabilized and the technical stability of the systems was achieved. For example, organizations resorted to increased staffing and manual processes in the technical stage while coping with technical disorder in the period immediately after go-live. As one of the respondents described it:

"We significantly increased the amount of on-call availability during the first month. Having technical and functional resources always on call was important to deal with the barrage of technical issues after go-live. We also kept the consultants on for a while, half a year, actually some were on our payrolls for a full year." (ERP Program manager in Case Study P)

The focus shifted to developing durable structures and regulations with which to restore order in the organization during the semantic stage as one manager described it.

"...Often when managerial reviews were done to find out why things were not moving, they would find out that the things support teams were working on change requests issued by individual employees which were no longer the priority for the manager. Once the initial transition problems were brought under control we had to rework our support processes by putting a system in place that ensured the change requests were prioritized and vetted by senior managers, and functional resources such as time of employees for integration testing was committed before the request for change and support was issues." (ERP technical director, Case Study I)

In the effectiveness stage, the focus was on adapting the structures and regulations to accommodate the new requirements placed on the systems due to internal and external changes.

"We had periodic regulatory audits which ensured that the systems were compliant to regulations. These audits were a lot of work but good in the sense that they forced us to fix the loose ends and/or introduce changes to provide for new requirements which were identified when preparations were being made to face the audits." (ERP director in Case study W)

Similarly, we found a progressive difference in the focus of the organization in developing the norms and cognition within the organization during the three stages. Several respondent quotes cited in the chapter elaborate the changes in the focus and approach.

Mintzberg *et al.* (1976) describe process theories as important means for providing structure to unstructured and abstract phenomenon by breaking them into simpler components

(stages) and describing their elements, supportive routines and factors that influence them. In this phase of research we use the data to develop the model further by identifying some of the key model components. In the following subsections we identify and describe the key components of the model: a) the key activities in all the three stages and b) the main challenges organizations face in executing those activities and some coping strategies organizations adopted to face those challenges.

6.2.3 Technical Stage

The technical stage was qualified as the period immediately after go-live until technical stability was achieved. An organization in this stage typically depicts two models of behavior simultaneously: adaptive and inertial. Like a human body that has undergone a vital organ transplant, the ERP-adopting organization, while adapting to the new system, also displayed signs of resisting/rejecting it. The situation in the organization post go-live had to be carefully monitored and stabilized through temporary managerial interventions, which could be equated to anti-rejection medications in the case of a human body. A large component of rejection activity can be attributed to many employees/groups in the organizations who resist the change. Some of these employees were naturally cast as the opponents of the ERP systems, as they perceive the systems as detrimental to their position and power within the organization; however, there are others who fail to see the value proposition of the change. These interventions though temporary, are very important as they help in lowering the resistance from the groups opposing ERP systems within the organization.

"A large portion of employees within most of the organizations could not clearly see the value of the innovation when it went live. Many people could not get their work done with ERP systems." (ERP Director, Case Study H)

Too little distinctive capability is developed as limited resources are applied to plugging technological gaps and holes in the configuration. Most of the regulations introduced in this stage, and efforts made to develop norms and cognition, were also intended to cope with the major problems and disorder elements that were affecting operations and putting the organization in risk of failure. Minor issues were automatically ignored due to scarcity of resources and buried towards the bottom of the long list to be tackled later. Most organizations suspended their performance evaluations in this period of reorientation. The efficiencies and excesses incurred through costs of intervention were ignored. Additional resources were infused to plug deficiencies for immediate effect.

Regulations and structures introduced in this stage were primarily temporary in nature and were meant to reduce disorder. Similarly, efforts to introduce new norms and enhance cognition were also made keeping the transitory nature of the situation in mind. Super users were encouraged to remain on call and coach the users in their departments/functional areas while they became used to the system. Efforts were made through lunch and learn sessions, and user group meetings, to initiate greater communication and knowledge exchange among the users across functional lines.

We found that the focus in the technical stage was on major problems, which were mainly associated to the following five issues that constituted the major activities in the technical stage:

- Incomplete/Improper configuration of the systems during the implementation project,
- Inadequate knowledge transfer from project personnel's to the support team,
- Trouble with interfaces with other systems,
- Conflicts with the existing infrastructure, and

- Need for providing support to users at point of need support.

Table 6-3: Technical Stage Enhanced Summary

Stage Description	Key Activities	Major Challenges	Key Coping Strategies
Critical period immediately after go-live. The systems are new to the organization and high technical disorder exists. It ends with achievement of technical stability. High business and technical disorder Focus is on resolving major technical issues	Completing implementation	Unclear requirements Lack of resources and cost overruns	Business case methodology and templates introduced Project re-planning/course corrections
	Ensuring knowledge transfer	Over the wall approach Lack of incentives for knowledge transfer	Cross functional and jointly (vendor and internal) represented teams Knowledge transfer incentives built in contracts
	Finding ERP infrastructure fit	Lack of available guidance on sizing and infrastructure needs Infrastructure upgrades not planned	Hiring of experts Additional resources secured
	Managing Inter-linkages with other systems	Coordinating changes in the inter-faces Managing inter-face related software problems	Res-structuring of the organization to put all systems in the same group Influence vendors through user groups
	Providing point-of-use support	Annoyed users Lack of proper training tools	Employing excellent communicators on support teams Developing user aids and simulations

6.2.3.1 Completing Implementation

Organizations can rarely plan well enough and pursue major technology builds and implementation projects in a timely manner. Projects of such large complexity are plagued with multiple major challenges. Many of these challenges are well documented in the IS literature: problems with software components, problems with system integration, modifications and scope changes, turnover of key project personnel. Experienced project champions and managers, knowing very well that exceeding project schedules can threaten project success, often respond with cutting the scope when faced with missing deadlines. Consequently, we found that almost all the organizations had to dedicate resources to complete and close several issues that were left open during implementation. As two of our respondents explain below, going live their organizations had running systems but much more was required to make them useful:

"....Very few people have good definitions of what do you mean by going live. In our department here the go-live definition was can we pay a cheque, can we issue a cheque,- and we were able to when we went live- on a press of a button - able to pay a cheque. But we weren't able to process accounts receivable, we were not able to issue reports, and we didn't have budgeting capability. The implementation team in our case had set fairly easy goals for going live. Their focus was to make sure they can deliver on time. The organization that picked up had to fix things and also face the wrath of senior management by telling them that whatever savings you have promised in the business plan would never be realized." (Director ERP program, Case Study E)

"We knew what the minimum system requirements were to go-live and went live, but there was a pent up demand. We even knew that some of things we were leaving unfinished were important but we did not know how important they were until we went live.....We had to do a lot of hard work in fixing the systems after go-live to achieve technical stability" (Program Manager, ERP Project Case Study H)

Several organizations were forced to clean up the mess left by failed implementation projects in the post implementation phase. Correcting mistakes was also a major component of this activity.

"We had a fairly short period of implementation for our current ERP systems (93 days). They (consultants) put some ... things in place just because they had to put something in within the project deadline not because they represented the business need in the organization. Processes took a big hit; some of them didn't work at all. The technical configuration had to be redone immediately and to meet a certain level of requirements for the critical processes." (ERP Manager, case Study I)

Interestingly, most of the organizations in our sample that ran into extensive trouble with incomplete implementations were organizations adopting ERP systems to address the Y2K problem and had non-negotiable deadlines. The technical stage in several organizations studied, which were trying to negotiate Y2K- imposed deadlines, was much longer than planned project because managers reworked the scope to meet those deadlines. Some of the organizations took up to two years to get the desired functionality. Both public and private sector organizations, irrespective of their size said that completing implementation was a key activity after going live.

"My predecessor told the management that things would get up and running much sooner. However, the project got into challenges and I was hired to do some heavy lifting." (ERP Director, Case Study E)

Major Challenges and Coping Strategies

1) Inability of the business to clearly lay down their requirements:

In many cases we found that organizations had requests that were ill defined. The originators of the requests in several cases were not aware of what was needed to be done. Some organizations used the organizational processes to give the request originators all the details and inputs required by the support team to take up a request.

"What we did was we introduced a small template one and half page long and we expect a business case which we call project charter 3-5 pages long. What it included were simple questions: what are the costs, benefits, and constraints; who are the project sponsors; and what are key milestones." (ERP Director, Case Study H)

2) Lack of resources and cost overruns:

While resources for the implementation phase were planned and approved in most organizations, few organizations expected significant cost overruns and allocated in sufficient resources for complete implementation. Consequently, managers had to re-plan and negotiate additional resources for completing implementation projects. ERP programs showed significant cost overruns.

6.2.3.2 Ensuring Knowledge Transfer

Unlike the legacy systems environment where organizations rely heavily on internal capabilities for system development and subsequent deployment, organizations relied primarily on consulting firms to scope, size, and deploy ERP systems. Employees were expected to learn by either attending vendor-organized training courses or while working on project teams with consultants and other experienced colleagues. Knowledge transfer between project and support personnel was therefore a prime activity in the technical stage in organizations. Particularly in organizations that disbanded the project teams on go-live, it was a more prominent activity. Knowledge transfer in these cases was not just taking place between members of the same team, it had to occur between project employees and support employees who may not have known each other before.

Major Challenges and Coping Strategies

1) Over the wall approach:

As one of our respondents summed up in his comments below, in some organizations the project was handed almost over the wall to a new support team at go-live. Knowledge transfer

was difficult in such situations and the organizations resorted to hiring very expensive consultants to somehow manage the show and achieve technical stability.

"In our organization, it was up to the team that took over from the implementation team to fix the systems after go-live. We soon realized that all the things, including the business case, were defined wrongly. As a leader, I had to sit down and look at what pieces are in place and how am I going to fix them. And because at that time, 1998, there were not many employees (public servants) with the knowledge, we had to depend on very expensive consultants and they were not many either. Naturally we started racking up costs and came up with a new business plan which shocked our superiors." (ERP Director, Case Study E)

2) Knowledge transfer not built into employee contracts:

Some organizations did not stress upon knowledge transfer and documentation components in their service level agreements with the contract employees and consulting organizations. These organizations faced significant challenges as the level of documentation developed was poor and very little time was spent by the consultants in extending the knowledge to employees in the organization.

In some cases, where we had access to explore the ERP-project related knowledge management systems in the organizations (4 organizations), we found that it was not easy to retrieve project information if the system was not properly maintained. In one case, more than 20,000 documents had accumulated in the system from multiple releases of the ERP software because the project teams had not been trained in efficient documentation and knowledge transfer practices.

"The quality of documentation available in the knowledge management system was so poor that we found it more efficient to figure out design problems ourselves by going into the configuration. It took hours while it would have taken a few minutes if proper documentation was available." (ERP Director, Case Study P)

On the other hand we found a case where both the adopting organization and the contractor worked well together and created a positive environment for knowledge transfer. They

ensured that proper and current documentation was maintained in an efficient knowledge management system.

"One of the significant factors which led to a smooth post go live period for our organization is the consulting company we work with. We partnered at all levels: functional levels, technical levels, and project management levels. Along with a robust documentation system and implementation methodology, we created a buddy system, i.e., one of our own employees who was to take up the support role (post go-live) was matched up with a corresponding partner/consulting company employee in the implementation project team. There was frequent exchange of information between the consultants and our company employees. Consequently, most problems were raised right at the design stage. The support teams thus were well qualified and knew the systems. As well they knew how to find their buddy consultant in case of problems." (ERP Director, Case Study M)

6.2.3.3 Finding ERP Infrastructure Fit

Many organizations, especially those which went live before Y2K, found that the systems were not responsive. The folklore in one organization was that you can go for a coffee break after giving a run command and you may find on your return that the system is still busy retrieving your request. One of the major reasons for this was that several components of the IT infrastructure did not meet the ERP application requirements:

"The system wasn't exactly responsive as several of the computers were old and some were new but not set up appropriately. (vendor name) Operating system and (vendor name) database applications required fine tuning. The earlier version of our (vendor name) ERP software didn't have much integration with the version of system we were using." (ERP Director, Case Study O)

Second, as one of the IT directors of a large organization explained:

"We had no previous experience and data on growth of database and growth of infrastructure. We were quite surprised to see how quickly the disc space was used up and how quickly performance issues due to system sizing were ready to be looked at.... we had to cope with several hardware and infrastructure related issues. We are a decentralized organization so we had to cope with bandwidth issues, as well, when serving the regions from a central server. At the time of go-live the system was very slow...at that point if someone launched an (ERP vendor name) application, he could come back after coffee and find that the system still is not up." (ERP Director, Case Study E)

Many organizations in our sample had to invest a significant amount of resources on fixing or fine tuning the infrastructure for improved performance in the technical stage.

Major Challenges and Coping Strategies

1) Lack of guidance:

There was very little guidance available on hardware and infrastructure sizing issues, as each organization had its unique combinations of infrastructure components. As one organizational ERP manager explained:

"We had a (vendor name) version of UNIX. The ERP (vendor name) system was working on UNIX in several other organizations but we could not find any organization using the same UNIX version we were using. In [the] case of problems related to the operating system we had to find our own way out." (ERP Manager, Case study AC)

Most firms had to rely on experienced consultants or "technical wizards" (as the respondent referred to them) to bail them out, but finding and recruiting reliable technical wizards was an expensive challenge in itself.

2) Hardware and Infrastructure upgrades were not planned:

Hardware and infrastructure upgrades were not planned in the implementation project so the organization had to go through the process of getting additional resources from senior management. In some cases, organizations worked hard to accrue these resources by cutting costs on some other key ERP functions. This eventually affected the future extent of use and rollout of ERP. Getting the trust of senior management again was a difficult process, and we found that project leaders were replaced in many organizations.

6.2.3.4 Managing Inter-linkages with Other Systems

Many organizations continued to use several other applications along with ERP systems at go-live. Many of these applications are interlinked; as they either feed in data into the ERP systems or are fed from ERP data. Organizations resorted to middle-ware brokers to integrate these applications or point-to-point interfaces when these applications needed to work together.

We found that these inter-linkages needed significant attention after go-live. In many cases, these inter-linkages did not work properly and in others they were frequently affected due to changes that were being made to the ERP systems in the technical stage.

"We continued to use many of our mission-critical legacy applications which were interfaced with the ERP systems. Managing the changes in the interfaces when one of the interfaced system[s] or when the ERP system changed (to incorporate a patch) was a prominent activity. Any change in the ERP system or the other systems meant that the inter-linkages had to be tested and/or updated." (ERP Manager, Case Study D)

In some cases the systems were not technically compatible or they were not widely inter-linked. Consequently, these inter-linkages were also new technical territory for ERP experts representing the vendor. As one of the managers explained:

"We had severe technical issues around integration of the work flow application which was supplied by another vendor (name). That was probably the biggest challenge because the technology was too new our ERP vendor was also figuring out issues with integration as were we. We had to bring in experts from the vendor's development headquarters frequently. That was the only one way out to deal with this problem." (ERP Director, Case Study P)

In one case, we found that inter-linkage was a severe challenge even when the other application was provided by the ERP vendor itself.

"We went in for this e-commerce application considering that there will be fewer problems as it was from our ERP vendor. However, we still found significant problems, as only the marketing organizations were merged as a result of acquisition of (name) this small company by (name) the ERP vendor. Technical organizations were still run separately and they had not figured out the integration issue we ran into." (ERP Manager, Case Study AD)

Major Challenges and Coping Strategies

1) Coordinating interface changes in very large organizations:

Several very large organizations who participated in this study had IT departments containing several hundred people. In some of these organizations, we found that different systems were managed under different directorates. ERP managers had to cross bureaucratic

boundaries to coordinate changes in the interfaces. At times when priorities differed in the support organizations of different systems, or if the communication link between employees managing the change were broken, significant number of difficult problems were faced. Organizations were trying to reduce this problem by restructuring their IT organizations and introducing better coordination mechanisms. For better coordination, one organization brought all the system organizations that interfaced with ERP under the same head.

2) Managing New Problems related to interfaces:

Organizations worked with vendors and/or user groups that shared information regarding problems. However, they faced significant challenges in resolving new problems related to interfaces when they surfaced. The first response from the vendors as one of the managers explained, was to lay the blame on the "other application." Particularly, in the cases of relatively smaller organizations in our sample (500-3,000 employees), getting the attention of the large vendors to new interface-related problems was a significantly more difficult issue. Organizations had to pursue the matter vigorously and isolate the problem as pertained to the vendor before proper attention was given.

6.2.3.5 Providing Point- of-Use Support

The technical stage also involved lot of user handholding and providing point-of-use support. It was an essential activity in most organizations which allowed them to work with the new systems in times of technical instability and gradually restore user confidence in the technology. It achieved two key objectives for the support organization: a) help the users in negotiating the newness of the technology and associated changes and b) help the support organization in sieving the complaints, whether they were due to users not understanding the system or due to conflicts in the configuration itself.

Most organizations encouraged users to call the support staff or super users in case of any problem during the technical stage. Support staff in a few organizations employed user screen control programs to walk them through the problem whenever possible, or came back with the relevant information when immediate solution of the problem was not possible. Simulations of screen shots or transaction scripts were frequently used by organizations to guide the users with transactions.

Major Challenges and Coping Strategies

1) Dealing with the annoyed user:

In many organizations ERP projects did not deliver functionality as expected on go-live and high technical disorder prevailed. Users in these organizations were annoyed due to the extra manual work needed to do the procedures that they had mastered with very little effort in the legacy environment. Some of these users associated their troubles with the systems and the people who were supporting these systems.

"On our old system, all the information could be entered on one screen; now our people had to enter information on 8 screens. Before it would take them a minute, now it would take them 10 minutes for that transaction. There was a 10-fold increase in the processing time. No wonder our people were frustrated and angry." (ERP Director, Case Study W)

Ensuring the availability of knowledgeable team members who had good communication skills was a key coping strategy in dealing with difficult users. Interestingly, as one ERP director commented:

"..Our support personnel were selected for their excellent technical skills. Many of them were poor communicators." (ERP Director, Case Study I)

One organization placed a senior human resources employee who was an excellent communicator on the support team, to coach ERP support staff and work with them on difficult cases and, at times, to interpret the situation for them.

2) Lack of appropriate tools and user aids:

Very few organizations invested resources in making appropriate tools to help the support function and develop point-of-use aids for the users themselves. The support staff in the organizations that did not invest in tools found more challenges in keeping track of user issues and resolving user requests efficiently.

Support management tools were found to be very helpful by organizations which invested resources in getting them. As one of the respondents commented:

"We found that many issues in this stage were related to lack of information and or newness of the software. The issue-tracking software was very helpful in analyzing the trends in support requests and we could proactively develop user aids (transaction simulations), which could walk the users through the process they were facing problems with or stress those points in our communications and training programs." (ERP Director, Case Study C)

6.2.4 Semantic Stage

The semantic stage was qualified as the period after technical stability was achieved, which ended when semantic stability was achieved. Assimilating the new system in the organizational realm by developing new regulations, organization learning, support structures, user skills, and norms dominated the ERP manager's agenda in the semantic stage. If we extend the vital organ transplant example, the organization in this stage has overcome the rejection threat, but has not yet developed the understanding, skills, and support systems required for thriving with the new systems. Organizations continue to face problems with the new systems until systems are semantically stabilized; this happens when a threshold understanding of ERP

systems is created and regulations, norms, and practices that facilitate routine system use are developed within the organization. We found several interesting insights into the dilemma organizations face in adapting to the new environment.

> "ERP systems introduce a new architecture within the organization that is integrated and its development is managed by the vendor. Unlike the previous environment of home grown legacy systems where systems could be tinkered to respond to the demands [of] powerful functional managers, any change in the ERP environment is constrained by several inter-dependencies and capabilities available within the application." (ERP Executive director, Case Study H)

Unlike the technical stage, the organizational focus in this stage is more on making interventions for developing norms, cognition, and culture for effective ERP use. Regulations and structures introduced in this stage are more stable in nature and are meant to restore order. Similarly, efforts are made to introduce new norms and enhance cognition keeping the longer term efficiency and effectiveness in mind. Super users are encouraged to remain on call and coach the users in their departments and functional areas. However, the focus of their efforts is on helping users in developing the enhanced capabilities required for utilizing the advanced features of ERP systems. Retraining is often provided to extend more efficient working models or best practices to users who are already using the systems. Use of propagating success stories through newsletters, presentations, and web casts is employed by several organizations to reinforce best practices. As the organization gradually resumes doing all its routine activities with the new systems, the focus is shifted from project activity to regular operations. Efficiencies and excess costs are no longer ignored. New performance measurement and evaluation frameworks are introduced.

We found the focus in the semantic stage was on major problems that were mainly associated with the following five issues which drew major activities in this stage.

- Prevailing confusion around the status of the systems,
- Several administrative and business policy were not aligned with the new systems,
- Support was provided through an ad-hoc organization and lacked robust processes,
- Systems were in conflict with several organizational processes, and
- Systems components required adjustments for performance.

6.2.4.1 Reinforcing the Change

Reinforcing the change was a major activity in the semantic stage. Even though the organization had achieved technical stability and weathered the roughest period of the process where nothing seemed to work, several doubts about the efficacy of the new systems and their ability to provide for organizational information needs remained. We found that ERP systems and the organizations themselves were still undergoing changes in the semantic stage and a high amount of confusion prevailed around the status of the system.

Having faced a considerable degree of change in their business and systems environment over the last few years, most managers and employees realize that their organizations must adapt to the changing environment in order to survive and prosper. However, significant difficulties and practical challenges commonly exist in managing the change. First, there are different views on how the change should be approached; for example, should change occur in small increments over a relatively long period of time or in an accelerated manner during a relatively short period of time.

Table 6-4: Semantic Stage Enhanced Summary

Stage Description	Key activities	Major Issues	Key Coping Strategies
Period between achievement of technical stability and achievement of semantic stability Business disorder still exists. Organizational focus in on establishing a better understanding of the systems to provide semantic stability.	Reinforcing the change	Managing expectations Managing bad news	Phased approach Daily updates and periodic news letters User participation in ERP committee meetings
	Changing administrative and business policies	Employees do not see value in changes Data on effectiveness of policies is hard to find	Communication to the organization Track data on policy effectiveness
	Developing support process and organization	Loss of key personnel Managing business/IT relationship	Engage consultants on a long term basis Steering committees, cross functional teams
	Ensuring ERP organizational fit	Vendor organization is not responsive Developing new models for service	Work with vendor representatives, user groups, and other forums New job descriptions
	Fine tuning systems	Prioritizing improvement projects Getting needs defined clearly	Policy for addressing issues based on importance Getting request originators to provide required information

"Helping the employees to understand the nature of the innovation was a key objective after technical stability was achieved as it was now only that the organization was ready to address the employee needs. The whole focus in the technical stage was making the systems workable and reduce business disruption" (ERP Director, Case Study W)

Major process changes also have significant implications for the employees in the organization who are used to the traditional ways of doing things in the organization. In many organizations, we found that ERP managers had to extend extensive support to make the change happen and achieve a fit. As the following two quotes from our respondents explain,

"Our organization is divided across French and English product lines. For example, we had two scheduling systems: one for the English and one for the French. When we put in the ERP systems we combined the French and English systems. However, it took us a while to get the common approach accepted in the organization and making [sic] it fit with the organization. It was very difficult at times for us in terms of making the changes to the systems." (ERP Director, Case Study L)

"In the old system, the (time recording application) system assumed that you were always at work unless you recorded an absence. So you recorded when you were on vacations. You recorded when you were sick. But other than that, the system said you were always here working. The way our new system works now is that you have to record all your attendance, i.e., I have to record that I worked on this project for three days and then I record that I was absent for two days. So it's the positive kind of recording. It was a big cultural change because before people didn't have to enter their time except when they were absent. Now they have to enter all your time. There were many complexities involved, which had to be taken care of before the new arrangement could work. Some people work on 15 projects, so they now have to record time for 15 projects. Of course, that was essential in terms of project . . ." (ERP Director, Case Study Q)

Reinforcing the change in terms of continued organizational support to the users and ERP program and communicating its activity status and the progress made so far is an important activity in this stage. It requires close involvement of both IS and organization leadership who have to assure the organization, using facts and figures, that technical stability has been achieved and significant progress is being made on several other fronts. The role of the program office or the organization that governed ERP systems was important in this activity, as they coordinate

this activity with the IT/IS and business leaders. Organizations used numerous means to communicate the progress made within the organizations and to propagate success stories, such as newsletters, lunch and learn sessions, emails, and memos. A few organizations in our sample also developed a web-based portal and/or used the firm's Intranet for communication and interaction with the employees.

Major Challenges and Coping Strategies

1) Managing expectations:

In the case of ERP systems, unlike the legacy systems, user expectations of system functionality are very high. Several of these expectations were ungrounded, as they were created by marketing campaigns or by some widely used managerial and consulting models not the ground reality within the organization. These sources promised a lot more than what can be practically achieved in their organization. Communication between the ERP support group and users is important to explain the reality and constraints under which the organizational systems program needs to work. This process is also important as novel ways to improve the program emerge when a communication link is set up between people who support the system and those who use it on day-to-day basis.

2) Communicating the bad news

In many cases we found the ERP managers had to undertake the tough task of informing their clients/users that the service they promised will not be available or that there is a delay. Many of these ERP managers were not liked in the organization because changes in the early stages of the systems they were supporting were adversely influencing the work life of the employees in their organizations.

"One of the key things I had to confirm to my organization was that going live is not an end, it is rather the beginning of a new end. We knew what we had to do to go live, but we also recognized that much more … needed to be done in terms of fixing the systems after going live." (ERP Director, Case Study H)

Organizations resorted to a phased approach and rolled out changes in stages so as to create the least disturbances to the routine working of the organization as a whole. Employees were involved early in the change process and asked to contribute by participating in committees dealing with departmental issues.

6.2.4.2 Changing Administrative and Business Policies

Introduction of ERP systems in the organization also extends several new capabilities to the organization. To harness the new capabilities provided by the system, several new administrative policies were needed and changes needed in many existing ones. We found that clarification, simplification, and standardization of new and changed policies were key activities in the semantic stage. Several clarifications were required before a policy could be implemented as desired. To make the new policies effective, managers had to make them simple and then standardize them for widespread usage, especially if the organization was very large.

Policy making activities required a heavy involvement of cross-functional process innovation teams in some of the organizations which took a systematic approach to managing this activity. Several organizations, however, took an ad-hoc approach and policies were changed mainly when urgently required, with very little time spent in anticipating intended and unintended consequences of the change.

Major Challenges and Coping Strategies

1) All employees do not see value in policy changes:

Many employees and managers do not see value in policy changes that affect them and continue to resist the change in active and passive ways. Getting such employees on board to contribute positively in the implementation of new policies was a significant challenge. Organizations, realizing the difficulties in changing opinions, tried to involve them in the change as much as possible to ensure that they contributed constructively and were not further alienated.

"...This particular senior manager was one of the most respected and experienced person[s] in the organization. I could not change his opinion about the changes we made to the HR policies with the introduction of the new systems, but we still engaged him in the process improvement process to not to miss on his experience. He remained a vocal critic but contributed significantly in improving the policy." (ERP Director, Case Study H)

2) Data on effectiveness of policies is hard to find:

Many organizational policies are based on managerial hunches, rather than on data and facts. Additionally, data on policy outcomes is hard to find in organizations, which makes the process of simplification and standardization difficult. Organizations tried to introduce new measures to monitor the policy outcomes going forward so that they could be used in future simplification and standardization.

6.2.4.3 Developing Support Processes and Organization

Perpetual use of ERP systems requires regular maintenance and enhancements, training and end user support, operational budgets and dedicated resources, and an extensive organization with adequate decision-making authority and processes to support these activities. While temporary structures and processes were used in the technical stage, developing a maintenance and support organization was a prime activity in the semantic stage. We found several models of support organizations were being used by the organizations.

Centralized ERP Services Model

Several organizations grouped all ERP-related employees into a centralized group, which was the central source for supporting all ERP-related activities- such as development projects; responding to change; and support requests, maintenance, and upgrades. In very large organizations this group was further sub-organized on the basis of the functional modules they supported or the major activities the group performed. Mostly, this group reported to the Chief Information Officer. In one case, we found it reporting to the Chief Financial Officer.

Decentralized ERP Services Model

This model used by a few organizations placed the functional analysts within the functions and reported to the functional managers while the core IT support people (ABAP programmers, BASIS consultants, and database administrators) were placed with the central IS organization and reported to the CIO. Functional analysts who worked closely with the IS team resolved all functional application-related issues, while the IS team looked after all technical issues

Federated Center of Excellence Model

This model was used by the Canadian federal government organizations we studied, who despite being very large organizations independently were part of the government and mandated by the Treasury Board regulations. In this model several departments combined resources to create a core (program) office that co-ordinated the activities related to the same vendor systems in the government. As one of the respondents explained:

"In the central government, we created federated support structure with a common and central support group called the IFMS (Integrated Finance and Material System) core group. Each department which is a member of this core and a SAP shop pays to have this central group,

which has become a center of excellence for 15 departments. In the department, we have a support structure here too, we have our own technical shop BASIS, ABAP, Knowledge Management, WEB, Functional groups (account[s] payable, account[s] receivable, budgeting, reporting and so on) for configuration, training and support. " (ERP Director, Case Study Z)

Federated ERP Service Provider Model

This was a novel and interesting model used by 18 independent provincial government organizations that were mandated to deliver similar services but in different areas of the province; they partnered to create a shared ERP service organization. This organization was governed and resourced by all 18 members and provided all the ERP services and needs to the partnering organizations. This model helped them gain significant savings as same technological infrastructure and people were used to provide the services.

The ERP service and support organizations need coordination and decision-making processes to smoothly run support activities for example, in most large organizations prioritization of requests was an important process. A decision process had to be put in place to help the support organization decide which request on the list to address first. Several of these decision processes needed inputs from other functions. Committees were frequently used to ensure coordination and inputs from other functional managers and employees. In very large organizations, it was a challenge to coordinate activities within the group itself so some organizations had to resort to an IT leadership committee comprising IT executives. An architecture committee was used by some organizations to ensure standards were followed and the organizations' IT architecture was respected and maintained. Organizations used IT councils and steering committees for making investment decisions and tracking projects. Process committees were used to get input on process changes with representation from the affected process owners and IS support people.

Major Challenges and Coping Strategies

1) Loss of key personnel:

Invariably, all organizations lost a few key personnel after go-live. Organizations relied on holding on to some consultants for longer than planned periods of time. As one manager explained:

"I kept one consultant engaged on our rolls just as insurance for someone leaving unexpectedly."

In some cases, where the project team was disbanded and the project was handed over to a support organization, turnover was found to more prominent as the support organization was able to retain many fewer trained and experienced project personnel.

2) Managing Business/IT relationship:

Managing ERP systems in the organization is a tough balancing act where the adopting organization has to coordinate the activities of two distinct groups within the organization: ERP users (business) and ERP support (IS/IT). These two groups operate with distinct cognitive frameworks and these groups often have different priorities. For example, the users are often inclined towards fulfillment of their short term need: "Solving today's problem which is bugging them right now." However, these problems could be antagonistically placed to long-term IT architectural concerns (costs, order, etc.), which are often the focus of the IT group. The support group, which is dominated by IT professionals, tends to be pre-occupied with standards, mastery of technology, and orderly deployment at the cost of slow response or no response to legitimate business needs. Managing the relationships of these two set of people and aligning their priorities was a major challenge for ERP managers.

Several changes were made in both IS and business organization to enable the effectiveness of ERP support organization. For example, many organizations in our sample ensured that business process re-engineering in the ERP organizations was equally an IS initiative as much as a responsibility of the functions so that when functional employees were making changes, IS architectural concerns were not ignored. An IS support group was brought in at the early stages when the organization was contemplating, making changes in the business processes to ensure that there were no surprises related to the systems.

"We brought in the HR and payroll experts when the union agreement was being deliberated. We were able to save significant dollars in IT investment which we had been putting in for years when we signed complex union agreements without thinking about practical nuances of implementing them though our systems. " (ERP Director, Case Study I)

On the other hand functional managers were involved in the ERP governance committees to ensure that functional concerns were addressed properly by the ERP support organization.

6.2.4.4 Ensuring ERP Organizational fit

ERP systems, unlike the legacy systems, are generic software applications developed for use by a large cross-section of organizations. They do not correspond automatically to several organizational processes and working styles. Ensuring that the systems fit with the organization, its work processes, and its strategic priorities is, therefore, a prominent activity in the semantic stage. Organizations devote a significant amount of resources and time in ensuring this fit. As one respondent explained:

"Our real estate requirements are so complex because of the nature of organization which is extended throughout the world. We have to deal with different legal systems, different leasing regulations and several other issues. We had demos from our ERP vendor but our requirement of maintaining leases in foreign countries was not addressed as they did not have this capability." (ERP Director, Case Study Z)

The fit is achieved mainly by changing the business processes to suit the systems. However, when processes cannot be changed, organizations resort to interfacing their ERP systems with other systems that can handle those business processes. In some cases, few minor changes are also made to the ERP systems to accommodate mission-critical organizational processes. However, making changes to the ERP systems is ill advised and expensive as it is a recurring investment - as changes need to be maintained with every upgrade. Interestingly, we found that some organizations in our sample decided to carry on their work without making any efforts to address some of the misfits.

The problem of misfit was found to be more deeply routed in the government organizations where a lot of processes mandated by legislated requirements were not yet supported by the ERP applications. One of the ERP directors in a federal government department explained

> "We made a decision to adopt a product designed for business organizations. However, we don't carry enough influence to motivate the vendors to modify their product to suit our needs. We are trying to influence them and how their products evolve by being part of the public sector user groups. This has led to more exposure of public sector needs within the vendor organization. The creation of the core program office has also been helpful as it allows us to join forces to make the vendors listen more." (ERP Director, Case Study Z)

Major Challenges and Coping Strategies

1) Vendor organization is not responsive:

Several organizations complained that large vendors were less responsive to their needs. Some of the managers expressed extreme frustration in their dealings with the vendor organization, even for resolving genuine complaints. Organizations were responding to this challenge by taking an active part in user groups that could influence the vendors. However,

several organizations in our sample that were relatively smaller (500-3,000 employees) said that they did not have spare resources and incentives to send their employees to user groups. They seemed resigned to continue a one-sided relationship until they were able to find a better alternative.

2) Developing new service delivery and support models:

Very little guidance on the effectiveness of service delivery and support models was available. Organizations had to go through a long process of implementing and tweaking the models to find a fit. Old and new employees had to be constantly educated about the new support model and policy changes and how they differed from the old one. Unlike the legacy systems where many organizations had developed the systems in-house, ERP support organizations were, in many cases, ill equipped to make major changes to the systems. And even when, the organization is technically equipped, the changes desired are often not practically possible, due to several reasons, or ill-advised.

"The whole vendor-supplied methodology and consultant support was there to get you live. There was nothing available to tell you how to pick up from there." (ERP Director, Case Study H)

"....as most of the staff you had on the implementation team was borrowed staff and many consultants, you now have to realign an operational structure. With the old one you had programmers and systems analyst[s]. For this one you need [a] business analyst, financial analysts, [a] materials management analyst, a few programmers, but not all that much. So it is a whole new game; it's a whole new environment so you have to create a new organization to support the ERP systems. And being part of the federal government, anytime you think of making a new organization means new job descriptions, new competitions, new classifications, and so on. The challenge easily sums up and you are faced with something that would take years to achieve and, as a result, by the time you build your organization to support the systems you have racked up huge consulting costs." (ERP Director, Case Study E)

6.2.4.5 Fine-tuning Systems

While the technology was stable in the semantic stage, several small interventions were still ongoing to fine-tune the systems to improve the overall system performance. These efforts were directed towards improving the utility of the system and resolving several minor issues that could not be addressed in the technical stage due to time and resource constraints.

Major Challenges and Coping Strategies

1) Prioritizing improvement projects:

Prioritizing which issues were more important and would make the most impact was a challenge. In several organizations we found that issues raised by the most vocal and/or important stakeholders were addressed first, irrespective of their importance for the organization. On the other hand, some organizations used *a priori*tization committee to handle which issues would be resolved first, on the basis of their importance to the performance of the organization, and which resources will be allocated to the activity. These committees were generally cross-functional to bring together the expertise that could take decisions on which issues were needed for early fixes and which can be finished later.

2) Getting business people to clearly identify their needs:

In many cases we found that organizations had ill-defined requests. The originators of the request at times did not provide enough information to qualify their requests. Organizations used templates and procedures to make sure that help request originators provided all the detail and input needed from their side.

6.2.5 Effectiveness Stage

The effectiveness stage is primarily the stage when stability, both semantic and technical is achieved. An organization in the effectiveness stage has weathered the storm caused by the

technical and semantic dissonance created by the introduction of new and advanced technological system. Now the need is to use the system serviced by an effective support environment for long-term operations to realize benefits. At this stage the organization is more concerned with problems related to optimizing and improving outcomes through continuous improvement. Several examples were uncovered in this study where the organizational members were able to leverage the ERP systems significantly in their day-to-day activities and in achieving organizational objectives.

If we extend the organ transplant analogy to this stage, the organization has mastered the change and developed an excellent support system to thrive in the new setup. The issues are more related to new developments and requirements which emerge with changes in the business and organizational environment. Upgrades to the system by applying patches and new software releases, consume a significant portion of resources and managerial attention in this stage. With organizations relying on the vendors for development and support of ERP systems, upgrade cycles are also dictated by vendor releases. We found that managing upgrades was a significant concern and managers were often frustrated by their lack of control in deciding when to upgrade.

New information requirements were often created by internal and external changes. For example, organizations undergoing an expansion or addition of a new business line or product had to scale their systems to accommodate new requirements. Similarly, changes in business models, mergers, acquisitions, and new regulatory requirements all have significant system implications and create additional work for the managers. Norms and practices for executing system responsibilities have changed in many ways. For example, unlike the EDP departments of the past who owned the data and provided it to the functions on request, data in most ERP organizations is owned and managed by the functions themselves. Business organization has a

far greater say in the IS initiatives as they participate heavily in the steering committees that decide which IS projects are to be funded. Similarly, involvement of IS representatives in business process changes and reengineering initiatives is early and more pronounced.

We found the focus in the effectiveness stage was on realizing the potential benefits. These were mainly associated to the following five issues which drew major activities in this stage:

- Keeping the systems current,
- Providing for new organizational needs,
- Improving the business processes,
- Improving usage levels for advanced application features, and
- Tracking Benefits.

6.2.5.1 Managing Upgrades

Managing upgrades is a major and almost constant activity for an ERP support organization. Their intensity may vary (from small patches to big releases) but upgrades are integral to any ERP software as the means through which the vendor provides fixes and additional functionalities in the software. Several upgrades were found to be as big as a major project.

"...Upgrades are not always easy and simple; several upgrades have implications for the infrastructure and may lead to significantly large projects." (ERP Director, Case Study O)

Not many ERP managers were enthusiastic about upgrades. While managers of avant-garde organizations found that upgrades offered too little improvement too late, those in more conservative organizations found they were often unnecessary.

Table 6-5: Effectiveness Phase Enhanced Summary

Stage Description	Key Activities	Major Issues	Coping Strategies
• Period after semantic stability is achieved till decline/replacement • Most potential benefits are realized • Focus is on enhancing the effectiveness of the systems	Managing upgrades	Scheduling upgrades Skills upgrade	Introducing a periodic process for system outages for upgrades Training programs
	Managing enhancements	Change management Retraining	Communication of changes New policies
	Continuous improvements	Getting employees involved Managing unintended consequences	Incentives for employee involvement A review process for evaluating impacts
	Enhancing adoption and use of advanced features	Enhancing employee qualifications Controlling use of shadow applications	Programs and courses for higher skills New regulations Counseling and coaching
	Performance management	Data collection Accounting for intangible benefits	Adding new fields for data capturing in ERP applications Enhancing awareness about intangible benefits

"...we fought to get an upgrade, as we thought the older version was underpowered to meet our needs, but the time the ERP vendor took to respond was a lot the feature desired has lost much of its value by the time it was available." (ERP Director, Case Study K)

"...many of the upgrades are totally useless as far as our organization is concerned; however, as they are part of the support package deal they have to be implemented." (ERP Director, Case Study S)

One of the managers in a more conservative ERP organization commented sarcastically:

"Our organization forgot about upgrades when they were planning for ERP." (ERP Director, Case Study AA)

Upgrades were particular despised by ERP managers of organizations who chose to make customizations in their systems. As one of our respondent commented:

"...By the time you finish stabilizing the ERP systems, you find that your ERP vendor has upgraded and will no longer support certain functions. The system per say is easy to upgrade but we have to spend a lot of time in testing all the interfaces and the modifications we have made in our systems." (ERP Director, Case Study S)

Major Challenges and Coping Strategies

1) Scheduling upgrades:

Scheduling upgrades was a major challenge for the organizations, as it needed system outages and dedication of resources to the upgrade activity or project. Managers had to defer all other activities at times of upgrades.

2) Retraining of employees:

Some upgrades meant significant changes in the way the things had worked before upgrades. Retraining was required to make the change.

6.2.5.2 Managing Enhancements

Organizations in the effectiveness stage often need to add new modules, features, and/or some configuration changes to enhance their ERP systems. Enhancements are important for negotiating new information needs and requirements put on the ERP systems by changes in the organization's business models, competitive environment, and, sometimes, compliance-oriented legislation (such as Sarbanes Oxley (SOX) act of 2002).

Enhancements could be large or small, depending on their scope and impact. For example, compliance to SOX legislation has been a major project for many public listed organizations in the United States. Significant changes have been made to business processes, controls, and ERP systems (which enables the organizations to implement the processes and controls) to comply with SOX requirements. Enhancement projects are a major activity in the effectiveness stage, which need significant management attention. Many organizations in our study treated delayed implementation of some modules as enhancement projects.

"When you go live with ERP, usually it is most likely not a full/whole implementation. It always takes time after go-live to fix the systems for usability." (ERP Director, Case study O)

"We had employee self serve capability on our plans but it was help-up in the initial project considering that ERP systems were already a big change. We implemented self serve now that the back end HR module has stabilized" (ERP Director, Case Study A)

Enhancement projects can pose significant challenges for the ERP organizations. The organization undergoes a new cycle of stabilization although not at the same scale and intensity as it is more familiar with the technology and has significantly developed capabilities to manage the implications.

Major Challenges and Coping Strategies

1) Retraining and change management:

Enhancement projects create new requirements for training and change management. Many new features are introduced that require retraining employees. Compliance projects, such as one for SOX compliance, can put significant demand on the organization for making continuous improvements and enhancements to the ERP systems. Employees may sometime

need to significantly change their ways of working with enhancements which also recreates the application of change management processes.

6.2.5.3 Continuous Improvement

We found that many benefits that organizations proclaimed to be realized resulted from organizational initiatives to reduce process complexity and continuously improve the systems. Several organizations allocated significant resources and managerial attention to these initiatives. Organizations undertaking these initiatives were able to identify many redundancies in the ERP environment and improve the systems.

"Once the systems were stabilized (both technically and semantically), we initiated a process of reviewing the processes. Several redundancies were identified and addressed. For example, we found that some assemblies, which were being shipped to our premises by the suppliers (mainly because of constraints placed by our previous system), could be directly shipped to our customers. Significant cost savings were realized because of this change." (ERP Director, Organization C)

Major Challenges and Coping Strategies

1) Getting employees involved:

The success of continuous improvement initiatives depends heavily on the active participation of employees. Getting the people excited and involved in initiatives to reduce process complexity was a challenge for many organizations. One organization created incentives for employee participation in system improvement initiatives. They held the improvement meetings in a relaxed and conducive environment after work hours with attractions such as free massage to get increased participation.

2) Managing the unintended consequences:

There are several unintended consequences of making changes in the process for reducing complexity. Sometimes key variables are overlooked and simplification exercises could result in loss of key information. One organization employed a review process that needed comments and signage from at least two managers who were designated as reviewers before the process changes could be applied.

6.2.5.4 Enhancing Adoption and Use of Advanced Features

Organizations had to make consistent efforts in the effectiveness stage to enhance use and adoption of several advanced features that were available through the enterprise systems. Employee adoption of the advanced capabilities offered by the systems was not automatic; the organization had to lay emphasis on the adoption before all the employees made the move.

"Since the original implementation, we've introduced material management. The logistic module was already there, but not being utilized to its capacity. That transaction is still occurring right now. Logistics is being emphasized more and more."

We found that coaching by super users and functional leads was a big influence in enhancing the use of advanced applications in several organizations.

Major Challenges and Coping Strategies

1) Enhancing employee qualifications:

Many employees in the organization did not possess the qualifications to use some advanced features. However, as the problem was isolated and identified, some organizations put procedures in place to encourage employees to seek programs and courses to upgrade their qualifications.

2) Controlling the use of shadow applications:

Employees had been using alternate means to accomplish some of these tasks that could be better accomplished through ERP applications. For example, we found that many managers continued to rely on spreadsheets for scheduling and planning resource allocations, despite advanced planning features extended to them in the ERP systems. Organizations faced a multi-faceted challenge here, as they had to first detect the use of shadow applications and then get the employees and managers to make a change in their work habits. To counter this problem, counselling, coaching, education, and help were offered along with changes in the policies and regulations.

6.2.5.5 Performance Management

Tracking benefits and performance was an important activity in the effectiveness stage where the systems were fully operational and the organization was focused on enhancing the benefits of ERP systems and business performance through ERP use while reducing the operational costs of running and maintaining the system. Organizations also need to keep track of resources consumed in ongoing enhancements and upgrade projects. Several organizations use outsourcing models for some key areas and need to monitor service-level agreements with contractors. This is also applicable where internal ERP support organizations work on a charge-back basis. Tracking the business value of the change is of interest to the business leaders and stakeholders, who are interested in knowing the return on their investment in ERP systems.

Managers dealing with change often find that the existing performance measurement systems lose their effectiveness in the new environment. It can be argued that if the systems do not evolve with organizational change, they can no longer be fully relevant for assessing organizational efficiency and effectiveness and for managing change. A significant effort is

required in designing and implementing metrics that align with organization needs. Several organizations in our study brought in external experts to design their performance and benefits tracking systems.

Major Challenges and Coping Strategies

1) Performance data collection:

Most performance measures rely on data. Collecting data to assess performance was an added responsibility for many employees and was resisted. Organizations resorted to adding automatic fields wherever they can in the application for collecting data for performance metrics.

2) Accounting for indirect benefits:

Many of the benefits associated with the use of ERP systems were indirect and intangible benefits that were hard to measure. Interestingly, in one organization where remunerations were linked to performance, we found an interesting conflict. "[T]here was a squabble on who should get the credit for some of the benefits and get the incentive: functional managers who were the process owners or the systems managers who were responsible for the ERP systems?"

6.3 Quantitative Data Analysis and Revised Variance Model

In this section we focus on the analysis of the quantitative data collected in the third phase of the study. In the following sub-sections, we describe the tests done to ascertain construct reliability, the univariate and correlation analysis performed, and we give descriptive statistics. As several independent variables in this research were operationalized using multi-item scales, data was tested for internal consistency of the multi-item scale measures by calculating the Cronbach's Alpha coefficients. Descriptive statistics and histograms are used to understand

and describe the basic features of data gathered in studies and we found them very helpful in understanding the data and its distribution.

We used convenient sampling collecting the data, as our focus was on a) replicating the cases that allow us to study similar characteristics and/or b) replicating the cases that provide us an opportunity to study differences across organizations. Univariate analysis is used for examination of variables across cases and it provides some very interesting information on the data. Finally, the correlation analysis examines support for hypothesized relationships between the independent and dependent variables.

6.3.1 Test for Internal Consistency

Several independent variables in this research were measured using the multiple manifest variables previously used in the innovation adoption literature. However, as these constructs were used in a new context, we tested them for internal consistence and reliability.

Table 6-6 lists all the study variables and the Cronbach Alpha values observed for them. As suggested by several researchers for exploratory studies a Cronbach's Alpha coefficient greater than 0.6 for each domain was considered adequate for reliability of construct (e.g. Malhotra, 2004). Interestingly, we found that the Cronbach Alpha was observed to be lower than 0.6 in some variables. We treat those items as independent constructs. Manifest variables of three constructs (Centralization, Organizational Receptivity to Change and Perceived Technological Complexity) which showed Cronbach's Alpha values as less than 0.6, were treated as independent variables for proceeding correlation analysis done in the next section to explore the relation of independent variables with dependent variables.

Interestingly, we found that not only was the Cronbach Alpha value lower than 0.6 for the construct, but also, in the context of ERP institutionalization, these manifest variables had

different impacts. For example, centralization was measured through three manifest variables: Centralized hiring, Centralized budgeting, and Centralized setting of work priorities. We conducted three review interviews after our analysis was completed in the third phase, where we asked these respondents to explain some of the findings of our data analysis. We found that centralized hiring helped in reducing the time to stabilize the systems as organizations using centralized hiring introduced ERP understanding as a must in the hiring conditions and these organizations could screen the employees being hired. On the other hand, centralized budgeting created difficulties for organizations because it meant that they had to go through a very long approval process, especially in cases where a course correction was applied to an ERP project, as happened in many organizations. Consequently, the time to achieve stability was delayed.

The review interviews were used to find the explanations for observed relationships and triangulating the information deduced from analysis. The explanations received were also important, as they provided us with new insights into the independent variables, especially the ones with lower Cronbach Alpha values in the context of ERP institutionalization.

Table 6-6: Internal Consistency (Cronbach's Alpha)

Latent Variables	**Manifest Variables**	**Alpha**
1) Structural		
Specialization	1) No of Functional Roles	NA
Centralization	1) Budgeting 2) Hiring 3) Setting Work Priorities	**0.415***
Interconnectedness	1) Communication with colleagues in other functions.	NA
Formalization	1) Jobs explicitly stated 2) Documented procedures followed	**0.615**
Functional Differentiation	1) Functional units configured in ERP systems	NA
Slack Resources	1) Resources available to the ERP program	NA

2) People Related		
Professionalism	1) Percentage of employees with university degrees 2) Percentage of employees with professional training.	**0.799**
Organizational receptivity to change	1) Organization uses incentives to reward innovative initiatives by employees 2) Employees resist introduction of new technologies	**0.107***
Job tenure	1) Longevity of jobs	NA
Knowledge resources	1) Average technical knowledge of employees 2) Average process knowledge of employees	**0.771**
3) Technological		
Complexity	1) ERP systems are easy to use 2) Employees need to attain higher technical skills for using ERP systems	**0.380***
Compatibility	1) ERP systems are compatible with all aspects of organizations work 2) ERP systems fit with the organization's working style	**0.796**
Relative Advantage	1) ERP systems enable employees to accomplish task quickly 2) ERP systems improve work quality 3) ERP systems provide greater control	**0.714**
4) Environmental		
Uncertainty	1) Variability in demand for organizational outputs (product/service) 2) Variability in availability of organizational inputs	**0.665**
Competition	1) Competitive threat faced by the organization	NA
Inter-organizational Dependence	1) Number of suppliers maintained in the ERP master data 2) Number of customers maintained in the ERP master data 3) Professional activities undertaken by employees 4) Organizational interaction with other organizations	**0.706**

* Manifest variables are treated as a separate independent variable as Cronbach's Alpha coefficient is less than 0.6

6.3.2 Moderating Variables

In the beginning of the study, we proposed the use of two moderating variables; - organization type and size of the organization -to identify if there are any differences in the effect of independent variables across organizations of different types and sizes. We explored the differences across these two variables: size by looking at organizations large and very large organizations and type by studying firms in both public and private sector. However, during our study we also found that getting a system that complied with Y2K requirements was a significant motivator for several organizations. Organizations that adopt ERP systems for Y2K compliance were often stressed by non-negotiable deadlines and shortage of skilled ERP professionals. Thus, we included the year 2000 as the third moderating variable to study differences between organizations that went live with ERP before and after the year 2000. We observed several interesting differences in relationships between independent and dependent variable across all three moderating variables.

6.3.3 Dependent Variables

The dependent variable in this research is the success of an organization in institutionalizing the new systems. Success, as discussed before in the literature review section and model development, is a multidimensional concept closely correlated to the time of assessment and the organization's objectives for the system. To take the multidimensional and relative nature of the dependent variable into account, we operationalized the dependent variable using three constructs: Pace of Institutionalization, Stability of Institutionalization, and Extent of Use of ERP systems. These three constructs were also used to facilitate comparative analysis across cases and provided us with a way to estimate organizational success in institutionalizing ERP systems in a reasonable way.

Table 6-7 provides the descriptive statistics for three dependent variables.

Table 6-7 Descriptive Statistics for Dependent Variables

Variables	N	Minimum	Maximum	Mean	Std. Deviation
1) Pace of Institutionalization	29	1.00	10.00	7.1379	2.68227
2) Stability of Institutionalization	30	2.00	6.00	4.1379	1.12517
3) Extent of use	30	1.00	4.00	2.5667	.77385

Pace of Institutionalization was one of the two temporal variables (the other was Stability) used to estimate an organization's success in institutionalizing ERP systems. It was operationalized as the length of time an organization took in institutionalizing ERP systems. It was estimated by summing up the two time estimations respondents were asked to make: a) the time their organization required to achieve technical stability after go-live and b) the time their organization required to achieve semantic stability once the technical stability was achieved. Respondents were asked to estimate the approximate time their organization needed for achieving technical stability in six categories: 1) Less than 3 months, 2) 3-6 months, 3)6-9 months, 4) 9-12 months, 5) 12-15 months, and 6) more (Please Specify). Similarly, we asked the respondents to estimate the approximate time their organization needed for achieving semantic stability after technical stability was achieved in the six provided categories. The two numbers were then added to represent the variable pace. We then developed a comparative scale that showed a bigger number indicating a higher pace - i.e., for pace, 12 was used to denote organizations taking less than 3 months to achieve stability (both technical and semantic) and 1

was used to denote organization taking more than 30 months to achieve stability (both technical and semantic).

Table 6-7 provides the descriptive statistics for pace. The distribution is also depicted in

Figure 6-10. A high mean value of 7. 13 suggested that an average organization in our sample took 12-15 months in institutionalizing ERP systems.

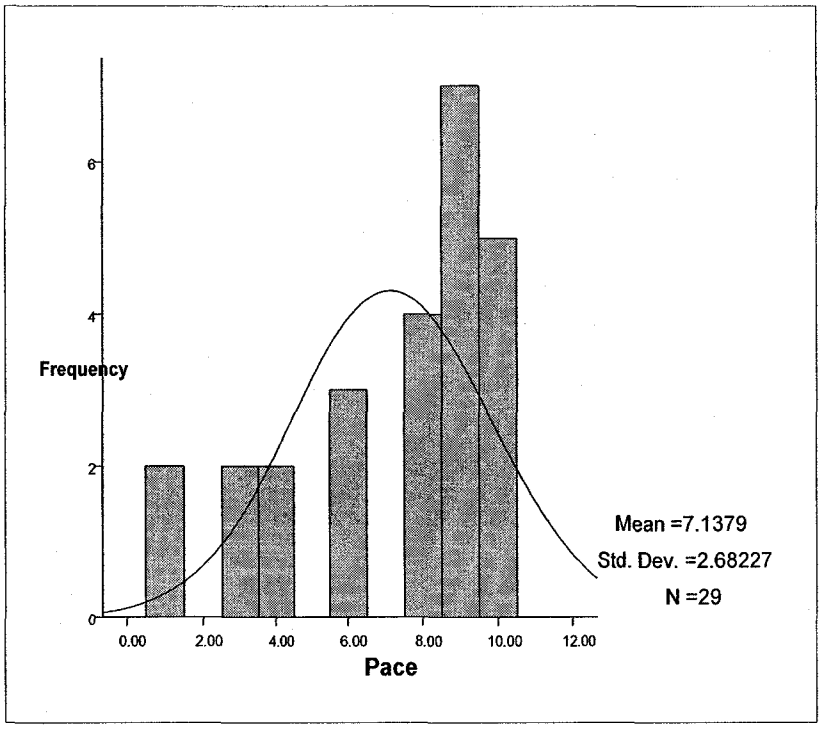

Figure 6-10: Histogram of Pace

Interestingly, while no significant difference was observed in pace in institutionalization across the moderating variables size and Y2K, we found significant differences across the moderating variable type of organization (public vs. private). Private sector organizations in our

sample showed a significantly higher pace of institutionalization. The significance of the differences in means was also indicated by an independent sample T-test.

Table 6-8 Independent Samples t Test (Public vs. Private)

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Upper	Lower
Equal variances assumed	11.669	.002	-3.364	28	.002	-2.86111	.85060	-4.60348	-1.11874
Equal variances not assumed			-4.020	20.723	.001	-2.86111	.71166	-4.34230	-1.37992

Stability of Institutionalization was the second temporal variable. It was calculated using the estimation made by the respondents regarding the time period their organizations would be using the ERP systems without undergoing major changes, such as switching vendors and platform. Respondents were asked to estimate the approximate time in years that their organization expected to use the current systems in the following six categories: 1) Less than 3 years, 2) 3-5 years, 3) 5-7 years, 4) 7-9 years, 5) 9-11 years, and 6) more (Please Specify). The respondents' estimation varied greatly. While a few respondents said that their organizations were looking to replace their ERP systems in 3-5 years (2) time frame, the majority said it would take their organizations several more years before going on to make changes to their ERP systems. Some respondents conveyed that given the investment of time and resources into the current systems and vendor relationships, a switch at the moment was unthinkable for their organization. An average organization expected to use the systems for at least 7-9 years. No significant difference was observed in stability across the three moderating variables.

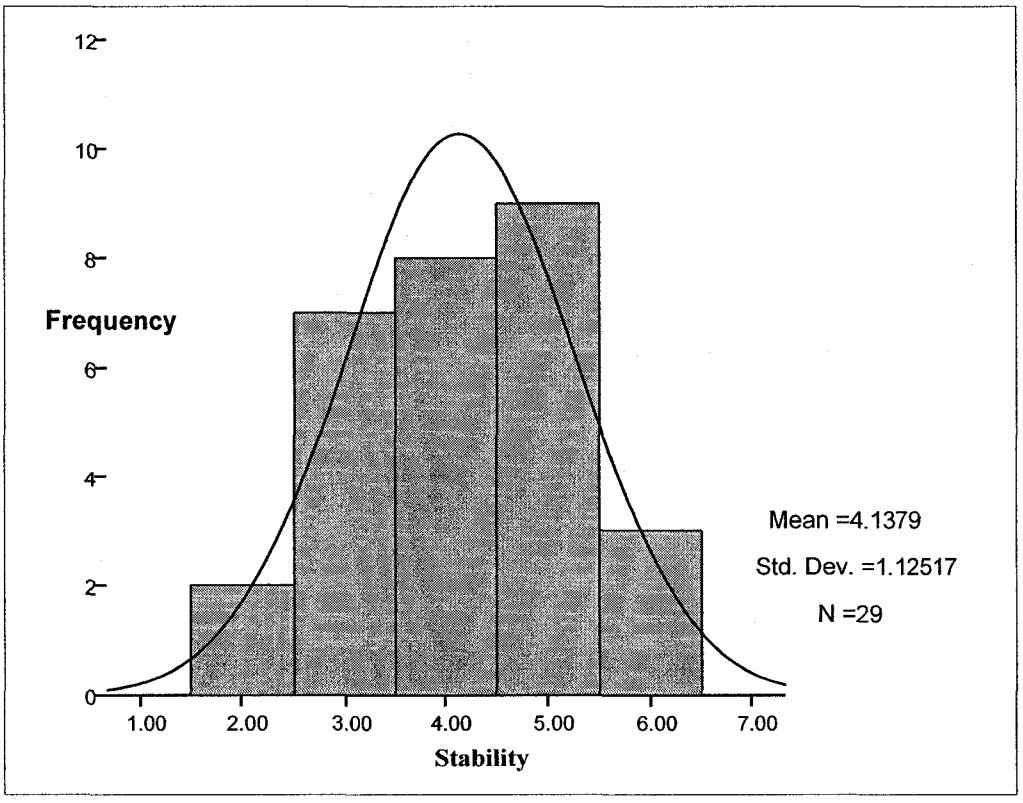

Figure 6-11: Histogram for Stability

Extent of institutionalization was operationalized using the outcome of ERP systems in terms of business transformations based on the IT-enabled business transformation framework suggested by Venkatraman (1994). While the higher levels of transformation indicate potentially greater benefits, they also require a correspondingly higher degree of effort for institutionalizing the new systems and associated changes in organizational routines such as logic of structuring, reporting relationships, performance assessment criteria, and informational flow. The respondents' perception was again used to determine at which of the following four levels their organization could be placed: 1) Localized Exploitation, 2) Internal Integration, 3) Process Redesign, and 4) External Integration. The four levels were explained in chapter 4. While a few

respondents acknowledged localized exploitation of ERP applications where the systems were only being used as advanced legacy systems, most organizations were able to utilize inherent integration functionalities of the ERP applications. Several organizations were able to redesign their business processes for effective ERP use, but only a few organizations achieved external integration of their ERP systems. No significant difference was observed in the extent of use across the three moderating variables.

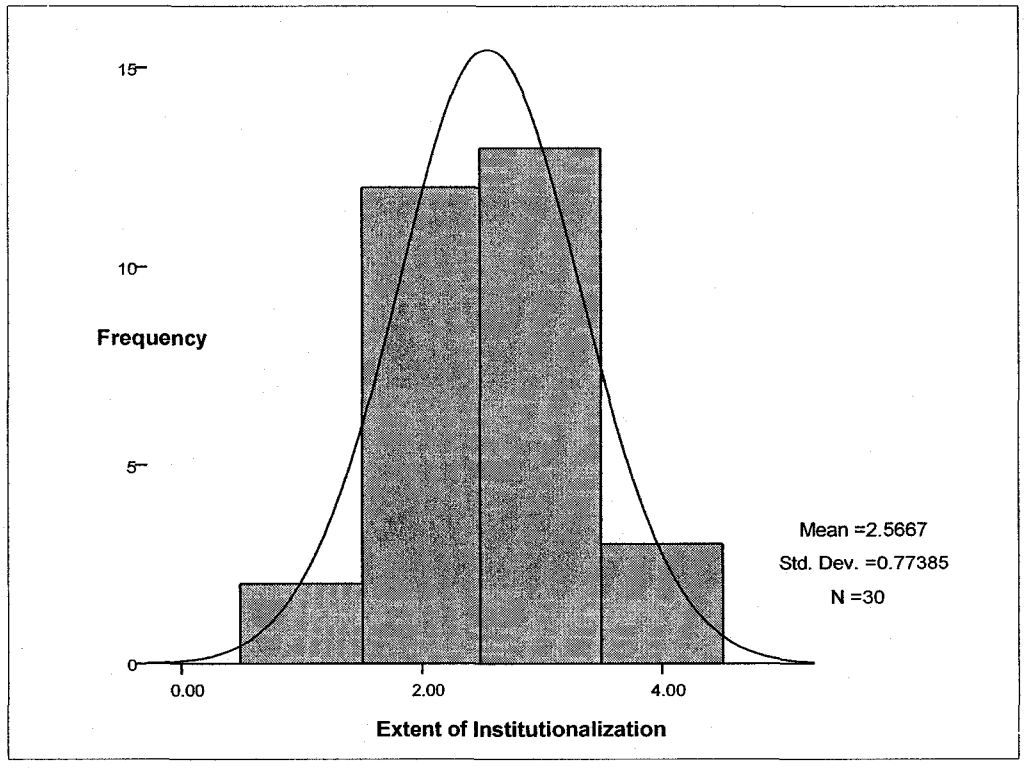

Figure 6-12: Histogram for Extent of Use

6.3.4 Independent Variables and Hypothesized Relationships

In the *a priori* model we grouped the organizational characteristics affecting institutionalization of ERP into four categories: structural attributes, people related attributes,

technological attributes, and environmental attributes. We observed several theoretically interesting relationships between some of these characteristics and the dependent variables.

6.3.4.1 Structural Characteristics

We studied the following six structural variables that were included in the *a priori* model: Specialization, Formalization, Centralization, Functional Differentiation, Availability of Slack Resources, and Interconnectedness. As we observed a low Cronbach Alpha value (less than 0.6) for Centralization, the three manifest variables of Centralization were treated as independent constructs. In this subsection we discuss the descriptive statistics and correlation analysis done on each of these eight (Table 6-9: Descriptive Statistics Structural Variables) variables to explore the hypothesized and observed relationship of these variables with the dependent variables.

Table 6-9: Descriptive Statistics Structural Variables

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Specialization	25	2	6	4.52	1.085
Formalization	24	1	6	3.5833	1.18566
Centralized Budgeting	24	1	7	3.4167	2.01983
Centralized Hiring	24	1	7	4.3750	1.92946
Centralized Decision Making	24	2	6	4.0417	1.36666
Functional Differentiation	25	4	6	4.76	.723
Availability of Slack Resources	26	2	6	3.77	1.243
Inter-connectedness	25	2	7	5.20	1.443

Means observed were higher than 4 for Specialization, Centralized Hiring, Centralized Decision Making, Functional Differentiation, and Inter-connectedness. Standard deviations for

the structural variables ranged from 0.723 to 2.019. A relatively low standard deviation and higher mean was observed for responses on Functional Differentiation and Specialization.

Specialization

Specialization in this research was operationalized as the number of functional roles configured and supported by ERP systems. We argued in the *a priori* model that specialization may add to the organization's specific needs for the ERP systems and hence may adversely affect institutionalization. Interestingly, a significant and positive correlation was observed between specialization and the pace of institutionalization.

H1 (*A priori*): Specialization and Institutionalization of ERP are negatively correlated.

H1 (Revised): Specialization and Pace of Institutionalization are positively correlated.

Table 6-10: Correlations Table for Specialization

	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Extent of use	0.086	-0.148	0.201	0.398	-0.015	0.304	-0.122
	25	11	14	10	15	12	13
Stability	0.213	-0.135	0.342	0.079	0.256	0.428	0.145
	25	11	14	10	15	12	13
Pace	**0.346***	**0.520 ***	0.391	0.449	0.348	**0.513***	0.285
	25	11	14	10	15	12	13
a) Time to technical stability	**0.367 ***	0.157	**0.469***	**0.552 ***	0.328	**.619****	0.203
	25	11	14	10	15	12	13
b) Time to semantic stability	-0.053	0.184	-0.145	-0.236	0.008	-0.289	0.158
	25	11	14	10	15	12	13

* Correlation is significant at the 0.1 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).

Across the sub-groups, correlation between pace and specialization was significant in the case of private sector organizations and those organizations that had implemented ERP systems before the year 2000. The data suggested that organizations that created a larger number of roles in their ERP configurations achieved technical stability quickly. By contrast, some (non-

significant) level of difficulty was added towards the task of achieving semantic stability, as suggested by a negative correlation between specialization and time taken to achieve semantic stability. However, overall there was a positive effect on the pace of institutionalization.

Discussion with respondents in the three review interviews revealed that it was easier for the organization to work with more roles than with fewer roles, as most of the ERP packages had standard roles built in them, in contrast to legacy software where a new role translated to extra development hours which translated to extra costs. No significant correlation was observed between Specialization and the other two dependent variables: extent of use and stability of institutionalization.

Formalization

Formalization in this research was operationalized using two items 1) the extent to which responsibilities, activities, and processes for individual jobs is explicitly stated or written and 2) the extent to which documented procedures are followed in the organization. We argued in the *a priori* model that more formalized organizations may find institutionalizing ERP systems challenging as they may have to unlearn many of the formalized rules and procedures, and relearn and re-formalize the new ways of operations with ERP systems. Our view was supported by the data and a significant negative correlation was observed between formalization and the pace of institutionalization.

H2 (*A priori*): Formalization and Institutionalization of ERP are negatively correlated.

H2A (Revised): Formalization and Pace of Institutionalization are negatively correlated

No significant correlation was observed between Formalization and the other two dependent variables: extent of use and stability of institutionalization. However, across the sub-groups, Formalization and Stability showed a significant negative correlation in the case of

private sector organizations and those organizations that had implemented ERP systems after Y2K.

Table 6-11: Correlations Table for Formalization

	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Extent of use	-0.032	-0.306	0.282	-0.200	-0.135	0.138	-0.217
	24	11	13	9	15	11	13
Stability	-0.303	**-0.533***	-0.252	-0.450	-0.180	-0.052	**-0.518***
	24	11	13	9	15	11	13
Pace	**-0.349***	-0.494	-0.175	-0.457	-0.254	-0.465	-0.123
	24	11	13	9	15	11	13
a) Time to technical stability	**-0.400***	**-.695****	-0.201	**-0.595***	-0.289	-0.484	-0.286
	24	11	13	9	15	11	13
b) Time to semantic stability	-0.053	-0.422	0.045	0.043	-0.106	0.321	-0.381
	24	11	13	9	15	11	13

* Correlation is significant at the 0.1 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).

H2B (Revised): Formalization and Stability of Institutionalization are negatively correlated for Private Sector Organizations and Organizations that implemented ERP after Y2K.

Apparently, formalization affected the time in achieving technical stability which was one of the contributing variables to pace. Data suggested that more formalized organizations took longer in institutionalizing ERP systems than less formalized ones. A discussion of this result with respondents in review interviews revealed two explanations on how formalization affected the pace of institutionalization. One executive in a large public sector organization explained that being more formalized, their organization had more intense bureaucratic procedures for approval of additional resources and project personnel and it affected their time to achieve both technical and semantic stability. Another viewpoint expressed by one of the respondents, representing a large private sector organization which adopted ERP post Y2K, was that being more formalized the organization had many more controls and process variants. Implementing all these variants

and stabilizing them in their ERP system required more time; consequently, both technical and semantic stability was delayed in their organization.

Centralization

Centralization in this research was operationalized using three items a) Centralized Decision Making, b) Centralized Budgeting, and c) Centralized Hiring. However, as the Cronbach's alpha for the variable was lower than 0.6 the individual items were analyzed separately. We argued in the *a priori* model that Centralization was negatively correlated to institutionalization as the range of new ideas considered by the organizations is restricted when only a few strong leaders dominate the organization.

H3 (*A priori*): Centralization and Institutionalization of ERP are negatively correlated.

We found no significant correlations with the dependent variables for any of the three centralization (component) variables. However, significant positive and negative correlations were observed across subgroups that led us to suggest the following revisions in the hypothesis (Table 6-12).

Table 6-12: Correlations Table for Centralization

	Dependent	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Budgeting	**Extent of Use**	0.282	0.470	0.098	-0.218	**0.564***	0.103	0.353
	Stability	0.103	0.135	0.095	**-0.732****	**0.441***	-0.180	0.060
Hiring	**Pace**	-0.168	-0.179	-0.418	0.240	-0.341	0.083	**-0.630****
	a) Time to technical stability	0.048	0.315	-0.197	0.197	-0.004	0.108	0.087
	b) Time to semantic stability	0.310	0.202	**0.507***	-0.200	**0.490***	-0,023	**-0.623****
	Stability	0.298	-0.249	**0.576***	0.260	0.225	0.469	0.176
Work Priorities	Stability	-0.222	0.484	-0.082	**0.667****	**-0.506***	-0.243	0.364

* Correlation is significant at the 0.1 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).

H3 A1 (Revised): Centralized Budgeting is positively correlated to Extent of Use in Large Organizations.

H3 A2 (Revised): Centralized Budgeting is positively correlated to Stability of Institutionalization in Large Organizations.

H3 A3 (Revised): Centralized Budgeting is negatively correlated to Stability of Institutionalization in Very Large Organizations.

The data suggested a higher extant of ERP use and stability of institutionalization in the organizational subgroup we defined as large organizations (more than 500 and less than 3,000 employees) who used centralized budgeting. Interestingly, a negative relationship was observed between centralized budgeting and stability of ERP systems in very large organizations. One of the respondents in a very large organization explained the negative relationship between centralized budgeting and stability as due to the reluctance of managers in very large organizations to pursue large project approvals.

H3 B1 (Revised): Centralized Hiring is positively correlated to Stability of Institutionalization in public sector organizations.

H3 B2 (Revised): Centralized Hiring is negatively correlated to Pace of Institutionalization in organizations implementing ERP systems after year 2000.

The data suggested centralized hiring was positively correlated to stability of institutionalization in public sector organizations, while a negative relationship was observed between centralized hiring and the pace of institutionalization in organizations implementing ERP systems after the year 2000. A review of the data and discussion with respondents revealed that, while centralized hiring affected the ease of hiring qualified employees as additional bureaucratic measures and controls were placed, it was also helpful in ensuring that ERP awareness was placed as an advantage in job descriptions across the organization.

H3 C1 (Revised): Centralized Work Priorities are positively correlated to Stability of Institutionalization in Very Large Organizations

H3 C2 (Revised): Centralized Work Priorities are negatively correlated to Stability of Institutionalization in Large Organizations

The data suggested that centralized work priorities were positively correlated to Stability of institutionalization in very large organizations (more than 3,000 employees), while a significant negative correlation was observed for the same relationship for the sub-group large organizations (between 500 and 3000 employees). Interestingly, most studies have clubbed all the organizations with more than 500 employees together as large organizations in their analysis. The opposite relationships suggested that the management approach to ERP institutionalization should not be the same in all organizations. The same characteristic can impede institutionalization in one organization while aiding it in another, much larger, organization.

Functional Differentiation

Functional Differentiation was operationalized in this research as the number of functional units and departments supported by the ERP systems. We argued *a priori* that more functionally differentiated organizations may find institutionalizing ERP systems more difficult. We found no significant correlation with the dependent variables. However, a strong negative correlation was observed between Functional Differentiation and one of the components of pace, i.e., time taken to achieve semantic stability. The correlations were significant for two sub-groups a) public sector organizations and b) organizations that went live with ERP systems before Y2K.

H4 (*A priori*): Functional Differentiation and Institutionalization of ERP are negatively correlated.

H4 (Revised): Functional differentiation and time taken to achieve semantic stability are negative correlated in Public sector organizations and organizations implementing ERP systems before Y2K.

Table 6-13: Correlations Table for Functional Differentiation

	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Extent of use	0.027	0.094	0.009	0.501	-0.225	0.071	0.067
	25	11	14	10	15	12	13
Stability	-0.140	-0.229	-0.099	0.116	-0.282	-0.196	0.007
	25	11	14	10	15	12	13
Pace	0.188	0.321	0.253	0.006	0.293	0.351	0.383
	25	11	14	10	15	12	13
a) Time to technical stability	-0.010	0.000	0.015	-0.200	0.068	0.184	0.022
	25	11	14	10	15	12	13
b) Time to semantic stability	-0.314	-0.117	**-0.452** *	-0.247	-0.342	**-0.504***	-0.258
	25	11	14	10	15	12	13

*. Correlation is significant at the 0.1 level (2-tailed).
**. Correlation is significant at the 0.05 level (2-tailed).

The data suggested that more functional differentiation makes achieving semantic stability more challenging, as the organizations with greater functional differentiation had to also travel the extra mile of integrating the cross-functional processes implemented through ERP systems. Especially, in the public sector organizations where functional boundaries were strongly etched and institutionalized, several challenges were faced in achieving semantic stability. As one of our respondents, in a large public sector organization that went live with ERP before Y2K commented:

"Our efforts to introduce changes induced by ERP in the processes are often seen by the functional units as transgression on their turf by IT department."

Apparently, the effect of functional differentiation was not so pronounced in the organizations going live after Y2K, as ERP systems in general were more accepted as a norm and were expected to introduce cross-functional processes and widespread changes in the ways that the organizations worked.

Slack Resources

Availability of slack resources was operationalized as resources available to the ERP programs. We argued in the *a priori* model that an organization with more slack resources available to the ERP program may find institutionalizing ERP systems relatively easier. We found no significant correlations with the dependent variables. Only a significant negative correlation was observed between availability of slack resources and one of the components of pace, i.e., time to achieve technical stability for one sub-group: Organizations implementing ERP after Y2K.

H5 (*A priori*): Availability of Slack Resources and Institutionalization of ERP are positively correlated.

The data suggested that the availability of more slack resources hindered technical stability in organizations implementing ERP systems after Y2K. Discussion with one of the respondents who went live with ERP after Y2K revealed that availability of slack resources to the ERP program was probably correlated to delayed technical stability, as the organizations obtained more functionality and configured systems that were technically more complex. The availability of slack resources to the ERP program, as explained by this respondent, also led to incremental changes and additional modules being adopted that had an adverse impact on the time taken to achieve technical stability of the systems.

Table 6-14: Correlations Table for Availability of Slack Resources

	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Extent of use	0.147	0.318	0.111	-0.021	0.216	-0.171	0.380
	26	11	15	11	15	13	13
Stability	0.152	-0.007	0.240	-0.176	0.342	-0.134	0.306
	26	11	15	11	15	13	13
Pace	-0.071	0.144	-0.014	-0.257	0.096	-0.177	0.026
	26	11	15	11	15	13	13
a) Time to technical stability	-0.305	-0.299	-0.280	-0.354	-0.259	-0.222	**-0.515****
	26	11	15	11	15	13	13
b) Time to semantic stability	-0.146	-0.012	-0.326	0.074	-0.303	0.077	-0.299
	26	11	15	11	15	13	13

* Correlation is significant at the 0.1 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).

Interconnectedness

Interconnectedness was operationalized as the frequency of communication between employees and colleagues in other departments of the organization. We argued *a priori* that interconnectedness is positively correlated to institutionalization of ERP systems. We found no significant correlations between interconnectedness and the dependent variables at the overall level. However, a significant positive correlation was observed between interconnectedness and the pace of institutionalization in one subgroup: private sector organizations.

H6 (*A priori*): Interconnectedness and Institutionalization are positively correlated.

H6 (Revised): Interconnectedness and Pace of Institutionalization are positively correlated for Private Sector Organizations.

The data suggested that more interconnectedness was helpful to private sector organizations, as higher information exchange between functional departments aided in the resolution of several technical and semantic problems that were cross functional in nature. As one of the respondents in a public sector organization commented: "Several times issues raised

as ERP problems were pertaining to lack of communication between functional representatives and we found that our role in resolving those issues was only to get these functional representatives to talk with each other." Interestingly, the correlations observed among interconnectedness and pace for other subgroups and overall were negative.

Table 6-15 Correlations Table for Interconnectedness

	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Extent of use	0.269	0.269	-0.010	-0.322	0.440	-0.118	0.302
	25	11	14	10	15	12	13
Stability	0.269	0.137	0.342	0.085	0.340	0.169	0.449
	25	11	14	10	15	12	13
Pace	-0.224	**0.568****	-0.435	-0.392	-0.201	-0.225	-0.128
	25	11	14	10	15	12	13
a) Time to technical stability	-0.299	0.348	-0.523	-0.292	-0.342	-0.169	-0.396
	25	11	14	10	15	12	13
b) Time to semantic stability	-0.010	-0.168	0.060	0.317	-0.126	0.234	-0.203
	25	11	14	10	15	12	13

* Correlation is significant at the 0.1 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).

6.3.4.2 People Related Characteristics

We include the following four people related variables in this study to explore their relationship with institutionalization success: Professionalism, Knowledge resources, Organizational receptivity to change, and Job tenure. In this section we discuss the descriptive statistics and correlation analysis done on each of these variables to explore the hypothesized and observed relationship of these variables with the dependent variables.

Means observed were higher than 4 for all the variables. Standard deviations for the people-related variables ranged from 0.8005 to 1.501. A relatively low standard deviation was observed for responses on professionalism, knowledge resources, and job tenure. Most firms in

the sample ranked high on professionalism and knowledge resources, where the minimum value was 3.

Table 6-16: Descriptive Statistics for People Related Characteristics

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Professionalism	24	3.00	6.00	4.4583	.80645
Knowledge resources	24	3.00	6.00	4.4792	.80053
Receptivity to change_1	25	2	6	4.36	1.075
Receptivity to change_2	24	2	7	4.42	1.501
Job tenure	25	2	6	4.40	.913

Professionalism

Professionalism in this research was operationalized using two items 1) Percentage of employees with university degrees and 2) Percentage of employees with professional training. We argued in the *a priori* model that, since professionalism of employees is associated with increased boundary-spanning activity, self-confidence, and a commitment to move beyond the status quo, it will aid in the cognitive development of employees and help institutionalization.

H7 (*A priori*): Professionalism and institutionalization of ERP are positively correlated.

Table 6-17: Correlations Table for Professionalism

	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Extent of use	-0.101	0.168	-0.153	0.063	-0.302	-0.044	0.078
	24	10	14	10	14	12	12
Stability	-0.200	0.193	-0.425	0.109	-0.278	-0.296	0.389
	24	10	14	10	14	12	12
Pace	-0.171	-0.019	-0.043	0.281	-0.385	0.305	-0.319
	24	10	14	10	14	12	12
a) Time to technical stability	-0.201	0.140	-0.150	0.313	-0.411	0.257	-0.180
	24	10	14	10	14	12	12
b) Time to semantic stability	0.069	0.135	-0.107	-0.187	0.139	-0.314	0.173
	24	10	14	10	14	12	12

* Correlation is significant at the 0.1 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).

Apparently, the data suggested no significant relation between Professionalism and Institutionalization, which could also be because most of the employees in the organizations in the sample were professionally qualified (High mean and relatively low standard deviation).

Knowledge Resources

Knowledge resources in this research were operationalized using two items 1) Average technical knowledge of employees and 2) Average process knowledge of employees. We argued in the *a priori* model that knowledge resources in the organization are positively associated with institutionalization of ERP systems as they increase the ability of organizations to understand new technical ideas more easily and aid in the development and institutionalization of those ideas in the organization. The data showed significant positive correlations between knowledge resources and all the three dependent variables. The hypothesis was supported for all three variables.

H8 (*A priori*): Knowledge Resources and Institutionalization of ERP are positively correlated.

H8 (revised): Knowledge Resources are positively correlated to Pace of institutionalization, Stability of Institutionalization and Extent of ERP Use in the organization.

Table 6-18: Correlations Table for Knowledge Resources

	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Extent of use	**0.333***	0.518	-0.099	0.364	0.416	0.329	0.274
	24	10	14	10	14	12	12
Stability	-0.089	-0.411	0.176	-0.282	-0.028	0.101	-0.439
	24	10	14	10	14	12	12
Pace	**0.432****	0.431	0.203	0.524	0.318	**0.511***	0.085
	24	10	14	10	14	12	12
a) Time to technical stability	**0.340***	0.000	0.181	**0.629***	0.103	**.640****	-0.345
	24	10	14	10	14	12	12
b) Time to semantic stability	**-0.381***	-0.389	-0.153	-0.294	-0.416	-0.258	-0.409
	24	10	14	10	14	12	12

* Correlation is significant at the 0.1 level (2-tailed).

** Correlation is significant at the 0.05 level (2-tailed).

This result also suggested that organizations could not ignore cultivating in-house technical and process knowledge resources when they adopt ERP systems. Even though ERP adoptions signify a move from proprietary systems to vendor-managed systems, and most ERP adopting organizations outsource several technical activities leading to reduction in technical support staff employed by these organizations, the importance of in-house technical and process knowledge resources has not reduced. Interestingly, the two components of pace - 1) Time taken to achieve technical stability and 2) Time taken to achieve semantic stability - showed significant correlations with opposite signs. Semantic stability was found to be delayed in organizations with higher knowledge resources. However, overall, the pace of institutionalization was faster in organizations with higher knowledge resources, and the extent of use and stability was also greater.

Organizational Receptivity to Change

Organizational receptivity to change in this research was operationalized using two items: 1) Organizational use of incentives to reward innovative initiatives by employees and 2) Employee resistance to the introduction of new technologies. We argued in the *a priori* model that greater organizational receptivity to change is positively associated with institutionalization of ERP systems. The two manifest variables were treated independently as a low Cronbach's Alpha (less than 0.6) was observed. It was also apparent in the discussion with respondents that, while one variable indicated promotion of innovation in the organization, the other pertained more to employees receiving change. Employee resistance to introduction of new technologies could be even higher when innovation is rewarded in the organization.

H9 (*A priori*): Greater Organizational Receptivity towards Change and Institutionalization are positively correlated.

Table 6-19: Correlations Table for Organizational Receptivity to Change

	Dependent	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Incentives for Innovation	Pace	0.106	**0.544***	0.265	-0.050	0.073	-0.060	0.401
	a) Time to technical stability	0.259	0.417	0.508	0.332	0.176	0.182	0.442
	b) Time to semantic stability	0.186	0.054	0.219	**0.574***	0.099	0.438	0.049
Employee Resistance to Change	Extent of Use	-0.325	-0.225	-0.313	-0.089	**-.523***	-0.114	-0.483
	Stability	-0.188	-0.172	-0.273	**-0.592(*)**	-0.028	-0.353	-0.048
	Pace	-0.009	-0.305	0.413	-0.089	-0.147	-0.190	0.181
	a) Time to technical stability	0.039	0.218	0.225	0.051	0.050	0.113	0.091
	b) Time to semantic stability	-0.068	0.140	**-0.436**	0.000	-0.100	-0.088	-0.083

* Correlation is significant at the 0.1 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).

We found no significant correlations between Organizational incentives for innovative employees and any of three dependent variables for any of the three variables. However, significant positive correlation was observed between the use of incentives and the pace of institutionalization in private sector organizations.

H9 A1 (Revised): Use of Incentives for Innovative Employees is positively correlated to the Pace of Institutionalization in Private Sector Organizations.

We found no significant correlations between employee resistance to change and any of three dependent variables for any of the three variables. However, significant negative correlations were observed across subgroups. Extent of use showed a significant negative correlation with extent of use for the sub-group large organizations, and stability of institutionalization showed a significant negative correlation for very large organizations, which led us to suggest the following revisions to the hypothesis.

H9 B1 (Revised): Employee Resistance to Change is negatively correlated to Extent of Use in Large Organizations.

H9 B2 (Revised): Employee Resistance to Change is negatively correlated to Stability of Institutionalization in Very Large Organizations.

Data suggested that employee resistance to change can have different implications for large and very large organizations. It could diminish organizational efforts in large organization to use the new systems fully, while continued resistance can affect the stability of institutionalization in very large organizations.

Job Tenure

Job tenure was operationalized in this research as Longevity of Jobs. We argued in the *a priori* model that the longevity of managers and employees in their jobs has been positively correlated with the institutionalization of ERP systems in the organization.

H10 (*A priori*): Job Tenure and Institutionalization are positively correlated.

Table 6-20: Correlations Table for Job Tenure

	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Extent of use	-0.273	**-0.510 ***	0.138	-0.199	-0.287	-0.402	-0.079
	25	11	14	10	15	12	13
Stability	0.040	0.145	-0.026	0.020	-0.015	-0.068	0.195
	25	11	14	10	15	12	13
Pace	0.079	-0.013	**.647****	-0.164	0.262	0.009	0.415
	25	11	14	10	15	12	13
a) Time to technical stability	0.023	0.000	**0.499****	-0.212	0.164	-0.030	0.198
	25	11	14	10	15	12	13
b) Time to semantic stability	-0.054	0.336	**-.586***	0.073	-0.123	-0.058	-0.064
	25	11	14	10	15	12	13

*. Correlation is significant at the 0.1 level (2-tailed).
**. Correlation is significant at the 0.05 level (2-tailed).

We found no significant correlations between job tenure and any of three dependent variables for any of the three variables. However, significant correlations were observed across two subgroups which led us to suggest the following revisions to the hypothesis.

H10 A1 (revised): Job Tenure and Extent of Use are negatively correlated for Private Sector Organizations.

H10 A2 (revised): Job Tenure and Pace of Institutionalization are positively correlated for Public Sector Organizations.

Data suggested that organizations in organizations in the private sector with high job tenure were less likely to use ERP systems extensively and public sector organizations with high job tenure were able to institutionalize the ERP systems more quickly.

6.3.4.3 (Perceived) Technological Characteristics

We studied the following three perceived technical characteristics which were included in the *a priori* model: Complexity, Compatibility, and Relative Advantage. In this section we discuss the descriptive statistics and correlation analysis done on each of these variables to explore the hypothesized and observed relationship of these variables with the dependent variables.

Table 6-21: Descriptive Statistics for Technological Characteristics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Complexity_easy to use	25	1	6	4.56	1.193
Complexity_skillsets	25	1	7	4.24	1.715
Relative Advantage	25	3.00	7.00	5.2400	.78481
Compatibility	23	2.00	7.00	4.1304	1.36696

Means observed were higher than 4 for all the three variables. Standard deviations for the structural variables ranged from 0.784 to 1.715.

Complexity

Complexity was operationalized in this research using two manifest variables 1) ERP systems are easy to use and 2) Employees need to attain higher technical skills for using ERP

systems. We argued in the *a priori* model that perceived complexity of ERP systems is negatively correlated with institutionalization of ERP systems in the organization.

H11 (*A priori*): Technological Complexity of ERP systems and Institutionalization are negatively correlated.

The two variables were treated independently as a low Cronbach Alpha was observed. We found no significant correlations between the components of complexity and any of three dependent variables for any of the three variables. However, significant correlations were observed across some sub-groups, which led us to make the following revisions in the hypothesis.

H11 A1 (Revised): Complexity (easy to use) was positively correlated with Extent of Use for Private Sector Organizations.

Table 6-22: Correlations Table for Complexity

	Dependent	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Easy to use	Extent of Use	0.073	**0.539(*)**	-0.140	-0.067	0.261	0.083	0.008
	Pace	0.138	0.243	0.109	0.280	0.029	-0.068	0.347
	a) Time to technical stability	**.401****	0.319	0.440	0.550	0.313	0.178	**.686****
	b) Time to semantic stability	**0.387***	0.457	0.416	0.251	**0.503***	0.429	0.450
Skill-set upgrade needed	Extent of Use	0.267	0.363	0.136	0.029	0.407	0.000	**0.495***
	Stability	-0.121	-0.018	-0.154	0.264	-0.285	0.502	**-0.519***
	Pace	0.020	0.126	-0.178	**-0.620***	0.296	-0.306	0.437
	a) Time to technical stability	-0.044	-0.082	-0.183	**-0.733****	0.253	-0.354	0.262
	b) Time to semantic stability	-0.042	-0.082	0.068	0.123	-0.104	0.125	-0.135

* Correlation is significant at the 0.1 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).

H11 B1 (Revised): Complexity (skills upgrade needed) was positively correlated with Extent of Use for organizations adopting ERP after Y2K.

H11 B2 (Revised): Complexity (skills upgrade needed) was negatively correlated with Stability of Institutionalization for organizations adopting ERP after Y2K.

H11 B3 (Revised): Complexity (skills upgrade needed) was negatively correlated with Pace of Institutionalization for Very Large Organizations.

Data suggested that private sector organizations using the systems more extensively found that the systems were relatively easy to use. On the other hand, higher skill upgrade was needed in organizations that implemented ERP after Y2K and used ERP systems more extensively. Interview data revealed that organizations using features to provide external integration required employees to better understand the applications and how they worked. The pace of institutionalization was slower in organizations that needed to upgrade the employee skill-sets of employees to use the ERP systems effectively.

Compatibility

Compatibility was operationalized in this research using the following two manifest variables: 1) ERP systems are compatible with all aspects of the organization's work and 2) ERP systems fit with the organization's working style. We argued in the *a priori* model that compatibility is positively correlated with the institutionalization of ERP systems in the organization.

H12 (*A priori*): Compatibility and Institutionalization are positively correlated.

We found significant positive correlation between compatibility and extent of use. Data suggested that compatibility of the ERP was an important factor in higher extent of use.

H12 A 1 (Revised): Compatibility and Extent of use are positively correlated.

Table 6-23: Correlations Table for Compatibility

	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Extent of use	**.517****	**.891****	0.276	0.102	**.562****	**0.591***	0.456
	23	10	13	9	14	11	12
Stability	0.278	0.048	0.381	0.156	0.367	**.797****	-0.015
	23	10	13	9	14	11	12
Pace	0.255	0.385	0.201	-0.115	0.435	0.163	**.592****
	23	10	13	9	14	11	12
a) Time to technical stability	0.251	0.206	0.230	0.135	0.341	0.358	0.219
	23	10	13	9	14	11	12
b) Time to semantic stability	-0.120	-0.173	-0.044	0.442	-0.316	0.214	-0.428
	23	10	13	9	14	11	12

*. Correlation is significant at the 0.1 level (2-tailed).
**. Correlation is significant at the 0.05 level (2-tailed).

Across the sub-groups, Compatibility was positively correlated to stability of institutionalization in organizations that implemented ERP before Y2K and the pace of institutionalization in organizations implementing ERP after Y2K.

H12 A2 (Revised): Compatibility and Stability of Institutionalization are positively correlated for organizations implementing ERP before Y2K.

H12 A3 (Revised): Compatibility and Pace of Institutionalization positively correlated for organizations implementing ERP after Y2K.

A review of the case study data revealed that the organizations adopting ERP after Y2K were more successful in institutionalizing the systems quickly (pace) when there was higher compatibility with the new systems. The organizations faced fewer technical challenges when systems were more compatible. On the other in organizations adopting ERP before Y2K, the organizations were looking to use the systems for a greater period of time when compatibility was higher.

Relative Advantage

Relative advantage was operationalized in this research using the three manifest variables: 1) ERP systems enable employees to accomplish a task quickly, 2) ERP systems improve work quality, and 3) ERP systems provide greater control. We argued in the *a priori* model that the relative advantage is positively correlated with the institutionalization of ERP systems in the organization.

H13 (*A priori*): Higher Relative Advantage and Institutionalization are positively correlated.

We found significant positive correlation between relative advantage and extent of use. Data suggested that firms using ERP systems to a higher extent were those which found higher relative advantage. It is an interesting finding as generally researchers have criticized ERP systems for being generic and not being a source of relative advantage.

H13 A1 (Revised): Higher Relative Advantage and Extent of Use are positively correlated.

Table 6-24: Correlations Table for Relative Advantage

	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Extent of use	**.422****	0.496	0.327	0.532	**0.460***	0.466	0.343
	25	11	14	10	15	12	13
Stability	0.093	-0.049	0.205	0.152	0.060	0.255	-0.143
	25	11	14	10	15	12	13
Pace	0.088	0.297	-0.072	**0.585***	-0.096	-0.092	0.123
	25	11	14	10	15	12	13
a) Time to technical stability	-0.191	-0.157	-0.361	0.446	-0.424	-0.077	**-.668****
	25	11	14	10	15	12	13
b) Time to semantic stability	**-0.368***	-0.315	-0.374	-0.460	-0.336	0.084	**-.684****
	25	11	14	10	15	12	13

*. Correlation is significant at the 0.1 level (2-tailed).
**. Correlation is significant at the 0.05 level (2-tailed).

Across the sub-groups a significant positive correlation was observed between relative advantage and pace of institutionalization in very large organizations. Data suggested that higher relative advantage helped very large organizations to institutionalize ERP systems quickly.

H13 A2 (Revised): Higher Relative Advantage and Pace of Institutionalization are positively correlated for Very Large Organizations.

H13 A1 (Revised): Higher Relative Advantage and Extent of Use are positively correlated.

A discussion with the respondents during review interviews revealed that a high relative advantage helped the organizations in making a stronger case for extent of use and helped them in negotiating the change more smoothly.

6.3.4.4 Environmental Attributes

We studied the following three environment attributes which were included in the *a priori* model: Uncertainty, Competition, and Inter-organizational Dependence. In this section we discuss the descriptive statistics and correlation analysis done on each of these variables to explore the hypothesized and observed relationship of these variables with the dependent variables.

Table 6-25: Descriptive Statistics for Environmental Variables

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Uncertainty	24	3.00	6.00	4.4375	.83812
Competitive threat	19	2	6	4.42	1.346
Inter-organizational dependence	21	3.00	7.00	4.9286	.96548

Both Competitive threat and Inter-organizational dependence were not applicable for some of the respondents. Some of the public sector organizations studied were solely responsible

for their activities in Canada and did not perceive any competitive threat. Similarly, some organizations could not comment on inter-organizational dependence in a meaningful way, as they did not have much close inter-linkage with suppliers, customers, and other organizations. Means observed were higher than 4 for all the three variables. Standard deviations for the structural variables ranged from 0.838 to 1.346.

Competition

Competition was operationalized in this research as Competitive threat faced by the organization. We argued in the *a priori* model that the longevity of managers and employees in their jobs has been positively correlated with institutionalization of ERP systems in the organization.

H14 (*A priori*): Competition and Institutionalization are positively correlated.

Interestingly, we found a significant negative correlation between Competition and Extent of use. Data suggested that organizations in our sample with a higher competitive threat were not using the systems more extensively. The finding was interesting as it provides a ground for further research into what role ERP systems play in reducing the competitive threat. Alternatively, the organizations with a high competitive threat could not afford to invest more heavily in a set of systems.

H14 A (Revised): Competition and Extent of Use are negatively correlated.

Table 6-26: Correlations Table for Competitive Threat

	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Extent of use	**-0.425****	**-0.603****	-0.195	**-0.654****	-0.375	-0.359	-0.453
	19	10	9	8	11	7	12
Stability	0.130	0.052	0.186	0.000	0.251	-0.067	0.336
	19	10	9	8	11	7	12
Pace	-0.123	-0.509	0.118	-0.247	0.074	-0.154	-0.013
	19	10	9	8	11	7	12
a) Time to technical stability	0.061	-0.373	0.424	-0.196	0.281	-0.142	0.295
	19	10	9	8	11	7	12
b) Time to semantic stability	0.244	0.144	0.319	0.258	0.205	0.130	0.287
	19	10	9	8	11	7	12

*. Correlation is significant at the 0.1 level (2-tailed).
**. Correlation is significant at the 0.05 level (2-tailed).

Uncertainty

Uncertainty was operationalized in this research using two manifest variables 1) Variability in demand for organizational outputs (product/service) and 2) Variability in availability of organizational inputs/raw. We argued in the *a priori* model that uncertainty and institutionalization are positively correlated.

H15 (*A priori*): Uncertainty and Institutionalization are positively correlated.

We found no significant correlations between Uncertainty and any of three dependent variables for any of the three variables. However, across the sub-groups a significant negative correlation was observed between uncertainty and pace of institutionalization in large organizations that led us to suggest the following revision to the hypothesis.

H15A (Revised): Uncertainty and Pace of Institutionalization are negatively correlated for Large Organizations.

Table 6-27: Correlations Table for Uncertainty

	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Extent of use	-0.079	0.032	0.046	-0.074	-0.167	-0.086	0.134
	24	10	14	10	14	12	12
Stability	-0.167	-0.013	-0.254	0.217	-0.249	-0.118	0.144
	24	10	14	10	14	12	12
Pace	-0.278	-0.290	-0.077	0.134	**-0.450***	-0.138	0.094
	24	10	14	10	14	12	12
a) Time to technical stability	**-.468****	-0.327	-0.351	-0.025	**-.629****	-0.287	-0.394
	24	10	14	10	14	12	12
b) Time to semantic stability	-0.060	-0.014	-0.292	-0.294	-0.026	-0.076	-0.465
	24	10	14	10	14	12	12

*. Correlation is significant at the 0.1 level (2-tailed).
**. Correlation is significant at the 0.05 level (2-tailed).

Inter-organizational Dependence

Inter-organizational dependence was operationalized in this research using the following four manifest variables:1) Number of suppliers maintained in the ERP master data, 2) Number of customers maintained in the ERP master data, 3) Professional activities undertaken by employees, such as attending conferences, workshops, training sessions, and seminars, and 4) Organizational interaction with other organizations (such as collaborative programs for product development, technology and knowledge transfer, personnel exchanges). We argued in the *a priori* model that the Inter-organizational dependence is positively correlated with institutionalization of ERP systems in the organization.

H16 (*A priori*): Inter-organizational Dependence and Institutionalization are positively correlated.

We found no significant correlations between Inter-organizational dependence and any of three dependent variables for any of the three variables. However, a significant negative correlation was observed across one subgroup which led us to suggest the following revisions to the hypothesis.

H16 A1 (Revised): Inter-organizational dependence and Stability of Institutionalization are positively correlated in Organizations Implementing ERP after Y2K

Table 6-28: Correlations Table for Inter-organizational Dependence

	All	Private	Public	Very Large	Large	Before Y2K	After Y2K
Extent of use	0.163	0.416	0.087	0.189	0.044	-0.028	0.384
	21	11	10	8	13	8	13
Stability	0.048	0.200	-0.102	0.117	0.077	-0.333	**0.458***
	21	11	10	8	13	8	13
Pace	-0.211	0.264	-0.227	-0.213	-0.147	-0.190	0.181
	21	11	10	8	13	8	13
a) Time to technical stability	**-0.359(*)**	0.328	**-0.522***	-0.456	-0.252	-0.467	0.042
	21	11	10	8	13	8	13
b) Time to semantic stability	0.034	0.431	-0.318	-0.331	0.158	-0.333	0.173
	21	11	10	8	13	8	13

*. Correlation is significant at the 0.1 level (2-tailed).
**. Correlation is significant at the 0.05 level (2-tailed).

A review of the case study data collected for these organizations revealed that organizations implementing ERP after Y2K were more aggressive in adopting the advanced supply chain and customer relationship management features of ERP systems. These features allowed the organizations to better handle their inter-organizational dependencies and provided greater stability to the organizational systems once institutionalized.

6.4 Concluding Remarks

In this chapter, we presented the outcomes of the third and final phase of this research. The ERP institutionalization process was further developed and validated with data provided by multiple case study organizations. This phase of the study provided us with an opportunity to test and validate the variance model. The data provided several novel and interesting insights into the relationships between organizational characteristics and organizational success in institutionalizing ERP systems.

Chapter 7 Discussion

This chapter elaborates upon some of the key findings and theoretical contribution made by this research. Several interesting insights about the ERP institutionalization process and the organizational characteristics that affect this process were uncovered in this study. By applying both process and variance theories to study the phenomenon as suggested by Sabherwal and Robey (1995), we were able to uncover additional insights into this complex phenomenon and explain how it unfolds in an organization. The next section of this chapter focuses on discussing the key findings made in the process theory component of the study. The second section is devoted to discussing the key findings of the variance theory component of the study. The third section reconciles some of the findings made by the process and variance theory approaches and discusses the additional insights revealed by using the two approaches together. Finally, the last section provides some concluding remarks highlighting the key points in the chapter.

7.1 ERP Institutionalization Process Highlights

Development and validation of the ERP institutionalization process model was one of the key outcomes of this study. We delineated the ERP institutionalization process by identifying the three broad stages of the process: technical, semantic, and effectiveness. The key events demarking the stages, major activities, and key challenges were also identified. We found that there were several similarities in challenges and coping strategies across firms facing similar contextual backgrounds and adopting ERP systems at a similar time frame. For example, government organizations adopting ERP in the pre-Y2K time frame faced severe shortage of ERP-skilled employees. On the other hand, the availability of employees was not as big an issue

in the post Y2K ERP adopting organizations, as the public services had by then figured out arrangements to hire and retain ERP-skilled employees.

The study showed that the focus of an adopting organization changes as it progresses through the stages in the institutionalization process. The focus in the technical stage was mainly on addressing pressing technical challenges such as fixing bugs, completing implementation; however, in the semantic phase the focus was more on addressing people related and structural issues such as reinforcing the change, developing the support organization in the semantic stage. In the effectiveness stage, the focus shifted once again to addressing the remaining structural issues and environmental pressures such as coping with the new information requirements, upgrades, and enhancements.

Table 7-1: Organizational Focus in Institutionalization Stages

	Stage I (Technical)	**Stage II (Semantic)**	**Stage III (Effectiveness)**
Technological Issues	Bug fixing, Completing implementation, System-infrastructure fit	---	---
People Related Issues	Point of use support, Knowledge transfer	Reinforcing change, Organizational fit, Fine tuning systems	---
Structural Issues	---	Developing support organization, Changing policies	Performance management Continuous Improvement
Environmental Issues	---	---	Managing upgrades and enhancements

The pattern we observed is interesting as it clearly provides us a way to analyze the ERP institutionalization in an organization. ERP systems can be more or less institutionalized in an organizational setting, depending on the extent of their diffusion and the effectiveness of

structures that the adopting-organization has developed to support and sustain these systems. Organizations can also identify the stage of they are in by analyzing the challenges they are facing, and they can then allocate resource accordingly. In the initial stage when technological issues were at their prime, it might be futile to address some of the people-related issues to enhance diffusion as those efforts cannot bear fruits until the system is reliable and technical uncertainty is reduced. ERP systems that are a collection of practices, technologies, and business rules applied through software systems are narrowly diffused in the technical phase. The mechanisms and structures to support the systems are weak and often ad-hoc. However, these systems are institutions in the making and, as we see in this research, they become full-fledged institutions when the employee skill-sets, support organization, and management structures that entrench them are fully developed in the effectiveness phase.

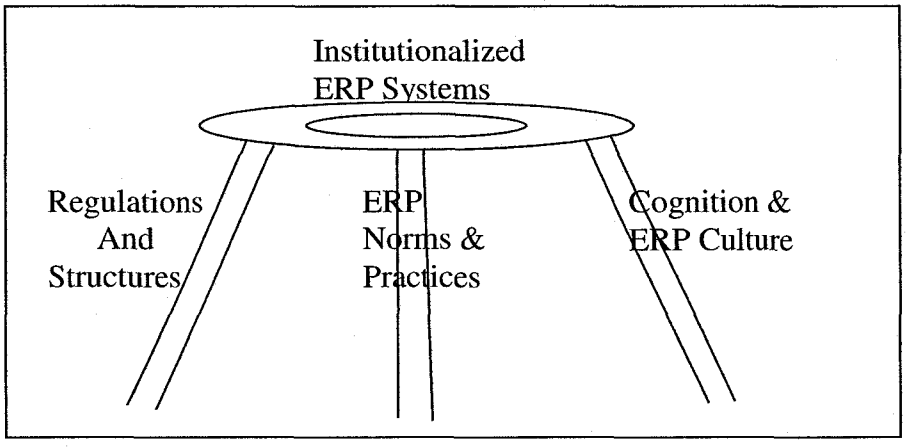

Figure 7-1: Three Pillars of ERP Institutionalization

We also found that the three means described by Scott (1995) as pillars of institutionalization (regulations, norms, and cognition) also clearly evolve through the three

stages identified in our model. The institutionalized systems depicted in Figure 7.1 are supported by regulations, norms, and cognition, which are progressively developed and refined as the adopting organization moves through the three stages of institutionalization. Organizations in the effectiveness stage exhibited effective regulations and structures that when supported by progressive norms and conducive ERP culture and cognition were key in maintaining the systems and realizing the potential ERP benefits.

7.2 Variance Model Highlights

The variance aspect of the study helped us in identifying the key organizational characteristics that influence the success of ERP institutionalization in adopting organizations. We explored the relationships between 16 independent variables (identified in the adoption literature as organizational determinants of innovativeness) and the three dependent variables. The data suggested significant relationships between seven of the independent variables which were classified *a priori* into four categories (structural, people-related, technological, and environmental) with at least one dependent variable.

Structural: Two structural variables specialization and formalization were found to be significantly correlated with pace of institutionalization. Specialization showed a positive correlation with the pace of institutionalization, which was a surprising observation as we have argued *a priori* than it is negatively related with institutionalization. Interview data suggested that it was relatively easier for organizations to adopt an ERP system in a more specialized environment as these systems aided coordination across functions and were well designed to handle the specialized roles which were mostly pre-designed. Formalization was negatively

correlated with the pace of institutionalization, as expected, and modeled *a priori*. Data suggested that more formalized organizations took longer to institutionalize ERP systems.

People-related: One people related variable, knowledge resources, was found to be significantly correlated with both extent of use and pace of institutionalization. Data suggested that organizations that used ERP extensively and institutionalized it quickly were those with higher knowledge resources. Both technical and process knowledge were included in this variable.

Technological: Two technological variables compatibility and relative advantage were found to be significantly correlated with extent of use of ERP in the organization. The observation was interesting as ERP systems have been widely diffused across organizations of different types and sizes. However, researchers suggest that organizations' ERP programs vary widely in terms of their aggressiveness and extent of use. This finding suggested that a) ERP managers need to work on enhancing the compatibility of the systems with their organization and b) The higher extent of use by adopting organizations offer higher relative advantage to the adopting organization.

Environmental: One environmental variable, competition, was found to be significantly correlated with extent of use. The observation was interesting because *a priori* we had modeled a positive relationship between competition and institutionalization. Instead, we found a negative correlation between competition and extent of use. The data suggested that organizations facing higher competitive threats were using the ERP systems to a lesser extent.

Moderating Variables: The three moderating variables helped us to analyze how the contextual differences in organizations affected these relationships. We observed several significant and theoretically interesting relationships across the three moderating variables which were not applicable to the overall sample. This supported our argument that difference in the organizations must be taken into account when managing an ERP program. For example, we observed significantly different relationships across private and public sector organizations in case of a few structural variables. We found that contrary to public sector organizations, private sector organizations showed significant negative relationships between formalization and stability of institutionalization, and a significant positive correlation between specialization and pace of institutionalization. Similarly, centralized hiring showed a significant positive correlation with stability of institutionalization for public sector organizations, while a high negative (non significant) correlation was observed for the same variables in the private sector organizations. Several other differences were observed across the moderating variables as already shown in the last chapter.

7.3 Reconciling Process and Variance Approaches

Sabherwal and Robey (1995) criticized the presentation of variance and process theories in the IS literature as alternatives that may be difficult to reconcile. We not only concur with the authors views, but found in the course of this study that the two approaches complement each other in many ways. The use of both process and variance approaches not only provided us with numerous independent insights into the phenomenon, but when used in conjunction the approaches led us more detailed insights, for example, several observed relationships between

the variables that emerged in the variance component of this study could not have been explained without the contextual knowledge and details extended to us by the process study.

Analysis of the qualitative data provided several instances when an independent variable showed positive a correlation with the time required to achieve technical stability and negative correlation with the time required to achieve semantic stability (e.g. Knowledge Resources). This reversal in the direction of relationship was surprising. However, we could not have explained this observation without the detailed background data of organizations collected in the process component of the study. We found out that while greater availability of knowledge resources helped the organizations in achieving technical stability quickly, the organizations took relatively more time in achieving semantic stability as organization faced greater challenges in developing acceptable systems for support and developing an understanding of the systems as these organizations also used the ERP systems to a greater extent.

7.4 Concluding Remarks

In this chapter, we discussed some of the key outcomes of the study. The study provided many novel insights into the process of institutionalization. Both variance and process components were individually important in providing insights into the phenomenon. We found that the approaches, when used in conjunctions as suggested by Sabherwal and Robey (1995) enhanced the understanding gained and the efficacy of the research study.

Chapter 8 Conclusion

This chapter provides a conclusion to the study by briefly discussing the contribution made by the study, its theoretical and managerial implications, some limitations the study, and ideas generated for future research. The first section focuses on the contribution made by this study and the implications for research and practice. The second section discusses some of the limitations of the study. The third section is devoted to discussing ideas for future research and, finally, the last section provides some concluding remarks by highlighting a few key points of the study.

8.1 Research Contribution

This is one of the first studies to address the phenomenon of the institutionalization of innovation in organizations in the context of ERP systems. ERP systems are considered one of the most significant innovations in organizational information management in the last decade. ERP systems have been implemented by many medium- and large-sized organizations in both the public and private sectors. However, the implementation of ERP systems is considered by many experienced ERP managers as only the beginning of an organization's ERP program, which marks the availability of some advanced tools to enable, enhance, and improve work processes in organizations. The benefits of ERP systems are realized in the post implementation phase when the ERP systems are institutionalized.

ERP systems, as previously discussed in this thesis, mark a paradigm shift in organizational approach to information systems. The integration of the enterprise functions they affect the whole organization, and they can then be aptly described as proto institutions or institutions in making a term coined by Lawrence *et al.* (2002). This makes post ERP

implementation experience of organizations an excellent subject to study institutionalization of complex innovations in adopting organizations. This study assimilated the post-implementation experience of 30 ERP-adopting organizations varying sizes (500 to 65,000 employees) in both private and public sectors; these organizations had implemented ERP systems from 1996 to 2004. The purpose was to delineate the ERP institutionalization process and identify some of the organizational determinants of an organization's success in institutionalizing ERP systems.

More than 75 managers were interviewed, in interviews that varied in length from 45 minutes to 2 hours, in the three phases of the study. The researcher joined the ERP support teams of three organizations on a part-time basis for more than six months in the first phase. We analyzed the data collected during the three phases of the study to develop, refine, and validate the ERP Institutionalization Model. We identified 15 key activities and several challenges in executing those activities along with coping strategies that firms employed to face these challenges. The model provides additional insight into the process of institutionalization as called for by several leading authors in the area who have identified the need for process studies on institutionalization of innovation, particularly in the context of an organizational unit (Tolbert and Zucker, 1996; Greenwood *et al.,* 2002).

The variance component of the study helped us in identifying some of the key determinants of organizational success in institutionalizing ERP systems. We found that several relationships that we had proposed *a priori*, based on the available literature on adoption were not supported by data in the context of ERP institutionalization. On the other hand, several new insights were uncovered with respect to significant relationships observed, and this provides a fertile base for future research. Further, by comparing information collected across three

contextual variables, we were able to uncover several differences that were observed across these subgroups. Particularly, differences observed across public and private sector organizations provided several new insights into the process of institutionalization across organizations of different type.

8.1.1 Theoretical Implications

This is one of the first studies to use empirical data in exploring the ERP Institutionalization process in the adopting organization. Most of the other empirical studies on ERP system have focused on the adoption and implementation issues of ERP systems (Markus *et al.*, 2000; Kumar *et al.,* 2002; Kumar *et al.*, 2003; Mabert *et al.,* 2003; Law and Ngai, 2007). With the help of the knowledge and insight gained by interviewing business and IT leaders in ERP-adopting organizations, we were able to de-lineate the process of ERP institutionalization in large organizations (more than 500 employees). The post-implementation experience of organizations in using complex innovations such as ERP systems is rarely explored in the literature. Even when it has been studied, authors have paid little attention to semantic problems and effectiveness issues (Markus *et al.*, 2000; Yu, 2005; Hendricks *et al.*, 2007). This study, by delineating the three-stage process model, provides a strong conceptual framework that could support future work in the area. Particularly, it extends the innovation management literature by drawing its attention to the semantic and effectiveness stages and associated challenges.

The study reinforces the idea that an ERP system cannot be studied independently of the adopting environment (Markus and Tanis, 2000), as it represents the adopting organizations-- their structure, ways of working, rules, and regulations. The processes of the organization are ERP-enabled by mapping them in the software. Another major contribution of the study is in expanding the understanding of organizational characteristics that influence the success of organizations in

institutionalizing ERP systems. By explaining the similarities and differences in experiences of different organizations that have successfully institutionalized ERP, the study provides enhanced insight into the phenomenon.

Further, as exploratory research, the study is focused on model development where a key idea is identification and development of reliable and valid measures to operationalize the proposed model. This study adds to the literature by operationalizing several measures that are necessary for empirically testing the propositions implied in the variance component of the proposed ERP institutionalization model. This study contributes to the literature by not only providing a strong model but also a series of pre-tested measures that have been developed in the context of ERP systems. On the methodology side, this study provides further support to Sabherwal and Robey's (1995) findings that more information can be derived from using process and variance approaches together in IS studies. Especially in areas where not much previous research is available the future work can benefit by using the contextual knowledge developed by process studies.

8.1.2 Managerial Implications

The study has several implications for managers. By delineating the ERP institutionalization process, it provides them with a simple process framework to manage the complex and critical process of institutionalizing an organizational innovation. Several key challenges and coping strategies were identified and documented in the study. Managers have particularly preferred process studies because they provide them empirically supported input by identifying the key challenges and coping strategies in the process being studied. The study is one of the first providing guidance on the complex process of institutionalizing organizational innovations such as ERP. The study particularly provides new guidance on the semantic and effectiveness stages, as much of the available literature has not focused on issues faced beyond the technical stage.

Further, managers could use the determinants of ERP institutionalization identified in the study to analyze and facilitate the ERP institutionalization process in their respective organizations. The study highlights the importance of contextual differences in organizations and shows how they affect the impact of managerial decisions with respect to the ERP program in the organizations. With supporting evidence, we argue that taking contextual differences into account is important for the successful institutionalization of ERP systems in adopting organizations. For example, public sector organizations cannot always rely on some of the very common practices used by private sector organizations in retaining their skilled employees.

8.2 Limitations

This research is at an exploratory level, as not much empirically supported research is available. We used a multiple case study methodology to understand the complex phenomenon of ERP-institutionalization. Further, we described the process and its contextual variances and explained the relationship between their characteristics and their organization's success in institutionalizing ERP systems. Process models have been criticized for their simplicity. The process models commonly depict the studied process in stages. There exists some amount of overlap in activities and challenges observed in the phases.

Some of the methodological and practical constraints of case study and exploratory research are also applicable to this study. For example, the results can only be generalized selectively because the case study sites were selected through a convenient sampling process and do not represent the whole population. However, several steps have been taken to increase the validity and reliability of the research. Adopting a three-phase research process and selectively seeking a representative sample of organizations as study sites will considerably increase the breadth and applicability of the results.

Tapping into the memories of the ERP managers could introduce two forms of error: distortion and memory failure. As for memory failure, there is no doubt that some information on false starts or unsuccessful steps during the decision processes went unreported. However, there is no reason to suspect any systematic distortion in this study, and we feel that the possibility of random distortion is reduced by multiple interviewing. Low sample size is another key concern; this affects the ability to make applications and generalizations using our results, especially in the variance component of the study. However, a representative sample of large organizations is chosen to enhance the reliability and accuracy of our results.

8.3 Future Research

The exploratory research reported in this thesis offers several insights and propositions concerning the institutionalization process and the organizational characteristics that determine the success of an organization in institutionalizing ERP systems. Specifically, the process component of the research revealed 15 key activities in three stages of the institutionalization process that researchers can use in planning future studies on the subject. We also pinpoint several determining variables that show strong positive correlation with an organization's success in institutionalizing ERP systems. The major insights gained through the research suggest a conceptual institutionalization model that will, hopefully, spawn both academic and practitioner interest in the topic and serve as a framework for further empirical research in this area. The ERP institutionalization model proposed in this study provides a conceptual framework consisting of two key components (variance and process) in an area where little prior research has been done. It is based on an interpretation of both qualitative and quantitative data generated through a number of case studies consistent with procedures recommended for theory development in the management

literature. The conceptual model and the propositions emerging from it provide a rich agenda for further research.

First, there is a need and an opportunity to develop an extended repository of challenges and coping strategies in the different stages of institutionalization. We found that the few studies available have focused on the semantic and effectiveness stages identified in the process model presented in the study. Research is needed to generate greater details and contextual evidence on activities, challenges, and coping strategies identified in this study, particularly, in the semantic and effectiveness stages. Second, in this study we focused on relatively large organizations (more than 500 employees) while a number of small- and medium-sized organizations have also started to use ERP systems. The findings of this study cannot be generalized to small- and medium-sized organizations using ERP systems without verification of their applicability to those organizations. We see a distinct opportunity to carry out this study in the context of small- and medium-sized organizations.

Third, research is needed to examine the nature of the differences in organizations adopting ERP systems and how these differences affect the ERP institutionalization process. This study, by comparing and contrasting organizational experiences across three sub-groups, provides ample leads to study the differences in organizations and their impact on the institutionalization process in details. Particularly, differences observed in organizational experiences across public and private sector organizations in this study provide an excellent opportunity to further research and analyze the differences in issues and challenges faced by these organizations and develop management approaches to suit the adopting organizations. In addition to offering valuable managerial insights to managers, further research on sector specific issues could help in suggesting sector-specific refinements to the proposed model.

8.4 Concluding Remarks

In this chapter, we provided a conclusion to this research by discussing the key contributions and implications of the research, the limitations of the research, and ideas for future research. This study has contributed to both research and practice in many ways. Several new avenues for theoretical research are strengthened by the outcomes of this exploratory study. On the practical side, the model developed provides substantial guidance to managers facilitating the ERP institutionalization process in their organizations.

References

Aiken, M. and J. Hage (1971). "The Organic Organization and Innovation." Sociology **5**(1): 63-82.

Aiken, M., Bacharach. S. B. and J. L. French (1980). "Organizational Structure, Work Process, and Proposal Making in Administrative Bureaucracies." Academy Management Journal **23**: 631-652.

Akkermans, H. A., P. Bogerd, E. Yucesan and L. N. van Wassenhove (2003). "The Impact of ERP on Supply Chain Management: Exploratory Findings from a European Delphi Study." European Journal of Operational Research **146**(2): 284-301.

Al-Mashari, M. (2003). "Enterprise Resource Planning (ERP) Systems: A Research Agenda." Industrial Management & Data Systems **103**(1): 22-27.

Aldrich (1979). Organizations and Environments. New Jersey, Prentice Hall.

Alsène, E. (1999). "The Computer Integration of the Enterprise." IEEE Transactions on Engineering Management **46**(1): 26-35.

Alsène, E. (2007). "ERP Systems and the Coordination of the Enterprise." Business Process Management Journal **13**(3): 417-432.

Anthony, R. N. (1965). Planning and Control: A Framework for Analysis. Cambridge:MA, Harvard University Press.

Applegate, L., R. Austin and W. McFarlan (2006). Corporate Information Strategy and Management: Text and Cases. Boston, Mass, McGraw Hill.

Baldwin, W. L. and J. T. Scott (1987). Market Structure and Technological Change. Chur,Switzerland, Harwood Academic Publishers.

Bancroft, N. H., H. Seip and A. Sprengel (1998). Implementing SAP R/3: How to Introduce a Large System into a Large organization. Greenwich, Manning.

Barley, S. J. and P. S. Tolbert (1997). "Institutionalization and Structuration: Studying the Link between Action and Institution." Organization Studies **18**(1): 93-117.

Basoglu, N., T. Daim and O. Kerimoglu (2007). "Organizational Adoption of Enterprise Resource Planning Systems: A Conceptual Framework." The Journal of High Technology Management Research **18**(1): 73-97.

Benbasat, I., D. K. Goldstein and M. Mead (1987). "The Case Study Research Strategy in

Studies of Information Systems." MIS Quarterly **11**(3): 369-385.

Berger, P. L. and T. Luckmann (1967). The Social Construction of Reality. New York, Doubleday Anchor.

Bingi, P., M. K. Sharma and J. Godla (1999). "Critical Issues Affecting an ERP Implementation." Information Systems Management **16**(3): 7-14.

Bradford, M. and J. Florin (2003). "Examining the Role of Innovation Diffusion Factors on the Implementation Success of Enterprise Resource Planning Systems." International Journal of Accounting Information Systems **4**(3): 205-225.

Brancheau, J. C. and J. C. Wetherbe (1990). "The Adoption of Spreadsheet Software: Testing Innovation Diffusion Theory in the Context of End-User Computing." Information Systems Research **1**(2): 115-143.

Brynjolfsson, E. and L. M. Hitt (1998). "Beyond the Productivity Paradox." Communications of the ACM **41**(8): 49-55.

Buckhout, S., E. Frey and J. Nemec (1999). "Making ERP Succeed: Turning Fear into Promise." Journal of Strategy and Business **17**(2): 60-72.

Burns, T. and G. M. Stalker (1961). The Management of Innovation. London, Tavistock.

Cavaye, A. L. M. (1996). "Case Study Research: A Multi-Faceted Research Approach for IS." Information Systems Journal **6**(227-242).

Chesbrough, H. W. and D. J. Teece (1996). "Organizing for Innovation: When is Virtual Virtuous?" Harvard Business Review **74**(1): 65-74.

Christensen, C. (1997). The Innovator's Dilemma. When New Technologies Cause Great Firms to Fail. Boston: MA, Harvard Business School Press.

Clemens, E. and M. Row (1991). "Sustaining IT advantage: The role of structural difference." MIS Quarterly **15**(3): 275-292.

Cohen, W. M. and D. A. Levinthal (2001). "Absorptive Capacity: A New Perspective on Learning and Innovation." Administrative Science Quarterly **35**(1): 128-152.

Cohen, B. H. (2001). Explaining Psychological Statistics. New York, John Wiley & Sons.

Collins, P. D., J. Hage and F. M. Hull (1988). "Organizational and Technological Predictors of Change in Automaticity." Academy of Management Journal **31**(3): 512-543.

Commons, J. R. (1924). The Legal Foundations of Capitalism. New York, Macmillan.

Cooper, R. B. and R. W. Zmud (1990). "Information Technology Implementation Research: A Technical Diffusion Approach." Management Science **36**(2): 123-139.

Cooper, D. R. and P. S. Schindler (1998). Business Research Methods. New York, McGraw-Hill International Editions.

Dacin, M. T., J. Goodstein and W. R. Scott (2002). "Institutional Theory and Institutional Change: Introduction to the Special Research Forum." Academy of Management Journal **45**(1): 45-57.

Daft, R. L. (1978). "A Dual Core Model for Organizational Innovation." Academy of Management Journal **21**(2): 123-139.

Damanpour, F. (1991). "Organizational Innovation: A Meta-Analysis of Effects of Determinants and Moderators." Academy of Management Journal **34**(3): 555-590.

Davenport, T. H. (1998). "Putting the Enterprise into the Enterprise System." Harvard Business Review **76**(4): 121-131.

Davenport, T. H. (2000). Mission Critical: Realizing the Promise of Enterprise Systems. Boston, Massachusetts, Harvard Business School Press.

Davenport, T. H. and J. D. Brooks (2004). "Enterprise Systems and the Supply Chain." Journal of Enterprise Information Management **17**(1): 8-19.

Dean Jr., J. W. (1986). Decision Processes in the Adoption of Advanced Technologies, Center for the Management of Technologies and Organizational Change, C.B.A. The Pennsylvania State University.

Dewar, K. D. and J. E. Dutton (1986). "The Adoption of Radical and Incremental Innovations: An Empirical Analysis." Management Science **32**(11): 1422-1433.

Diebold, J. (1952). Automation: The Advent of Automatic Factory. New York, Van Nostrand.

DiMaggio, P. J. and W. W. Powell (1983). "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields." American Sociological Review **48**(2): 147-160.

DiMaggio, P. J. (1988). Interest and Agency in Institutional Theory. Institutional Patterns and Organizations: Culture and Environment. L. G. Zucker. Cambridge: MA, Ballinger.

Donaldson, L. (2000). "Organizational Portfolio Theory: Performance Driven Organizational Change." Contemporary Economic Policy **18**(4): 386-396.

Downs, G. W. and M. L. B (1976). "Conceptual issues in the study of innovation." Administrative Science Quarterly **21**(4): 700-714.

Dubé, L. and G. Paré (2003). "Rigor in Information Systems Positivist Case Research: Current Practices." MIS Quarterly **27**(4): 597-637.

Eisendhart, K. M. (1989). "Building Theories from Case Study Research." Academy of Management Review **4**(4): 532-550.
Ferguson, P. R. and G. J. Ferguson (2000). Organizations: A Strategic Perspective. New York, St. Martin's Press.

Fichman, R. G. and C. F. Kemerer (1997). "The Assimilation of Software Process Innovations: An Organizational Learning Perspective." Management Science **43**(10): 1345–1363.

Fichman, R. G. and S. A. Mosses (1999). "An Incremental Process for Software Implementation." Sloan Management Review **40**(2): 39-52.

Fligstein, N. (1991). The Structural Transformation of American Industry: An Institutional Account of Diversification in the Largest Firms. The New Institutionalism in Organizational Analysis. W. W. Powell and P. J. DiMaggio. Chicago, University of Chicago Press.

Forbus, K. D. (1984). "Qualitative Process Theory." Artificial Intelligence **24**: 85-168.

Galaskiewicz, J. and S. Wasserman (1989). "Mimetic Processes within an Inter-organizational Field: An Empirical Test." Administrative Science Quarterly **34**(3): 454-479.

Gatignon, H. and T. S. Robertson (1989). "Technology Diffusion: An Empirical Test of Competitive Effects." Journal of Marketing **53**: 35-49.

Geertz, C. (1973). The Interpretation of Cultures. New York, Basic Books.

Glaser, B. G. and A. L. Strauss, (1967). The Discovery of Grounded Theory: Strategies for Qualitative Research, Chicago, Aldine Publishing Company.

Gibson, C. F. and R. L. Nolan (1974). "Managing the Four Stages of EDP Growth." Harvard Business Review **27**(1): 76-88.

Giddens, A. (1976). The New Rules of the Sociological Method. New York, Basic Books.

Greenwood, R., R. Suddaby and C. R. Hinnings (2002). "Theorizing Change: The Role of Professional Associations in the Transformation of Institutionalized Fields." Academy of Management Journal **45**(1): 58-80.

Grover, V., K. Fiedler and J. Teng (1997). "Empirical Evidence on Swanson's Tri-Core Model of Information Systems Innovation." Information Systems Research **8**(3): 273-287.

Hammer, M. (1996). Beyond Re-engineering, Harper Business.

Hendricks, K.B., V.R. Singhal, and J. K. Stratman (2007). "The impact of enterprise systems on corporate performance: A study of ERP, SCM, and CRM system implementations." Journal of Operations Management **25**(1): 65-82.

Holak, S. L., D. R. Lehmann and F. Sultan (1987). "The Role of Expectations in the Adoption of Innovative Consumer Durables: Some Preliminary Evidence." Journal of Retailing **63**: 243-259.

Holdaway, E., J. F. Newberry, D. J. Hickson and R. P. Heron (1975). "Dimensions of Organizations in Complex Societies: The Educational Sector." Administrative Science Quarterly **20**(1): 37-58.

Holland, C. P. and B. Light (1999). "A Critical Success Factor Model for ERP Implementation." IEEE Software **16**(3): 30-35.

Holsti, O. R. (1968). Content Analysis. Handbook of Social Psychology: Vol 2. Research Methods. G. Lindzey and E. Aronson. Reading: MA.

Jaccard, J. and C. K. Wan (1996). LISREL Approaches to Interaction Effects in Multiple Regression. Thosand Oaks: CA, Sage.

Jepperson, R. L. and J. W. Meyer (1991). The Public Order and the Construction of the Formal Organization. The New Institutionalism in Organizational Analysis. W. W. Powell and P. J. DiMaggio. Chicago, University of Chicago Press.

Jones, G. R. (1999). Organization Theory. New York, Addison-Wesley.

Joshi, K. and T. W. Lauer (1999). "Transition and Change during the Implementation of Computer Based Manufacturing Process Planning System: An Analysis Using the Equity Implementation Model." IEEE Transactions on Engineering Management **46**(4): 407-416.

Kaimen, M. I. and N. L. Schwartz (1982). Market Structure and Innovation. Cambridge:, Cambridge Univ. Press.

Kalakota, R. and M. Robinson (1999). E-Business: Roadmap for Success. Massachusetts, Addison-Wesley: Reading.

Katz, M. and C. Shapiro (1994). "Systems Competition and Network Effects." Journal of Economic Perspective **8**: 93-115.

Kerr, S. (1988). "IS Trims Down." Datamation **34**(19): 46-49.

Kimberly, J. R. and M. Evanisko (1981). "Organizational Innovation The influence ofIndividual, Organizational, and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations." Academy of Management Journal **24**(4): 689-713.

Kimberly, J. R. (1986). The Organizational Context of Technological Innovation. Managing Technological innovation. D. D. Davis. San Francisco, Jossey-Bass: 23-43.

Klaus, H., M. Roseman and G. G. Gable (2000). "What is ERP?" Information Systems Frontiers **2**(2): 141-162.

Kline, S. J. (1989). Research, Invention, Innovation, and Production: Models and Reality,". Stanford, CA, INN-lD, Thermoscience Div., Dept. Mechanical. Engineering, Stanford University: 1-32

Koch, C., D. Slater and E. Baatz (1999). The ABCs of ERP. CIO Magazine. **2000**.

Kumar, V., S. Murphy and S. Loo (1996). " An Investment Decision Process: The Case of Advanced Manufacturing Technologies in Canadian Manufacturing Firms." International Journal of Production Research **34**(4): 947-958.

Kumar, K. and J. v. Hillegersberg (2000). "ERP Experience and Evolution." Communications of the ACM **43**(4): 23-26.

Kumar, V., B. Maheshwari and U. Kumar (2002). "Enterprise Resource Planning Systems Adoption Process: A Survey of Canadian Organizations." International Journal of Production Research **40**(3): 509-523.

Kumar, V., B. Maheshwari and U. Kumar (2003). "An Investigation of Critical Management Issues in ERP implementation: Empirical Evidence from Canadian Organizations." Technovation **23**(10): 793-807.

Kwon, T. H. and R. W. Zmud (1987). Unifying the Fragmented Models of Information Systems Implementation. Critical Issues in Information System Research. J. R. Boland and R. Hirshheim. New York, John Wiley: 227-251.

Lai, V. S. (1997). "Critical Factors of ISDN implementation: An Exploratory Study." Information & Management **33**(2): 87-97.

Law, C. H., and E. W. T. Ngai (2007). " ERP Systems Adoption: An exploratory study of the Organizational Factors and Impacts of ERP Success." Information and Management **44**(4): 418-432

Lawrence, T. B., C. Hardy and N. Phillips (2002). "Institutional Effects of Inter-organizational Collaboration: The Emergence of Proto-Institutions." Academy of Management Journal **45**(1): 281-290.

Leblebici, H., G. N. Salancik, A. Copay and T. King (1991). "Institutional Change and the Transformation of Inter-organization Feilds: An Organizational History of U.S. Radio Broadcasting Industry." Administrative Science Quarterly **36**(3): 333-363.

Lee, A. S. (1989). "A Scientific Methodology for MIS Case Studies." MIS Quarterly **13**(1): 33-52.

Lee, R. (1998). "An Enterprise Decision Framework for Information System Selection." Information Systems Management **15**(4 (Fall)): 7-13.

Lee, Z. and J. Lee (2000). "An ERP Implementation Case Study from a Knowledge Transfer Perspective." Journal of Information Technology **15**(4): 281-288.

Lee, A. S. (2000). "Researchable Directions for ERP and Other Information Technologies." MIS Quarterly **24**(1): iii-viii.

Mabert, V. A., A. Soni and M. A. Venkataramanan (2003). "Enterprise Resource Planning: Managing the Implementation Process." European Journal of Operational Research **146**(2): 302-314.

Malhotra, N. (2004). Marketing Research. Englewood Cliffs, NJ, Pearson Education.

Markus, M. L. (1990). Toward a Critical Mass Theory of Interactive Media: Universal Access, Interdependence and Diffusion. Organizations and Communication Technology. J. Fulk and Steinfeld C. Newbury Park, CA, Sage.

Markus, M. L. and C. Tanis (2000). The Enterprise Systems Experience-From Adoption to Success. Framing the Domains of IT Research: Glimpsing the Future Through the Past. R. W. Zmud. Cincinnati, OH, Pinnaflex Educational Resources, Inc: 173-207.

Markus, M. L., S. Axline, D. Petrie and C. Tanis (2000). "Learning from Adopters' Experiences with ERP-Successes and Problems." Journal of Information Technology **15**(4): 245-265.

Meyer, J. W. and B. Rowan (1977). "Instituionalized Organizations: Formal Structure as Myth and Ceremony." American Journal of Sociology **83**(2): 340-363.

Meyer, J. W. and R. Scott (1983). Organizational Environments: Ritual and Rationality. Newbury Park, California, Sage Publications.

Miles, M. B. and A. M. Huberman (1994). Qualitative Data Analysis: An Expanded Sourcebook. Thousand Oaks: CA, Sage.

Miller, D. and P. H. Friesen (1982). "Innovation in Conservative and Entrepreneurial Firms Two Models of Strategic Momentum." Strategic Management Journal **3**(1): 1-25.

Miller, S. I. and M. Fredericks (1991). "Some Notes on the Nature of Methodological Indeterminacy." synthese **88**(3): 359-378.

Mintzberg H., D. Raisinghani and A. Theoret (1976). "The Structure of 'Unstructured' Decision

Processes." Administrative Science Quarterly **21**(2): 246–275.

Mohr, L. B. (1982). Explaining Organizational Behavior: The Limits and Possibilities of Theory and Research. San Francisco, Jossey-Bass.

Moller, C. (2005). "ERP II: A Conceptual Framework for Next-generation Enterprise Systems?" Journal of Enterprise Information Management **18**(4): 483-497.

Moore, G. C. and I. Benbasat (1991). "Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation." Information Systems Research **2**(3): 192-212.

Ng, J. K. C., W. H. Ip and T. C. Lee (1999). "A Paradigm for ERP and BPR Integration." International Journal of Production Research **37**(9): 2093-2108.

Nonaka, I. and H. Takeuchi (1996). "A theory of organizational knowledge creation." International Journal of Technology Management, **11**(7/8): 833-846.

Nooteboom, B. (1989). "Diffusion, Uncertainty, and Firm Size." International Journal of Research in Marketing **6**: 109-128.

Oliver, C. (1990). "Determinants of Inter-organizational Relationships: Integration and Future Directions." Academy of Management Review **15**(2): 241-265.

Orlikowski, W. J. and S. J. Barley (2001). "Technology and Institutions: What can Research on Information Technology and Research on Organizations Learn from Each Other." MIS Quarterly **25**(2): 145-165.

Ostlund, L. E. (1974). "Perceived Innovation Attributes as Predictors of Innovativeness." Journal of Consumer Research **1**: 23-29.

Parsons, T. (1951). The Social System. New York, Free Press.

Parsons, T. (1960). A Sociological Approach to the Theory of Organizations. Structure and Process in Modern Societies. T. Parsons. Glencoe: IL, Free Press.

Perry, J. L. and H. G. Rainey (1988). "The Public-private Distinction in organization Theory- A Critique and Research Strategy." Academy of Management Review **13**(2): 182-201.

Pierce, J. L. and A. L. Delbecq (1977). "Organizational Structure, Individual Attitudes, and Innovation." Academy of Management Review **2**(1): 26-37.

Pliskin, N. and M. Zarotski (2000). Big-Bang ERP Implementation at a Global Company. Annals of Cases on Information Technology, IDEA Group Publishing,.

Powell, W. W. (1991). Expanding the Scope of Institutional Analysis. The New Institutionalism

in Organizational Analysis. W. W. Powell and P. J. DiMaggio. Chicago, University of Chicago Press.

Powell, T. C. and A. Dent-Micallef (1997). "Information Technology as Competitive Advantage: The Role of Human, Business and Technology Resources." Strategic Management Journal **18**(5): 375-405.

Pugh, D. S., D. J. Hickson, C. R. Hinings and C. Turner (1968). "Dimensions of Organization Structure." Administrative Science Quarterly **13**(1): 65-105.

Quattrone, P. and T. Hopper (2001). "What does Organizational Change Mean? Speculations on a taken for Granted Category." Management Accounting Research **12**(4): 403-435.

Roach, S. (1991). "Services Under siege-- the Restructuring Imperative." Harvard Business Review **69**(5): 82-91.

Robertson, T. S. and H. Gatignon (1986). "Competitive Effects on Technology Diffusion." Journal of Marketing **50**(July): 1-12.

Robey, D., J. W. Ross and M.-C. Boudreau (2001). Learning to Implement Enterprise Systems: An Exploratory Study of the Dialectics of Change, Georgia State University and MIT Center for Information Systems Research: 1-45.

Roessner, J. D. (1977). "Incentives to Innovate in Public and Private Organizations." Administration and Society **9**(3): 341- 365.

Rogers, E. M. (1962). Diffusion of Innovations (1st edition). New York, Free Press.

Rogers, E. M. (1983). Diffusion of innovations (2nd edition). New York, Free Press.

Rogers, E. M. (1995). Diffusion of innovations (3rd edition). New York, Free Press.

Rogers, E. M. (2003). Diffusion of innovations (4th edition). New York, Free Press.

Rolland, C. and N. Prakash (2000). "Bridging the Gap between Organizational Needs and ERP Functionality." Requirements Engineering **5**(3): 180-193.

Rosner, M. M. (1968). "Economic Determinants of Organizational Innovation." Administrative Science Quarterly **12**(4): 614 -625.

Ross, J. W. (1999). "The ERP Path to Integration: Surviving vs. Thriving." eAI Journal accessed at http://www.eaijournal.com/ERPIntegration/ERPPath.asp.

Ross, J. W. and M. R. Vitale (2000). "The ERP Revolution, Surviving vs. Thriving." Information Systems Frontiers; special issue of On The Future of Enterprise Resource Planning Systems **2**(2): 233-241.

Sabherwal, R. and D. Robey (1995). "Reconciling Variance and Process Strategies for Studying Information System Development." Information Systems Research **6**(4): 303-327.

Salomon, G. (1991). "Transcending the Qualitative-Quantitative Debate: The Analytic and Systemic Approaches to Educational Research." Educational Researcher **20**(6): 10-18.

Sarich (2005). "A Silver Lining." Best's Review **105**(10): 34-37.

Schwab, D. P. (1999). Research Methods for Organizational Studies. Mahwah: NJ, Lawrence Erlbaum Associates.

Scott, W. R. (1981). Organizations: Rational, Natural, and Open Systems. New Jersey, Prentice Hall.

Scott, W. R. and J. W. Meyer (1983). The Organization of Societal Sectors. Organizational Environments: Ritual and Rationality. J. W. Meyer and W. R. Scott. Beverly Hills: CA, Sage.

Scott, W. R. (1995). Institutions and Organizations. Thousand Oaks, California, Sage Publication Ltd.

Scott, J. E. and I. Vessey (2000). "Implementing Enterprise Resource Planning Systems: The Role of Learning from Failure." Information Systems Frontiers; special issue of on The Future of Enterprise Resource Planning Systems **2**(2): 213-232.

Scott, W. R. (2001). Institutions and Organizations. Thousand Oaks, California, Sage Publications.

Scott, J. E. and I. Vessey (2002). "Managing Risks in Enterprise Systems Implementations." Communications of the ACM **45**(4): 74-81.

Selznick, P. (1949). TVA and the Grassroots. Berkeley, University of California Press.

Selznick, P. (1957). Leadership in administration. New York, Harper & Row.

Shang, S. and P. B. Seddon (2002). "Assessing and Managing the Benefits of Enterprise Systems: The Business Manager's Perspective." Information Systems Journal **12**(4): 271-299.

Shannon, C. and W. Weaver (1948). A Mathematical Theory of Communication. Urbana, University of Illinois Press.

Sharpe, A. (1997). "The Productivity Paradox: An evaluation of competing explanations." Canadian Business Economics **6**(Fall): 32-47.

Siegel, D. S., D. A. Waldman and W. E. Youngdahl (1997). "The Adoption of Advanced

Manufacturing Technologies: Human Resource Management Implications." IEEE Transactions on Engineering Management **44**(3): 288-298.

Simon, H. A. (1957). Administrative Behavior. New York, Macmillan.

Soh, C. and M. L. Markus (1995). How IT creates business value: A process theory synthesis. Proceedings of the Sixteenth International Conference on Information Systems, Amsterdam, The Netherlands.

Soh, C., S. S. Kien and J. Tay-Yap (2000). "Cultural Fits and Misfits: Is ERP a Universal Solution?" Communications of the ACM **43**(4): 47-51.

Soliman, F. and M. A. Youssef (1998). "The role of SAP Software in Business Process Re-engineering." International Journal of Operations and Production Management **18**(9/10): 886-895.

Stevens, J. (1996). Applied Multivariate Statistics for the Social Sciences. Hillsdale: NJ, Lawrence Erblaum Associates.

Stinchcombe, A. L. (1968). Constructing Social Theories. New York, Harcourt, Brace and World.

Strang, D. and J. W. Meyer (1993). "Institutional Conditions for Diffusion." Theory and Society **22**(4): 487-511.

Strassman, P. A. (1990). Business value of computers, Information economic press.

Swanson, E. B. (1994). "Information Systems Innovation among Organizations." Management Science **40**(9): 1069-1092.

Tchokogué, A., C. Bareil and C. R. Duguay (2005). "Key Lessons from the Implementation of an ERP at Pratt & Whitney Canada." International Journal of Production Economics **95**(2): 151-163.

Thornburg, B. (1998). How to Assure Success in ERP Implementations," ERP world, *accessed at* http://www.erpworld.org/proceed98/nfiles/n450/n450.html#_Toc421700663,(1998).

Tolbert, P. S. and L. G. Zucker (1996). The Institutionalization of Institutional Theory. Handbook of Organization Studies. S. R. Clegg, C. Hardy and W. R. Nord. Thousand Oaks, Sage.

Tornatzky, L. G. and K. J. Klein (1982). "Innovation Characteristics and Adoption-Implementation: A Meta-Analysis of Findings." IEEE Transactions on Engineering Management **29**(1): 28-45.

Tornatzky, L. G. and M. Fleischer (1990). The Processes of Technological Innovation. Lexington, Massachusetts, Lexington Books.

Tushman, M., W. H. Newman and E. Romanelli (1986). "Convergence and Upheaval: Managing the Unsteady Pace of Organizational Evolution." California Management Review **29**(1): 29-44.

Van de Ven, A. H. (1986). "Central Problems in the Management of Innovation." Management Science **32**(5): 590-607.

Van de Ven, A. H. and R. Garud (1989). A Framework for Understanding the Emergence of New Industries. Research in Technological Innovation. R. S. Rosenbloom. Greenwich: CT, JAI.

Van de Ven, A. (1993). "The Institutional Theory of John R. Commons: A Review and Commentary." Academy of Management Review **18**(1): 129-152.

Van de Ven, A. H., D. E. Polley, R. Garud and S. Venkataraman (1999). The Innovation Journey. New York, Oxford University Press.

Veblen, T. (1904). The Theory of Business Enterprise. New York, Charles Scribner's Sons.

Veblen, T. (1909). "The Limitation of Marginal Utility." Journal of Political Economy **17**(9): 620-636.

Venkataraman, M. P. (1991). "The Impact of Innovativeness and Innovation Type on Adoption." Journal of Retailing **67**(51-67).

Venkatraman, N. (1994). "IT-Enabled Business Transformation: From Automation to Business Scope Redefinition." Sloan Management Review **35**(2): 73-87.

Waarts, E., Y. M. van Everdingen and J. van Hillegersberg (2002). "The Dynamics of Factors Affecting the Adoption of Innovations." Journal of Product Innovation Management **19**(6): 412-423.

Watson, E. E. and H. Schneider (1999). "Using ERP in Education." Communications of the AIS **1**(Article 9).

Weston, F. C. J. (1999). Dynamic BPR: the Future of ERP Software. Fort Collins, Colorado State University.

Westphal, J. D., R. Gulati and S. M. Shortell (1997). "Customization or Conformity? An Institutional and Network Perspective on the Content and Consequences of TQM Adoption." Administrative Science Quarterly **42**(2): 366-394.

Woodward, J. (1965). Industrial Organizations: Theory and Practice. Oxford: U.K., Oxford University Press.

Yin, R. K. (1984). Case Study Research: Design and Methods (1st Ed.). Beverly Hills: CA, Sage.

Yin, R. K. (1994). Case Study Research: Design and Methods (2nd Ed.). Beverly Hills: CA, Sage.

Yin, R. K. (2003). Case Study Research: Design and Methods (3rd Ed.). Beverly Hills: CA, Sage.

Yu, C. S. (2005). "Causes Influencing the Effectiveness of the Post-Implementation ERP System." Industrial Management & Data Systems **105**(1): 115-132.

Zaltman, G., R. Duncan and J. Holbek (1973). Innovations and organizations. New York, Wiley.

Zeitz, G., V. Mittal and B. McAulay (1999). "Distinguishing Adoption and Entrenchment of Management Practices: A Framework for Analysis." Organization Studies **20**(5): 741-776.

Zucker, L. G. (1977). "The Role of Institutionalization in Cultural Persistence." American Sociological Review **42**(5): 726-743.

Zucker, L. G. (1983). Organizations as Institutions. Research in the Sociology of Organizations. S. Bacharach. Greenwich: CT, JAI.

Zucker, L. G. (1987). "Institutional Theories of Organizations." Annual Review of Sociology **13**: 443-464.

Appendix I: Contact Summary Sheet

Contact Category: Business leader/ IS Leader/ Referent

Name: **Organization**:

Contact medium: In-person/phone/email

Contact Details

Phone: Contact Date:

Email: Today's Date:

1. What are the main objectives of this contact? (to be filled prior to making the contact)

2. Summary of information gathered (failed to gathered) on each of the objectives.

3. Anything else that was salient, interesting, illuminating or important in this contact

4. **What new objectives (or remaining) objectives need to be followed up in the next contact with this site?**

Appendix II: Interview probe and Questionnaire

Managing ERP Systems in the Post Implementation Phase

This study focuses on empirically developing an understanding of best practices and challenges in enacting and maintaining ERP systems and a culture for their effective use in the Post Implementation phase.

I would prefer an opportunity to speak to you in-person or on phone to ask the questions listed in the questionnaire. I can come to your office or call you at a time convenient to you. Alternatively, you can mail/fax/e-mail your completed response to the address listed below. Please feel free to use additional space if needed when you choose to respond by filling the questionnaire.

Please be assured that your responses will be held in confidence by the researchers. All the responses will be coded and aggregated and only summarized results will be presented in the final report. The respondent and the organization will not be identified in any part of the study.

Your response is valuable for completing this Ph.D. thesis research and is greatly appreciated. If you have any questions or concerns, please feel free to contact the researcher.

Thank you, for your interest and support.

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Instructions

Enterprise Resource Planning (ERP) is a generic term for a commercial enterprise software package that enables the integration of business processes throughout an adopting organization. Each ERP instance is unique as adopting organizations configure it to suit their business model, needs, and environment. In this process, both the technological systems and the organizations undergo dramatic changes. This study focuses on understanding the post implementation experience of organizations in both public and private sectors in supporting, and maintaining these systems.

The following questionnaire consists of 2 sections. The first section seeks information about the ERP systems and your organization. The second section seeks information about your post implementation experiences, efforts and challenges in managing ERP systems. Please feel free to use additional space if you choose to fill out the survey.

Section I –ERP History and Status Information

ERP implementations are generally large and multi-phased projects. Organizations have a significantly large estimated service period in mind. ERP scope, type, level of integration, number of modules used, project budget, number of active users, varies significantly in different organizations.

1. Please describe the ERP systems in your organization?
(Hint: scope, configuration, modules used, vendors, level of integration, add-ons and complimentary technologies, how they have evolved since original implementation, future plans etc.)

2. When was the first ERP Module implemented / Project Phase I completed (First Go-live date, please indicate the year and month). .....

3. What is the estimated time in years which your organization expects to use the current systems at the same level of benefits (i.e. without major changes such as vendor/platform).....

Less than 3 years 3-5 years 5-7 years 7-9 years 9-11 years
more (Please Specify).....

4. Which of the following statements will be best applicable to your organization?

1. Organization is using independent modules of the ERP software in some functional areas.
2. Organization has integrated its various functional ERP applications, however, much needs to be done in terms of process redesign for business process integration.
3. Organization has integrated its various functional ERP applications and has significantly redesigned its business processes to integrate them as well.
4. Organization has implemented integrated ERP systems in conjunction with systems of some suppliers/customers.

The following scaled questions (5-8) are being asked to assess some organizational characteristics, which can affect the extent of ERP use, work load, complexity, and effectiveness of ERP systems program. Please circle your choices. Circle NA when not applicable to your organization.

5. On a scale of 1-7, (where 1 stands for low and 7 stands for high), please rank the following statements.

	Low						High	
1. To what extent an organization in a task environment similar to your organization is likely to have an ERP?	1	2	3	4	5	6	7	NA
2. To what extent is use of ERP system taken for granted/entrenched in the routine functioning of your organization?	1	2	3	4	5	6	7	NA
3. To what extent in your organization are the ERP users and their skill-sets developed for effective use of ERP?	1	2	3	4	5	6	7	NA
4. To what extent has your organization developed its technical and ERP support infrastructure to facilitate effective use of ERP?	1	2	3	4	5	6	7	NA
5. To what extent has your organization's implementation of ERP systems enhanced its service delivery and value proposition to its customers?	1	2	3	4	5	6	7	NA

6. On a scale of 1-7 (where 1 indicates Always and 7 Never), please indicate the extent to which the following statements apply to your organization.

Centralization and Formalization	Always						Never	
1. All budgeting decisions are made by the head quarters	1	2	3	4	5	6	7	NA
2. All hiring decisions are made by the head quarters	1	2	3	4	5	6	7	NA
3. Work priorities are set by the headquarters	1	2	3	4	5	6	7	NA
4. Responsibilities, activities, and processes for individual jobs is explicitly stated or written	1	2	3	4	5	6	7	NA
5. Documented procedures are followed in the organization	1	2	3	4	5	6	7	NA
6. Organization uses incentives to reward innovative initiatives by employees	1	2	3	4	5	6	7	NA

7. On a scale of 1-7 (where 1 indicates Weak and 7 Strong), please indicate the strength of the following statements with respect to your organization.

ERP and Organizational Fit	**Weak**						**Strong**	
1. ERP systems enable employees to accomplish task quickly	1	2	3	4	5	6	7	NA
2. ERP systems improve work quality	1	2	3	4	5	6	7	NA
3. ERP systems provide greater control	1	2	3	4	5	6	7	NA
4. ERP systems are compatible with all aspects of organizations work	1	2	3	4	5	6	7	NA
5. ERP systems fit with the organization's working style	1	2	3	4	5	6	7	NA
6. ERP systems are easy to use	1	2	3	4	5	6	7	NA
7. Employees need to attain higher technical skills for using ERP systems	1	2	3	4	5	6	7	NA
8. Employees often communicate with their colleagues in other functional departments	1	2	3	4	5	6	7	NA
9. Employees resist introduction of new technologies	1	2	3	4	5	6	7	NA

8. In comparison with an average organization in the similar task environment/industry, please rank your organization for following attributes on a given scale of 1-7 (where 1 indicates low, 4 same, and 7 high).

Organizational and Task Complexity	**Low**			**Same**			**High**	
1. Variability in demand for organizational outputs (product/service)	1	2	3	4	5	6	7	NA
2. Variability in availability of organizational inputs/raw materials	1	2	3	4	5	6	7	NA
3. Competitive threat faced by the organization	1	2	3	4	5	6	7	NA
4. Number of suppliers maintained in the ERP master data	1	2	3	4	5	6	7	NA
5. Number of functional units/departments supported by ERP	1	2	3	4	5	6	7	NA
6. Number of customers maintained in the ERP master data	1	2	3	4	5	6	7	NA
7. Number of functional roles configured/supported by ERP system	1	2	3	4	5	6	7	NA
8. Organizational interaction with other organizations (such as collaborative programs for product development, technology and knowledge transfer, personnel exchanges)	1	2	3	4	5	6	7	NA
9. Turnover of employees	1	2	3	4	5	6	7	NA
10. Longevity of jobs	1	2	3	4	5	6	7	NA
11. Extent of new hiring	1	2	3	4	5	6	7	NA
Organizational Resources	**Low**			**Same**			**High**	
12. Resources available to the ERP program	1	2	3	4	5	6	7	NA
13. Percentage of employees in your organization that are professionally trained	1	2	3	4	5	6	7	NA
14. Percentage of employees in your organization with university degrees	1	2	3	4	5	6	7	NA
15. Professional activities undertaken by employees such as attending conferences, workshops, training sessions, and seminars	1	2	3	4	5	6	7	NA
16. Frequency of change in key technologies/processes used by your organization for carrying out its work.	1	2	3	4	5	6	7	NA
17. Average technical knowledge of employees in the organization	1	2	3	4	5	6	7	NA
18. Average process knowledge of employees in the organization	1	2	3	4	5	6	7	NA

Section II - Post Go-live experience

A) Technical Stability

Many technical irritants are realized after organizations go live with ERP systems and organizations gradually achieve a stage where systems can be considered technically stable. One example of the indicators of Technical stability could be that tweaking/configurational changes to the ERP systems to suit the business and infrastructure are no longer required on a regular basis.

1. What is the estimated time which your organization took after going live in achieving technical stability of ERP systems.....

Less than 3 months 3-6 months 6-9 months 9-12 months 12-15 months
more (Please Specify).....

2. What contributed to achieving technical stability/order?

(Hint: technical capabilities and support within the organization; support from vendors and/or consultants, scalability of the technical infrastructure, top management support and leadership, knowledge sharing with other friendly organizations, development of support processes and routines, issues management mechanism etc.)

3. Do you recall any major challenges in achieving technical order? Please explain these challenges.

(Hint: People related (support staff, users, managers, senior executive), Availability of Resources, Technological related (Complexity, Hardware, Software, Upgrades/enhancements), Business Processes, Organizational complexity, Training etc.)

B) Routine Usage

Organizations can continue to face problems with the new systems until a threshold understanding and familiarity with the systems is developed. One of the indicators of routine usage is that average user understanding and interaction with ERP for information access reached a stable point. (Functional consultant/ coach support is not required). Users are comfortable with the new systems and can employ its features effectively in their routine activities.

1. What is the estimated time which your organization took after achieving technical stability in achieving routine usage of the ERP systems.....

Less than 3 months 3-6 months 6-9 months 9-12 months 12-15 months
more (Please Specify).....

2. What factors contributed (both internal and external to the organization) to routinizing ERP systems in the organization? (Hints: Change management program, support organization, communication program, competency development program, etc.)

3. Do you recall any major challenges in achieving routine usage and understandability of ERP systems? Please explain, especially with respect to the following

(Hint: Availability of resources, People related (support staff, users, managers, senior executive), Technological related (Complexity, Hardware, Software, Upgrades/enhancements), Business processes, Organizational complexity, Training etc.)

C) ERP Support, Maintenance, and Continuous Improvement
Organizational Innovations like ERP need an extensive support structure and before they get entrenched into the organization and institutionalized. Perpetual use of these systems requires maintenance and enhancements, regular operational budgets and dedicated resources.

1. How is ERP support (Technical and competency development) provided in the organization?
(Hint: How are user complaints and support request handled? How are system change request handled? How is ERP training organized and provided in your organization?)

2. How is maintenance of ERP systems managed in the organization?
(Hint: Are there any maintenance routines and/or schedules? Are there any formal/informal contingency plans in place?)

3. How are resource allocation decisions made for new developments/improvements regarding ERP systems? (Hint: prioritization process, weighting criteria, governance process, steering committee)

4. What regulations, best practices, and/or performance measures have been introduced in the organization to promote effective ERP usage and realization of ERP benefits?
(Hint: Any general directions/stipulations from management for ERP use, any measurable criteria employed for assessing performance, any positions created, moved, or abolished due to ERP in the organization)

5. What significant structural changes have been made in the organization post ERP implementation? Can you please draw/provide an organization chart for the ERP support organization? (Both Technical and Competency Development)

6. What is the role of external ERP project partners such as configuration consultants, system vendor in the post implementation stage? (Hint: vendor, consultants etc.)

D) ERP Usage Norms, Cognition, and Culture
ERP systems are uniquely enacted in any organization where they are put to use as both the organization and the systems adapt to each other. Enactment of the ERP systems includes cultural and cognitive changes in perceptions; ways of working in the organization; development of new process designs, routines, and norms.

1. Do you think your organization has enacted the ERP systems? Please explain with some examples how do you think enactment of ERP systems have led to changes in the organizational culture, processes, routines, and norms.

2. Please describe some of the activities which you think have lead to developing the understanding of the new systems in your organizations?
(Hint: training, seminars, external linkages such as regional (OCRI, OMN), industry (ACFO, CATA) and/or professional associations (CMA, PMAC etc.), ERP user groups (ASUG, OAUG etc.)

3. What were the key challenges faced in developing an understanding of the new systems in your organization?

4. Please describe some of the activities which you think have led to the development of culture and norms for ERP usage in your organization?
(Hint: New capabilities associated with ERP systems, Clarification, standardization and simplification of processes)

5. What were the key challenges faced in developing culture and norms for ERP usage in your organization? Please describe.

Research Results Requisition /Follow-up permission

1. Would you like to receive the summarized results of the study? □Yes □No

2. In case of any follow-up study/clarification, would you mind if we contact you? □Yes □No

Your views are extremely important for research. Thank you very much for your time and support.

Appendix III: Letter of Informed Consent

Principal Researcher: Bharat Maheshwari Ph.D. Candidate, Sprott School of Business Carleton University
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Co-Supervisor: Professor Uma Kumar, Sprott School of Business Carleton University
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I, the undersigned, agree to participate in this research study titled "ERP Systems Institutionalization: The Effect of Organizational and Perceived Technological Characteristics" conducted by Bharat Maheshwari, who is a Ph.D. candidate at Sprott School of Business, Carleton University. I understand that this study this research is being conducted in partial fulfilment of the requirements for the doctoral degree in Business Administration and the results may also be disseminated in scholarly journals and conference proceedings.

I also agree to be interviewed and understand that this interview will take roughly 45-50 minutes and will be taped. It is my understanding that the information provided will be held anonymously and that my interview will be confidential. Further I understand that the data I provide will be destroyed after the study.

During the interview I understand that I may decline to answer any and all questions and that my participation is voluntary. I understand that I may contact Professor Gualtieri the Chair of the Carleton University Ethics Committee at 613-520-2517 or at ethics@carleton.ca if I have any questions regarding this study.

Participant Name, Signature and date:

Researchers Name, Signatures and date:

Bharat Maheshwari

Professor Vinod Kumar

Professor Uma Kumar

Appendix IV: Interim case study report (Organization C)

a. Case study organization's context pertaining to ERP institutionalization:
    a. Very large high-tech sector
    b. Industry downturn
    c. Post Y2K Cohort
b. Status of ERP in the organization
    a. Live with SAP R/3 in 2001 (FI, CO, MM, PP, HR)
c. Brief chronology and description of main events in the institutionalization process.
    a. 6 months in tech stability; well funded and managed program in a technology savvy organization.
    b. Semantic Stability, 6-9 months, challenges included moving to global processes, integrating merged organizations.
    c. Effectiveness: Technology was effective in replacing a number of old legacy systems, inventory was more visible
d. Description the major issues identified in the ERP institutionalization process of the organization in detail.
    a. Building a support organization in highly unfavorable business environment
e. Innovativeness of ERP institutionalization process in the organization.
    a. Multiple training methodologies
f. Outcomes of the institutionalization process.
    a. Stabilized systems
g. Attachments: data displays such as chronology, role and conceptually ordered matrices, specific logical models, references to relevant documents, and list of persons interviewed.