INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

**ProQuest Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600**

UMI[®]

**A Study of ERP Adoption and Implementation
Experience of Canadian Organizations**

by

Bharat Maheshwari, (B.E. Mechanical)

**A thesis submitted to
the Faculty of Graduate Studies and Research
in the partial fulfillment of
the requirements for the degree of**

Masters of Business Administration

**Eric Sprott School of Business
Carleton University
Ottawa, Ontario
May 14, 2001**

© Copyright Bharat Maheshwari, 2001

**National Library
of Canada**

**Acquisitions and
Bibliographic Services**

**385 Wellington Street
Ottawa ON K1A 0N4
Canada**

**Bibliothèque nationale
du Canada**

**Acquisitions et
services bibliographiques**

**385, rue Wellington
Ottawa ON K1A 0N4
Canada**

Your file Votre référence

Our file Notre référence

The author has granted a non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of this thesis in microform, paper or electronic formats.

The author retains ownership of the copyright in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author's permission.

L'auteur a accordé une licence non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de cette thèse sous la forme de microfiche/film, de reproduction sur papier ou sur format électronique.

L'auteur conserve la propriété du droit d'auteur qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

0-612-66865-7

Canada

The undersigned recommend to
the Faculty of Graduate Studies
acceptance of the thesis

**A Study of ERP Adoption and Implementation
Experience of Canadian Organizations**

Submitted by **Bharat Maheshwari, B.E. (Mechanical).**
in partial fulfillment of the requirements for
the degree of Master of Business Administration

Thesis Co-Supervisor

Thesis Co-Supervisor

Director, Eric Sprott School of Business

Carleton University
May 14, 2001

Abstract

ERP adoption and implementation is a complex exercise in organizational innovation and change management. It has enterprise-wide implications, high resource commitment, and high potential business benefits and risks, which make it important for research. Unfortunately, not much empirically supported research on the issue is available. This has motivated us to study this process in organizations which have adopted and implemented ERP systems.

The innovation process theory approach is taken for the study and Markus and Tanis (2000) model is adopted to delineate the ERP adoption process. However, as many of the organizations in our study had not moved into the post implementation stage, the study is focused on the adoption and implementation stages of the ERP adoption process. Data is collected through a questionnaire and structured interviews. Although each adopting organization has a distinct set of objectives for its systems, we found many similarities in motivations, concerns, and strategies across organizations.

Acknowledgements

I would like to express my profound gratitude to my co-supervisors, Professors Vinod Kumar and Uma Kumar for their guidance, understanding and financial support throughout the study. I would like to thank my examination committee members Professors David Cray, Gerald Grant, and Dr. Linda Moffat for their constructive suggestions and reading through the drafts of this thesis at very short notices.

I am grateful to Professor Lorna Unger for helping me with the editing of the draft. My special thanks to Jean Blair, who has always provided me, best possible administrative assistance and support. I would also like to thank my family, their unwavering support and encouragement has been my prime source of motivation. Finally, I am indebted to my wife Manjari for her patience, understanding, and support throughout the program.

Table of Contents

ACCEPTANCE SHEET	ii
ABSTRACT	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENTS	v
LIST OF TABLES	vii
LIST OF FIGURES	viii
1 INTRODUCTION	VI
2 LITERATURE REVIEW	XIII
2.1 ENTERPRISE RESOURCE PLANNING (ERP) SYSTEMS	XIII
2.1.1 What is ERP?	xiii
2.1.2 Evolution of ERP	xv
2.1.3 How does an ERP System Work?	xvi
2.1.4 Main Characteristics of an ERP System	xviii
2.1.4.1 Enterprise Integration	xviii
2.1.4.2 Best Business Practices	xxii
2.2 ERP ADOPTION: AN ORGANIZATIONAL INNOVATION PROCESS	XXIV
2.2.1 Innovation Theories	xxiv
2.2.2 Innovation Process Models	xxvi
2.2.3 Soh and Markus Model	xxvii
2.2.4 ERP Systems Experience Cycle	xxx
2.2.5 ERP Adoption Issues	xxxiii
2.2.6 ERP Implementation Issues	xxxv
2.2.7 Post ERP Implementation	xxxix
3 RESEARCH OBJECTIVES	XL
4 RESEARCH METHODOLOGY	XLII
4.1 RESEARCH DESIGN	XLII
4.2 SAMPLE	XLII
4.3 QUESTIONNAIRE DESIGN AND DATA COLLECTION	XLIII
4.4 PRETEST	XLIV
4.5 DATA ANALYSIS	XLIV
5 SAMPLE DESCRIPTION	XLVI
5.1 RESPONDING ORGANIZATIONS	XLVI
5.2 SYSTEM STATUS AND STRATEGY	XLVII
5.3 IT INFRASTRUCTURE	XLIX
6 RESEARCH RESULTS AND DISCUSSION	LII
6.1 THE PROJECT CHARTERING PHASE	LII
6.1.1 Adoption Initiation	liii
6.1.2 Business Case	lvi
6.1.3 Product, Project Manager and Implementation Partners Selection Criteria	lx
6.1.4 Initial Project Plans and Communication to the Organization	lxiv
6.2 THE PROJECT CONFIGURATION PHASE	LXVI
6.2.1 Detailed Project Plans	lxvii
6.2.2 Project Team	lxviii
6.2.3 Ongoing Project Management	lxx
6.2.4 Training	lxxiv
6.2.5 Infrastructure	lxxvii
6.2.6 Software Configuration and Institutionalization	lxxviii
6.2.7 Testing and QA	lxxxi

6.3	SHAKE DOWN PHASE	LXXXII
6.3.1	<i>Shakedown Challenges</i>	lxxxiv
6.3.2	<i>Problem Resolution Strategies</i>	lxxxv
6.3.3	<i>Organizational Change</i>	lxxxvii
7	CONCLUSION.....	XC
7.1	KEY RESEARCH FINDINGS	XC
7.1.1	<i>Chartering ERP</i>	xc
7.1.2	<i>Implementation Partners</i>	xc i
7.1.3	<i>Project Planning</i>	xc ii
7.1.4	<i>Managing Change</i>	xc ii
7.1.5	<i>Training</i>	xc iii
7.1.6	<i>Infrastructure</i>	xc iii
7.1.7	<i>Incompatibilities between organization and the systems</i>	xc iii
7.1.8	<i>Project Success</i>	xc iv
7.1.9	<i>Lessons Learnt</i>	xc iv
7.1.10	<i>Shakedown challenges</i>	xc v
7.1.11	<i>User acceptance</i>	xc vi
7.1.12	<i>Respondent's perception of success</i>	xc vii
7.2	BENEFITS AND LIMITATIONS	XCVII
7.2.1	<i>Limitations</i>	xcvii
7.2.2	<i>Benefits of the Study</i>	xcviii
7.3	IMPLICATIONS FOR FUTURE RESEARCH.....	XCVIII
	REFERENCES	92
	APPENDIX I Questionnaire	97
	APPENDIX II Covering Letter	115
	APPENDIX III DESCRIPTION OF RESPONDENTS	117
	APPENDIX IV PROJECT CONFIGURATION MODELS	119

1 INTRODUCTION

Enterprise resource planning (ERP) systems are reshaping business structures because they promise to solve the challenges posed by portfolios of supposedly disconnected and uncoordinated business applications (Davenport, 1998). Also referred to as enterprise systems due to their enterprise-wide scope, these integrated enterprise-computing systems provide seamless integration of all the information flowing through an organization (Davenport, 1998; Markus and Tanis, 2000). Given the richness of these systems in terms of added functionality over legacy systems and potential integration benefits, it should not be surprising that a large number of organizations are adopting these systems to manage their operations for various reasons¹ (Ross, 1999).

Organizations that have successfully adopted ERP systems view them as one of the most important innovations that have lead to the realization of substantial tangible and intangible improvements in a variety of areas (Davenport, 1998, 2000; Markus and Tanis, 2000). However, there are a number of examples where organizations were not successful in reaping the potential benefits that motivated them to make large investments in these systems (Davenport, 1998, 2000; Markus and Tanis, 2000). Not all organizations are aggressively adopting ERP systems. Some have adopted certain stand-alone or partially integrated functional modules, while some organizations have even discontinued implementing or using ERP systems after adoption² (Davenport, 1998; Bingi *et al.* 1999). The lack of empirically supported research on critical ERP adoption issues has motivated

¹ Firms give many technical and/or business reasons for investing in ERP systems. Technical reasons include Y2K issues, replacing legacy systems, etc. Business reasons include capabilities for planned production capacity “available to promise” to the customer, etc.

us to study the ERP adoption and implementation³ process by surveying the organizations, which have adopted ERP systems.

ERP systems are packaged software applications originally targeted at manufacturing companies. Several studies to date have focused on adoption and implementation of packaged software applications and advanced manufacturing technologies (Dean Jr., 1986; Noori, 1992; Kumar *et al.*, 1996; Siegel *et al.*, 1997; Harrison *et al.*, 1997; Lassila and Brancheau, 1999). However, the enterprise-wide implications, high resource commitment, high potential business benefits and risks associated with ERP systems make their adoption and implementation a much more complex exercise in innovation and change management than any other software package or advance manufacturing technology. Radding (1999) argues that when an organization puts millions of dollars into a core business application and re-engineers its business processes around it, the system is destined to become much more than an application.

Studying ERP adoption is also important because problems in ERP projects tend to take root if the company does not make the right strategic choices in the adoption process (Davenport, 1998; Buckhout *et al.*, 1999; Markus and Tanis, 2000). Further, it is the adoption phase where the organization wants to ensure that the ERP system fits the business and its needs for information (e.g. Davenport, 2000). One of the respondents in our study responsible for an ERP adoption in his organization puts it this way:

“Having an ERP is much more than having another IT⁴ tool, it is a decision on how to shape the organizational business.”

² Sobeys, the second largest retail chain in Canada, recently decided to abandon the ERP systems initiative and take a resulting \$49.9 million charge in the current quarter (Financial Post, Jan 25, 2001)

³ The innovation adoption process within organizations is generally seen as consisting of two very broad phases: adoption and implementation

ERP implementation locks the operating principles and processes of the organization into software systems. If organizations fail to reconcile the technological imperatives of the enterprise systems with their business needs, the logic of the system may conflict with the logic of business systems (Davenport, 1998). The cost, complexity, investment of time and staff, and implications of modifications, however, make a rollback very difficult. One extreme example of not getting strategic ERP adoption choices right is FoxMeyer Drugs, where the bankruptcy trustees are suing its systems' vendor and consultant company, blaming the ERP system for its business failure (Davenport, 1998).

A Deloitte consulting study of ERP implementing companies found that more than 53 percent of the respondents recognized that going live with ERP systems is not the end of the ERP project, but rather the end of a beginning (Baldwin *et al.*, 1999). An executive quoted in the study considers the visible portion of an iceberg analogous to the tangible return on investment which companies achieve by implementing the ERP systems. The intangible benefits which have a much greater scope are the portion of the iceberg below water that remains to be discovered by the companies by bringing about massive changes and implementing supporting technology.

This research explores the key considerations in typical activities in the ERP adoption process. The theoretical foundation is based upon the innovation process theory approach wherein we adopt the "ERP systems experience cycle" framework of Markus and Tanis (2000) to delineate the innovation process. As most of the firms studied have

⁴Applications of digital computers and communication technologies are now commonly known as Information Technologies (IT).

yet not moved or recently moved to the final phase described as the Onwards and Upwards phase in the framework, this research focuses on the first three phases: Project-Chartering, Project-Configuration, and Shakedown of the ERP experience cycle. In addition, this research is likely to generate a base for further detailed research on organizational concerns in ERP adoption and implementation.

The next chapter provides a literature review of ERP and the organizational innovation process of ERP adoption. Chapter 3 describes the research objectives. Chapter 4 describes the research methodology used in collecting data and analysis. Chapter 5 describes the Sample used in the study. Chapter 6 discusses the research results. Chapter 7 presents our conclusion and suggestions for further research. Finally, benefits and limitations of this study are discussed in Chapter 8.

2 LITERATURE REVIEW

The literature reviewed for the study can be classified into two main areas: one related to ERP and the other related to the organizational innovation process of ERP adoption. ERP being a relatively new concept made a review of the literature on ERP systems and some key underlying concepts important. A literature review of the adoption process within organizations and critical ERP adoption and implementation issues was undertaken to develop the theoretical background and provide the rationale for the study.

2.1 Enterprise Resource Planning (ERP) Systems

2.1.1 What is ERP?

ERP is a popular term, widely used yet probably not well understood. It is an acronym for Enterprise Resource Planning, a concept developed for the next generation Manufacturing Resource Planning systems (MRP II) by the Gartner Group in the early 1990's (Dahlen and Elfsson, 1999; Keller, 1999). The concept posits integration of software applications of manufacturing beyond MRP II to other functions such as finance and human resources. The term was well received by the enterprise software vendors, who have used it as a popular buzzword for selling their products. Russell and Taylor (1995) define ERP as an updated MRP II with relational database management, graphical user interface, and client-server architecture. The initial definition of ERP was targeted at manufacturing companies. However, the concept of enterprise resource planning has been adopted by other sectors also. ERP systems are now being configured for organizations in many different sectors such as services and government. Today, the term ERP

encompasses all integrated information systems that can be used across any organization (Koch *et al.*, 1999).

Watson and Schneider (1999) describe Enterprise Resource Planning (ERP) as a generic term for an integrated enterprise computing system. They define it as an integrated, customized, 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 the description of ERP provided above by Watson and Schnieder (1999).

Organizations configure ERP systems in three distinct ways (Dahlen and Elfsson, 1999):

- Integrated Standard Application Packages
- Integrating Systems In-house
- Joint Venture Systems

Standard application packages refer to integrated packaged applications developed by vendors to satisfy generic industry-wide business requirements. Many firms configure ERP by integrating best of breed functional applications by means of the shelf or specially developed middle-wares. In many cases standard integrated application packages and best of breed applications are integrated to meet ERP requirements. This combination of standard application packages and best of breed functional applications has been termed as joint venture systems by Dahlen and Elfsson (1999).

2.1.2 Evolution of ERP

The ERP applications we see today can be traced back to and have evolved from Materials Requirement Planning (MRP) and Manufacturing Resource Planning (MRP II) systems. In the 1960s enterprises developed simple information systems mainly for automating some simple applications for inventory control in manufacturing and accounting in finance. In the 1970s the focus in information systems shifted to the use of MRP (Materials Requirement Planning) systems in manufacturing, which translated the master schedule built for the end items into time-phased net requirements for sub-assemblies, components and raw material planning and procurement. In the 1980's the concept of MRP II (Manufacturing Resources Planning) evolved, which was an extension of MRP to shop floor and distribution management activities. In the early 1990's, MRP II was extended to cover areas like engineering, finance, human resources, and project management; i.e., the complete gamut of activities within an enterprise. Hence the term ERP (Enterprise Resource Planning) was coined (Gumaer, 1996). The evolutionary characteristics of ERP systems also include various added technical features like graphical user interface, relational database, client server architecture, open systems, portability, use of computer aided software engineering tools in development and use of fourth generation language (Watson and Schneider, 1999).

ERP systems 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). Originally, ERP systems did not provide an environment for decision support activities such as analyzing historical trends, drawing conclusions, scenario building and planning. However, these systems have evolved with

the growing needs of organizations and electronic business requirements. They have been extended to include World Wide Web capability and many advanced non-transactional, primarily data-analysis, and decision support applications. 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. These applications are identified individually as complimentary systems which often work with data generated by ERP systems and are supplied by specialized vendors. However, major ERP system developers such as SAP, Oracle, Baan, PeopleSoft, and J.D. Edwards have also developed many of these applications and provide them as an integral component of their ERP systems. When provided by ERP vendors as integrated components of the ERP systems they are identified as part of ERP systems in the adopting organization. The ERP systems continue to evolve with the organizational and market needs. The latest developments include functionality to support inter-organizational processes and transactions (Kumar, 2000).

2.1.3 How does an ERP System Work?

ERP systems are comprehensive packaged software solutions that automate and integrate organizational processes. 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 ERP system, a purchase order entered by a sales person triggers necessary

Figure 2.1

ANATOMY OF AN ERP SYSTEM

Adopted from Davenport (1998).

action at the production, inventory management, accounting, and distribution levels of the organization at the same time. If the systems are also interfaced with the supplier's systems, the same order also provides information to the suppliers for activating 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 interfaced with those of its suppliers and customers, an organization can have access to and visibility of real time information across the value chain. By integrating this information from partner systems into production schedules and inventory levels, organizations can further lower operation costs, improve forecasting, reduce cycle times, better relationships with suppliers, and increase customer satisfaction.

2.1.4 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.

2.1.4.1 Enterprise Integration

Enterprise integration is the key idea underlying the development of ERP systems. Enterprise resource planning posits using information technology to achieve a capability to plan and integrate enterprise-wide resources, i.e., 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, p.91) stated that:

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

As early as 1969, Blumenthal proposed an integrated architecture and a framework for organizational information systems, 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 very problematic due to the numerous technical and organizational challenges (Joshi and Lauer, 1999; Kumar, 2000).

Alsène (1999) asserts that integration is problematic not only because there are numerous technical and organizational problems to be solved (connectivity among computer systems, modeling of the enterprise, resistance to change etc.), but also because of the imprecision and confusion of terms. Many authors use expressions such as “computer integration of the enterprise”⁵ and “systems integration”⁶ as equivalent and these terms are sometimes even confused with enterprise integration⁷, which is the complex task of improving the performance of an organization by managing the interactions among the participants. 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

⁵ Computer integration of the enterprise is the integration achieved through the application of information technology.

⁶ Systems integration involves interconnecting systems and making applications talk to each other.

integration, i.e., efficiently executing business processes using the enterprise means (e.g. human resources, applications, and physical resources) depending on the availability of internal or external enterprise objects (e.g. events, information entities, physical entities, etc.) 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).

Confusing enterprise integration the with computer integration of enterprise or systems integration or treating computer integration and systems integration as equivalent is a misapprehension in which ends and means are confused. Both computer integration and systems integration are important means of achieving enterprise integration but 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; Alsène, 1999).

The organizational approach to configuring enterprise systems is critical for achieving integration benefits (Bingi *et al.* 1999; Markus and Tanis, 2000; Koch *et al.*, 1999). An organization may purchase only one module of the enterprise systems, or may allow its business units to adopt a different enterprise system, or may allow each unit to configure the same system however 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 it as a challenge of portfolio assembly, in which firms will pull together a wide variety

⁷ Enterprise integration refers to forming an ensemble, a coherent whole, of the various administrative units

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 organizations adopting an ERP system will need to interface the integrated standard applications packages to the company's own proprietary "legacy" systems for which the enterprise system does not provide an adequate replacement. The organizations may also need to acquire and interface the packages to a number of "bolt-on" applications from third-party vendors for various tasks.

Many of the claims of ERP vendors are marketing pitches and are overstated. Deciding which systems to adopt, between various available integrated systems and best of breed applications, is a significant challenge. 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). 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, with possibly unique, technical and managerial choices and 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 individual functional performance perspective. The organizational difficulty in making an

that make up the enterprise, each of which assumes certain functions.

efficient systems and enterprise data strategy is further enhanced by rapid technological development and shortened technology life cycle.

2.1.4.2 Best Business Practices

Embodying best business practices is another key underlying premise used in developing ERP systems. ERP applications represents a set of unique business practices which are automatically acquired by the ERP adopting organization within a certain degree of flexibility for modifying them to adapt to their existing business processes. ERP adoption thus 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 to 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 reengineering activities (Bancroft *et al.*, 1997; 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 reengineering (Hammer, 1995). 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 in terms of incorporating future evolutions or new releases for the systems, and

high costs associated with customizing/modifying these complex systems. ERP implementation poses a serious challenge to adopting organizations to find a balance between reengineering 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. In order to realize the advantages of these best practices, organizations adopting ERP must commit themselves to some degree of business process reengineering (Markus and Tanis, 2000). The relative advantages of reengineering 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).

The importance of dynamically aligning business needs and strategies with system capabilities has been considered critical by many authors for realizing business benefits from information systems (Henderson and Venkatraman, 1992; Chan and Huff, 1993; VanDerZee and DeJong, 1999; Davenport, 2000). Weston (1999) suggests for sustaining a competitive advantage, organizations adopting ERP must ensure, either by reengineering processes or modifying systems or a mix of both that their processes fit the current business needs, customer expectations and organizational strategies.

2.2 ERP Adoption: An Organizational Innovation Process

The term “innovation” has been used in three different contexts: “an invention” (Tushman *et al.*, 1986), “a new object” (Tushman *et al.*, 1986), and “a process” (Daft, 1978). In our study, the “process” context is most applicable as most organizations develop and deploy ERP systems with purchased technologies and products invented by vendors. IT systems and technologies are not an innovation in themselves (Clemens and Row, 1991) and organizations cannot depend on advanced information technologies 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). An organizational innovation process that includes the use of IT systems and technology, and the development of complimentary business and human resources is more important in drawing competitive advantage from technology implementation than the IT systems themselves (Powell and Dent-Micallef, 1997).

The following sub sections discuss the innovation theories and some models used in the literature for the study of organizational innovation process. Major issues in ERP adoption and implementation process described in the literature are also discussed.

2.2.1 Innovation Theories

ERP adoption is a complex exercise in technology innovation and organizational change management (Markus and Tanis, 2000). 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 the investigator attempts 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 to do not so well when the outcomes are uncertain as in the case of ERP adoption. 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. A common track within this approach is to inductively develop stage models which identify a set of stages or phases, relatively, fixed in number and sequence, through which organizations pass on their way to innovations.

Another accepted classification scheme parses academic theories of outcomes of IT-related innovations into rational actor, external control, and emergent process theories (Kling, 1983; Markus and Robey, 1988). Rational actor theories emphasize the great, but bounded, ability of organizations and decision makers to realize their goals. An example of such a theory is the technology acceptance model (Davis *et al.*, 1989) which includes the factors that enter into an individual's choice of technology for particular tasks when faced with alternatives. On the plus side, rational actor theories highlight peoples' motivations and the actions they take to achieve their goals. Therefore these theories tend to be very appealing to practitioners. A drawback of rational actor theories is that they downplay the influential forces beyond the decision-maker's control; furthermore, these theories accept managers' goals as givens without questioning their suitability relative to the external constraints.

The second type of theory - external control theory - emphasizes the inexorable environmental forces, such as the trajectory of technological development or competitive

industry forces. Academicians employ external control theories when they claim information technology alters industry structure or changes decision-making processes in an organization. The strength of external control theories is their explicit acknowledgement that organizations and people have less than perfect ability to make their goals a reality; on the downside, they minimize the ability of exceptional people and companies to change our world.

The third type of theory – emergent process – emphasizes the often-unpredictable interactions between people in organizations and the environment. Emergent process theories assume that people try to achieve their goals but acknowledge that outcomes are often different from those intended – sometimes better and sometimes worse. External forces sometime make a mockery of peoples’ goals and actions, but sometime the forces line up to favor the most unlikely goal. A prominent example of an emergent process theory in the IS field is structuration theory (DeSanctis and Poole, 1994; Orlikowski and Robey, 1991). One of the strengths of emergent process theories is that they account for mutual influences between the organization and its environment. Weaknesses of emergent process theory include they have greater explanatory rather than predictive power and they assign a prominent role to chance.

2.2.2 Innovation Process Models

A common track within process theory approach is to inductively develop stage models which identify a set of stages or phases, relatively fixed in number and sequence, through which organizations pass on their way to innovations. There are many theoretical models (Table 1) proposed by researchers that trace the innovation path from adoption decision to 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). In our study we conceptualize innovation as a decision-making process (Rogers, 1983) consisting of three broad phases of adoption, implementation (Rogers, 1983) and post-implementation (Soh and Markus, 1995). Soh and Markus add a post implementation phase to Rogers' 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 upon the Soh and Markus model (Figure 2.2), providing a framework for the study of the ERP adoption process. We adopt Markus and Tanis model for our study to delineate the ERP adoption process (Figure 2.3).

Table 1. Innovation Process Stage Models

Authors	Year	Phases
● Rogers	1983	Adoption and Implementation
● Cooper and Zmud	1990	Initiation, Adaption, Adoption, Acceptance Implementation and Institutionalization
● 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

2.2.3 Soh and Markus Model

Soh and Markus (1995) model the “IT investment to business value” process as a series of three linked models that correspond to the phases of IT investment, system development, implementation and ongoing operations. Their model is based on emergent process theory.

Soh and Markus (1995) argue that there cannot be a necessary and sufficient relationship between spending on information technology and improved organizational

performance 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 organizational effectiveness literature shows that organizational performance varies depending on how we view organizations (Bedian and Zammuto, 1991). For example, if we view an organization as a rational, goal seeking entities, successful goal accomplishment may be an appropriate performance measure. Organizational performance is a multi-dimensional construct as more than one perspective may be simultaneously valid or integrated for an organization. Organizational performance thus, should reflect all the different perspectives.

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:

- The IT conversion process: organizational spending on IT subject to the varying degree of effectiveness during the IT management process results in IT assets.
- The IT use process: quality IT assets combined with appropriate IT use yield favorable IT impacts.
- The competitive process: favorable IT impacts, if not adversely affected during the competitive process, lead to improved organizational performance. (Figure 2.2).

Soh and Markus also stress three key points to develop an understanding of the success of information system in their model. First, they argue that quality information technology assets, though necessary conditions for a successful outcome, are not always sufficient for success. Second, the outcomes of one phase become the starting condition for the next. Thus decisions and actions in a phase may increase or decrease the potential of success (optimal success) subsequently. Furthermore, because each phase generally involves different groups of people, the framework directs attention to the communication difficulties that accompany the handoffs from one phase to next. Third, the outcomes of each phase result from interactions between external conditions and activities that characterize the phase. This process model helps to understand 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.

Fig 2.2 Soh and Markus Model

Fig 2.3 ERP Systems Experience Cycle (Markus and Tanis Model)

2.2.4 ERP Systems Experience Cycle

Markus and Tanis (2000) have built their “ERP Systems Experience Cycle” framework by incorporating their experience with enterprise systems in the Soh and Markus model. They have added an initial phase to the Soh and Markus model that includes the important organizational decisions and actions before the project officially starts. They call this phase chartering. The remaining three phases in the enterprise system experience cycle (the project configuration phase, the shakedown phase, and the onward and upward phase) correspond loosely to the three phases in the Soh and Markus model. They have 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, and so forth.

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 proceed with the project within certain parameters with a sound or unsound business case. An example of an unsound adoption might be a decision not to allocate sufficient resources for change management and training (Ross, 1999). Another might be

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 as success may also depend on 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 (include 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; 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 business model. Some projects are terminated owing to cost or schedule overruns or severe technical problems.

The **shakedown** phase is the organization's coming 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 the end users. Activities include bug fixing and rework, system performance tuning, retraining and staffing up to handle temporary inefficiencies. Errors

to the prior 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. It is a critical phase as some enterprise systems are terminated in the shakedown phase, as in the case of Fox-Meyer Drug (Bulkeley, 1996).

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 organization is finally able to ascertain benefits (if any) of its investment. 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's 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. The organizations may be unwilling to undertake further improvements or upgrades.

The Markus and Tanis (2000) model is an innovation process model based on emergent process theory. While providing the benefits of process models such as a greater explanatory power, it also has certain disadvantages such as it's not being focused on outcomes. The advantages and disadvantages of process theory approach and

emergent process theory discussed earlier (Section 2.2.1 and 2.2.3) also apply to Markus and Tanis (2000) model.

2.2.5 ERP Adoption Issues

The bankruptcy trustees of FoxMeyer Drug are suing its systems supplier and implementation consultant, and are blaming the ERP implementation for its business failure (Bulkeley, 1996). Dell Computers realized that the system it was implementing would not fit its management model after initiating the ERP project and had to write off millions of dollars already invested in the project (Davenport, 1998; Buckhout *et al.*, 1999). These may be extreme examples, but there are many other examples of many struggling ERP implementations throughout the world which have been published. Many ERP projects face cost and time overruns and fail to achieve corporate goals (Buckhout *et al.*, 1999; Holland and Light, 1999).

On the other hand, there are examples of a large number of companies like Microsoft, Monsanto, Nestle and many others who have adopted and implemented ERP systems successfully (Bancroft *et al.*, 1997; Davenport, 1998; Kalakota and Robinson, 1999). These companies claim that ERP systems have not only delivered a high return on investment in terms of tangible savings in inventory, customer service costs, etc., but also provided various other intangible benefits such as increased customer satisfaction.

ERP implementation involves significant technical and organizational challenges which often force organizations to rethink their IT strategies. The broad flexibility provided by advanced information technologies that support new ways of working while amplifying potential benefits also transform an IT 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 compliments organizational processes, policies and measures. 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 adoption decision-making process. Management's difficulty in deciding about technological choices is worsened by the fact that many of the applications are new and the organization does not understand them at this early stage (Thornburg, 1998).

High risks and difficulties in realization of potential ERP benefits require that adoption decisions be viewed in terms of their strategic importance. Strategic decisions are important in terms of actions taken, resources committed or precedents set (Mintzberg, 1976). They are also crucial to the success of the organization, consume a great deal of top management time, are often made from vague and contradictory information, and may be preceded by a series of incremental decisions (Cray *et al.*, 1994). 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 ERP adoption process (Davenport, 1998).

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). While ERP systems integrate key data and information across the organization and provide enhanced functionality, a key issue Buckhout *et al.* (1999) raise

is of need analysis. The adopting organizations should analyze the amount of control and functionality that needs to be provided by its ERP system 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

A complex workflow requires 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; thus they do not realize organizational efficiencies evolving due to simpler processes while adopting ERP systems. Other key issues faced by companies when adopting an ERP system are building a business case, selecting the software package, organizing an implementation project which 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).

2.2.6 ERP Implementation Issues

Implementing an ERP system is a careful exercise in strategic thinking, precision planning, negotiation with departments and divisions, and change management. ERP implementations are expensive, and multiyear projects which require continual participation and support from senior executives in many large corporations (Davenport, 1998). Small and medium companies, which comprise the middle market for ERP vendors, have been discouraged from adopting ERP even though their operations may be just as complex as large companies in terms of operational complexity, multiple sites,

business units and users because of very large resource commitments, scope and complexity of ERP implementation. Major ERP vendors realizing the inhibitions of the small and medium size companies, have focused on the requirements of this middle market. They are offering new products and focused implementation strategies such as Accelerated SAP, Baan-on-Board, Oracle Fast Forward, or Peoplesoft Select to compress implementation costs and time, and make their products accessible to the middle market (Burns, 1999).

Joshi and Lauer (1999) broadly classify challenges in IT implementation as technical and behavioral. Both of these types of problems are encountered in implementing ERP systems. However, technical challenges once identified can be solved relatively easily with appropriate resources. On the other hand behavioral problems also referred to as people problems by some analysts are difficult to diagnose and even more difficult to resolve. Attributed to various factors ranging from individual resistance to change to political issues, behavioral problems have been cited as prime challenges in ERP implementation (Bingi *et al.*, 1999; Davenport, 1998; Hammer, 1999).

Austin and Nolan (1999) reports that more than 65% of executives believe ERP systems have a moderate chance of hurting their business because of the potential for implementation problems. Trepper (1999) argues that the sheer size and complexity of ERP implementations makes managing these projects difficult. The implementation process itself spins out of business control naturally, a characteristic inherent with large and complex projects (Buckout *et al.*, 1999). Lack of comprehensive corporate vision for the role of ERP systems and fragmented IS strategy make things more complicated for

ERP managers due to midstream scope creeps for the project when the organization realizes the gaps in their initial planning and role for ERP (Grant, 2000).

Austin and Nolan (1999) view challenges in ERP implementation as analogous to those in a new business venture in many aspects like tendency to change shape as they evolve; high costs, high risks and involvement of diverse teams. These authors suggest that management should treat their ERP systems as a new venture by structuring investments in stages, sharing risks among stakeholders and focusing on the creation of high-performance cross-functional teams.

In the literature there are two basic approaches that have been identified as ERP implementation strategies followed by organizations:

- 1) “Big Bang” (implementing everything at once)
- 2) “Step-by-step” (phased implementation strategies).

Phased implementation strategies are further sub classified depending on whether their scope was by business process, ERP module (Finance, HR etc.), business line, site or country. When implementation projects have taken care of all the functionality within the defined project at once, they have been often called as mini bangs or modified big bangs. Many analysts identify the Big Bang approach as most desirable from both functional and technical viewpoints because of speed and simplicity, but find it impractical or impossible to accomplish.

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 is 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.

Adoption of ERP systems dramatically changes the work environment because these systems are integrative and information intensive. 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 the workers need to upgrade their skills in order to adapt with new requirements placed by the new technology and changed work profile (Seigel *et al.*, 1997). The systems also enforce a shift from 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).

Other major implementation challenges that have been highlighted in the literature include a shortage of ERP skilled personnel, training, technical complexity, organizational resistance to change, difficulty in interfacing with legacy existing systems, mid stream changes in project scope, difficulties in customizing ERP to meet specific requirements, turnover of key project personnel, project leadership and shortage of

resources (Davenport, 1998; Bingi *et al.*, 1999, Buckhout *et al.*, 1999, Holland and Light, 1999; Trepper, 1999).

2.2.7 Post ERP Implementation

A Deloitte consulting 1999 study of ERP implementing companies refers to the post ERP 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 a beginning. An executive quoted in the study considers the visible portion of an iceberg analogous to the tangible return on investment which companies achieve implementing the ERP systems. The intangible benefits which have a much greater scope are the portion of the iceberg below water that remains to be discovered by the companies by bringing about massive changes and implementing supporting technology. Markus and Tanis (2000) identify the second wave as Onwards and Upwards stage in their "Enterprise System Experience Cycle" framework. The stage is characterized by activities to realize business benefits from IT resources created by having ERP systems configured and stabilized. However, many of the ERP adoptions being studied have not yet moved into the Onwards and Upwards stage, which characterizes post implementation in Markus and Tanis model. A follow up study is that is not in the scope of this thesis is suggested.

3 RESEARCH OBJECTIVES

Increased adoption of ERP systems has been recognized as one of the most significant changes in the organizational strategies for information systems. It marked a major shift in organizational approach as firms move from proprietary made to order or homegrown legacy systems to outsourcing generic application packages. Despite using the same basic technology and vendors, not all organizations have been successful in realizing their objectives in adopting these new systems.

The lack of empirically supported research in area of adoption and implementation of ERP systems has motivated us to study this process by surveying organizations which have adopted or implemented ERP in Canada. The main objectives of this research is to explore the organizational experience and typical activities in the first three phases of the “ERP Systems Experience Cycle” framework described by Markus and Tanis (2000): Project-Chartering Phase, Project Configuration Phase, and Shakedown Phase. As most of the organizations studied were in the shakedown phase and a few have recently moved into the final Onwards and Upwards Phase, the Onwards and Upwards Phase has not been explored. The key research questions that have been addressed are:

1. How was ERP adoption initiated, evaluated, and justified?
2. How was the ERP system implementation project organized and managed in the adopting organizations?
3. What are the challenges in ERP implementation and what strategies do organizations employ in meeting these challenges?

4. What are the challenges in stabilizing the systems during shakedown and what strategies do organizations employ in meeting these challenges?

In addition, this research is likely to generate a base for further detailed research on organizational concerns in ERP adoption and implementation. Specifically, a detailed study of major problems identified in typical activities in ERP adoption such as Training will lead to development of improved models for ERP Training in the organization.

4 RESEARCH METHODOLOGY

This chapter describes the research methodology used to conduct the study. It is divided into five sections. Section 4.1 discusses the research design and research strategy. Section 4.2 describes the sample and its selection procedure. Section 4.3 provides a detailed account of the questionnaire design and data collection method. Section 4.4 presents the pretest results. Finally, section 4.5 discusses the data analysis.

4.1 *Research Design*

This research is at an exploratory level as ERP is a relatively new concept and not much empirically supported research is available. The research may not produce generalizable results; however, a reasonably representative sample provides valuable insight into ERP adoption and institutionalization activities of the organizations. A self-administered survey was used to collect data. The questionnaire is provided in Appendix I. Wherever possible an in-person/telephone interview was also taken to find deeper insights into the ERP experience of the organization. A survey approach was preferred over a case based approach because of its efficiency and empirical nature.

4.2 *Sample*

The sample used for this study consists of ERP project managers or managers responsible for ERP in their organization. The sample was so proposed, as the respondents will have the necessary insights and experience of managing the typical activities in ERP adoption and implementation process. A convenience sample was chosen because getting enough respondents was difficult due to the extensive nature of the survey and the associated time constraints. In all, 80 organizations were requested for

the survey and the associated time constraints. In all, 80 organizations were requested for participation and the questionnaire was followed upon with requests from the researcher through phone, fax, and emails. The results presented here are based on responses from 19 leading organizations in various stages of ERP experience.

4.3 Questionnaire Design and Data Collection

The questionnaire was designed to capture the organizational concerns and experiences around the typical activities in the first three phases of the “ERP systems experience cycle” framework. The framework was adopted to delineate the ERP adoption process in adopting organizations. Available literature on ERP, AMT, large software packages adoption, and data from interviews with ERP experienced professionals was used to design the questionnaire. The main focus was on exploring key issues and typical activities described in the first three phases of the “ERP experience cycle.” Most of the questions asked were open-ended which helped in getting the top of the mind concerns and avoiding choice bias. The questions were also kept open ended and as broad as possible to accommodate the difference in many project terminology and nomenclatures specific to the individual organization.

The questionnaire consisted of five sections. The research framework was explained to the respondent in the introduction. Each ERP system is different, due to its unique set of objectives, distinctive to the adopting organization (Markus and Tanis, 2000). The first section focused on finding the organization’s status with ERP, its systems strategies and supporting IS infrastructure to understand the status of ERP, strategy and objectives for implementing the system. The next three sections of the

questionnaire focused on exploring the typical activities and their implications in the first three phases of project chartering, project configuration, and shakedown in the “ERP experience cycle.” The last section gathered background information on the respondent and the organization.

Organizations that have implemented ERP were identified from lists of Canadian customers of major ERP vendors. Some lists are available on the web sites of some ERP vendors, while some were obtained from the vendors directly. The ERP project managers or managers responsible for ERP in their organization were identified by contacting the organizations. The questionnaire was then mailed to the identified executives with a covering letter explaining the intended motives of the research, requesting their participation and assuring confidentiality of the information provided. The covering letter is provided in Appendix II. Wherever possible a telephone/in-person interview was conducted to gather more detailed insights about the ERP experience of the organization.

4.4 Pretest

The questionnaire was pre-tested with two organizations to check its validity to assist in revising the questionnaire. The pre-test did not result in significant improvement of the research instrument. These two organizations are part of the 19 respondents.

4.5 Data Analysis

Mainly qualitative data analysis has been used to analyze the data. The research is exploratory in design and the objective is to find empirically supported and grounded evidence from adopting organizations around key concerns and typical activities in the ERP adoption process. Also, detailed quantitative analysis was not feasible due to

concerns of validity related to the small and highly varied sample. However, an extensively detailed questionnaire and interviews were taken wherever possible, providing greater insight and anecdotal evidence to support the analysis. Some organizations did not answer a few questions because they could not divulge with that information or the questions were not applicable to their experience. The descriptive statistics and frequencies provided are for valid responses received for those questions. The sample size is provided in each table that represents the results.

5 SAMPLE DESCRIPTION

This chapter describes the sample used in the research. As a large variance was expected in the responding organizations and their ERP systems, it was important to take into account variations in organizations, their system strategy, and objectives when trying to understand their ERP experience, typical activities, and their impacts on downstream consequences. The first and the fifth sections of the questionnaire were focused on gathering information about the responding organizations, status and strategy for ERP in the organization, and the supporting IT infrastructure.

The chapter is divided into three sections. Section 5.1 discusses the classifications used to categorize the responding organizations. Section 5.2 discusses the system status and ERP strategies of the responding organizations. Finally, section 5.3 discusses the IT infrastructure of the adopting organizations and change in the infrastructure to support the ERP systems.

5.1 Responding Organizations

We received 19 responses from about 80 organizations contacted. The respondents differed widely in their operations, business, strategies, time of initiation of adoption and experience with ERP. The individual organizations are described in Appendix III. Names of the organizations are not disclosed because of the confidentiality concerns of the respondents.

We grouped the respondents in four ways based on the following criteria: the ERP status (Table 2a), time of initiation of ERP (Table 2b), sector in which the responding

organization belongs (Table 2c), and size of the organization (Table 2d). Despite wide variations in the organizations many similarities in motivations, concerns, and strategies across organizations were observed. Some similarities in concerns can be seen across the groups, attributed to the ERP status, time of initiation, sector, and size of the firm.

Table 2. Sample Description (n=19)

a) ERP Status	No of Firms	b)Time of Initiation	No of Firms
● Evaluating	1	● In the last 1 year	3
● Chartering	2	● 1 to 3 year ago	1
● Configuring	1	● 3 to 5 years ago	10
● Stabilizing	7	● 5 to 7 years ago	4
● Onwards and Upwards	8	● More than 7 years ago	1
c)Sector		d)Size(No. of Employees)	
● Public	9	● Small (≤ 200)	4
● Private	10	● Large (>200)	15

5.2 System Status and Strategy

The ERP experience of an organization can only be assessed in the context of the implementing organization, its systems strategy and objectives for the system (Markus and Tanis, 2000). It was thus important to determine the status of ERP in the organizations, their systems strategies, and IS infrastructure. We found that our respondents used mainly two ways for configuring an ERP (Table 3). About 56% of the respondents adopted single vendor off-the-shelf package while the rest used multi-vendor off-the-shelf packages supplied by vendors, which were integrated. About 61% respondent systems could be described as Single ERP systems for the whole organization while 39% used multiple ERP systems (Table 4).

Table 3. System Description (n=18)

System Description (Percentage Respondents)
● Single Vendor off the shelf package (56%)
● Multi-Vendor off the shelf packages (44%)

Table 4. System Strategy (n=18)

System Description (Percentage Respondents)
● Single ERP system for the whole organization (61%)
● Multiple ERP systems in the Organization (39 %)

Table 5 gives the description of modules used and their integration status. Some modules were partially integrated, while some were not integrated at all. Some of the respondents were in the process of integrating systems. Most of the respondents either had a finance module or were in the process of implementing a finance module. The next most popular modules were purchasing, sales and distribution and manufacturing. Many organizations also reported developing business specific add-ons. For example, an educational institution had developed a research information system not provided by the vendor to manage the research grants and funding of its faculty. Interestingly, not all modules were integrated.

Table 5. Modules used (n=18)

Modules	Using	Integrated	Partially Integrated
● Finance	14	11	1
● Purchasing	13	12	1
● Sales and Distribution	11	10	1
● Manufacturing	10	5	5
● Human Resources	8	3	3
● Engineering	4	4	0
● Plant Maintenance	2	1	0

5.3 IT Infrastructure

IT Infrastructure is a multifaceted concept that has been described to include two related but distinct components: The technical IT infrastructure and the human IT infrastructure (Broadbent and Weill, 1997; Henderson and Venkatraman, 1992). A competent IT function is critical and essential for effective ERP implementation (Al-Mashari and Zairi, 2000). An assessment of IT infrastructure of the adopting organizations was made by asking the respondents about their Human IT and Technical IT infrastructure.

There was wide variation in the IT infrastructure depending mainly on the size of the organizations. The IT teams of the respondents varied from a 4 person IT function to a 410 people strong IT team. Interestingly, one of our respondents coming out of an ERP implementation commented that the size of the IT function could be viewed from a different angle:

“ERP are not IT driven, they are functional systems, and so far I would estimate that there is less IT support for ERP systems compared to support for multiple stove-piped legacy systems.”

Reducing dependence on IT has been described as one of the objectives of ERP systems (Al-Mashari and Zaidi, 2000). ERP systems also signify a shift in IS strategy from proprietary legacy software to outsourced generic packaged applications. As well, ERP systems had a user-friendly graphical user interface allowing business users an easy access to relevant information. The respondents were asked to describe the IT infrastructure before and after ERP implementation to gauge the change in IT infrastructure as a result of ERP system adoption (Table 6). On the aggregate level respondents found that required IT support did not decrease after ERP implementation.

The number of people in IT R&D reduced as organizations moved away from developing and coding their own systems, while there was an increase in IT operations and applications development staff. More than one respondent stated that they underestimated the IT staff salaries. There was also a lack of understanding of basic maintenance and growth of the system. The number of upgrades was also a concern which increased the IT support requirement. One respondent said that:

“You barely get out of implementing when you are faced with another upgrade. Each time an upgrade is done, all the system would have to be tested.”

In the technical infrastructure, there was a visible shift towards the client server architecture from the mainframe environments. For database management systems, there was a move from multiple enterprise databases used to an increased use of single relational databases. The data communication systems evolved to an increased use of Internet, WAN (Wide area networks), and EDI (Electronic data interchange).

Table 6. IT Infrastructure Before and After ERP (n=16)
Stated Limitations of ERP (Percentage Respondents)

-
- Employees in IT
 - IT Operations ++
 - IT Application development ++
 - IT R&D --
 - Hardware Systems
 - Mainframes --
 - Client Server ++
 - Database Management systems
 - Multiple databases --
 - Relational databases ++
 - Data Communication
 - LAN--
 - WAN ++
 - EDI ++
 - Internet ++
 - Diskette/Tape Exchange --
-

++ means increase; -- means decrease

Complexity of the Technical IT infrastructure also varied from organization to organization. Asking about other complimentary systems and technologies in the organization which were complimentary to the ERP systems but were not installed as a unified package or part of the project, provided an assessment of the complexity of ERP. Table 7 gives the aggregate description of the complimentary systems used. Data warehouse, decision support systems, business intelligence applications, e-commerce and supply chain applications came as the first five complimentary application choices. Wide variation in the complimentary systems used could be attributed to the difference in business and organization specific needs. Many organizations also had other systems, which were not complimentary to the ERP but were being independently used for specific business requirements. For example, one of the responding organizations used many scientific systems for its research.

Table 7. Use of other Complimentary Softwares (n=18)

Other Complimentary Softwares (Percentage Respondents)

- Data warehouse (44%)
- Decision support systems (33%)
- Business intelligence (22%)
- E-commerce(22%)
- Supply chain (16%)
- Data mining (11%)
- Customer relationship (11%)
- Knowledge management (5%)
- Groupware (5%)
- Sales management (5%)
- Forecasting system (5%)
- Research information System (5%)
- Automatic order faxing(5%)
- Asset management system (5%)
- Collection management system (5%)

6 RESEARCH RESULTS AND DISCUSSION

This chapter discusses the research findings in the first three phases of the “ERP experience cycle” and their management implications. The chapter is divided into three sections. Section one discusses the research findings of enterprise experience in the *project-chartering phase*. Section two discusses the *project-configuration phase* and finally, section three discusses the *shakedown phase*.

6.1 The Project Chartering Phase

The project-chartering phase is comprised of an organizational decision-making process that leads up to the approval and funding of an ERP systems project. The outcome of this phase may be a decision not to proceed with an ERP system project or a decision to proceed. Many typical activities and key players (Table 8) characterize this phase. The time spent by responding organizations in chartering an ERP system project varied from 1 to 12 months; on average the responding organizations spent 6 months in the project-chartering phase.

We explored the typical activities by asking our respondents about their organization’s experiences in ERP project chartering. The research results in the project-chartering phase and their implications are discussed in the following four sub sections: Adoption Initiation; Business Case; Product, Project Manager and Implementation Partners Selection Criteria; and Initial Project Plans and Communication to the Organization.

Table 8. The Project Chartering Phase("ideas to dollars")

Phase Description and Key Actors	Typical Activities
<ul style="list-style-type: none"> ● Decisions leading up to project approval and funding ● Executives, selected IT specialists, enterprise systems vendor, and /or consultants (may be IT driven with low executive involvement or executive driven with low in-house IT involvement) 	<ul style="list-style-type: none"> ● Idea of adopting enterprise systems surfaced ● Business case for investment developed (may be highly informal) ● Selection of software, hardware platform, networking database, implementation partner, project manager ● Initial plans for how system will be rolled out, supported, and maintained, upgraded, etc. (may be deferred) ● Communication to organization ● Decision to proceed, approval of project plan

6.1.1 Adoption Initiation

Adoption initiation is strongly influenced by the expected benefits of ERP adoption in the organization. Different organizations may adopt an innovation for entirely different reasons. For example, recognition of a need or an opportunity may initiate the idea of ERP adoption. It is important to take into account these variations in motivations for adopting ERP systems when attempting to assess or explain their impact on downstream consequences, e.g. an ERP adoption initiated for largely technical reasons may configure ERP as a technology driven project. In our study respondents were asked to rank 25 expected benefits listed from the ERP literature on a scale of 1-7 (1 representing weak, 4 strong, and 7 very strong motivations). These benefits belonged to four categories: Systems Improvement, Operational Improvement, Work Effectiveness, and Strategic.

Eliminating redundant data entry and accompanying errors, improving functionality of the information systems, and providing better order tracking and fulfillment appeared as the top three benefits in the aggregated average ranking. Interestingly, Y2K readiness did not appear in the aggregate top five motivators, and providing for growth and e-business initiatives did not appear in the aggregate top ten

motivators (Table 9). Y2K readiness was ranked very strong only by organizations that initiated implementation of ERP 3 to 5 years ago (Table 2b), while providing for growth and e-business initiatives was ranked high by ERP adopters in the last one year time window. A similarity can be seen in significance of motivators across adoptions taking place at the same time. This can be explained by evolution in organizational needs. Organizations adopting ERP 5 to 7 years ago were mainly motivated by tangible benefits like costs and measurable efficiency such as inventory turnovers. While those in the 3 to 5 year window considered both tangible benefits and Y2K issues, the adopters in the last one-year are motivated more by ERP's capabilities of supporting strategic growth and e-business initiatives. One of the respondents commented:

"Some of the motivations like e-business initiatives have become more prominent now when we are looking for upgrades, they were not as important when we implemented ERP systems."

Table 9. Aggregated Average Scores of Expected Benefits (n=17)

Expected Benefits	Scores (on a scale of 1-7)
● Eliminating redundant data entry and accompanying errors	(6.06)
● Improving functionality of information systems	(5.94)
● Providing better order tracking and fulfillment	(5.73)
● Improving information quality	(5.72)
● Achieving overall improvement in organization efficiency	(5.69)
● Solving Y2K related problems	(5.67)
● Increasing integration of business processes/functional groups	(5.50)
● Standardizing business processes	(5.50)
● Automation of key business processes	(5.39)
● Providing better inventory management and planning	(5.20)

How and by whom the idea to adopt an ERP is initiated may also influence the problem definition, justification, and other preceding activities in the innovation process (Dean Jr., 1986). Strategic decisions and managing changes accompanying an ERP adoption necessitate top management commitment and support from initiation of the idea to its successful implementation (Davenport, 1998; Bingsi *et al.*, 1999). Sometimes ERP

vendors sell directly to top management with minimal IT involvement; IT specialists with minimum top management involvement directly drive other decisions. One of the respondents put their ERP initiation onus equally on their president, her working style, and a need for replacing outgrown systems. He gave the following description for their initiation:

“In our organization ERP was initiated by our new president; after taking the reigns she had detailed discussions with 50 employees in different areas about their operating difficulties. The meeting came up with a recommendation for a single data source and an integrated system. An ERP systems initiative was announced with the president promising to overhaul and replace the systems within two years.”

Another respondent put it as follows:

“We have a computer network association for our industry; our director came back from a conference with the idea of adopting ERP.”

We found that top management initiated the idea of ERP adoption in about 74% of the responding organizations. Interestingly, in one case, it was initiated by a pre-IPO requirement placed by venture capitalists. A few respondents also said it was a stipulation from significant partners such as a parent organization, an acquiring company, or a major customer that lead to the initiation of ERP adoption in their organization. In organizations where the impetus for ERP adoption was a parent organization, top management involvement in ERP adoption was less, as the implications of ERP were perceived to be well understood. Interestingly, these firms found challenges in getting enough headquarter support and the respondents felt that more top management support and involvement would have been helpful.

6.1.2 Business Case

Once the idea of ERP adoption is initiated, the next steps in the adoption process are justification, identification of risks, mitigation of risk, evaluation and selection of product, selection of implementation partners, selling the idea to the organization, selection of a leader (usually a project manager or an executive champion), and developing an initial plan. Markus and Tanis (2000) club these activities under developing the business case for adoption. They are extremely important as they lead to definition of strategic objectives and diagnosis of implementation difficulties. All ERP systems model and support business. The important questions that arise in developing a business case are: Does the system model the business in the best way? Do the system's technical imperatives coincide (or conflict) with the company's business imperatives? Does the organization have, or can it draw upon, enough resources to mitigate perceived and unperceived risks? The management team developing the business case becomes important due to its responsibility to lay down the strategic objectives and vision for the systems as well as for developing a sound business case.

The respondents in this study were asked to list the key players in business case development. The key players identified included senior management, functional and IT specialists, consultants, and parent company employees (Table 10). The precise structure of the team developing the business case varied. The variance can be largely explained by how the idea was stimulated in the organization. For example, parent company employees were involved where ERP was already in place in another division or headquarters of the organization. Consultants were involved in cases where specific

problems or a need for improvement (e.g. process re-engineering, product evaluation) necessitated professional help.

Table 10. Key players in Business Case Development (n=18)

Key Players (Percentage of respondents)
<ul style="list-style-type: none"> ● Senior management (72%) ● Functions (67%) ● Consultants (50%) ● IT people (44%) ● Parent company employees (17%)

Depending on how the idea of ERP adoption was initiated and by whom, some adoption motivations may offer more significant reasons than others for justifying an investment. In the survey, respondents were asked to list the major reasons for justifying an investment in ERP (Table 11). Resolving Y2K issues was listed by about one third of the respondents as the prime reason for justifying an ERP investment. Interestingly, most of these organizations adopted ERP 3 to 5 years ago; these organizations, which constitute a major cluster of our respondents, found that resolving Y2K issues, along with added functionality and reliability, lowered operating costs, need to replace aging legacy applications, etc. provided the justification for an ERP investment. Similarly, across organizations adopting ERP in the last year, the importance of strategic advantages such as providing for growth and e-business initiatives are seen as major reasons for justification; these organizations deemed the ERP systems as strategic. Some organizations also justified ERP as a means of standardizing business processes across the organization. One of the respondents who represented a crown corporation stated:

“We were facing numerous problems with the legacy systems. The system vendors had dropped support. We viewed the new ERP system as an opportunity to do things in a better way and differently. The new systems also resolved the Y2K issues and were one of those approved by Treasury Board’s shared systems initiative.”

Table 11. Reasons Organizations used for Justification (n=18)

Reasons Organizations used for Justifying (percentage respondents)
<ul style="list-style-type: none"> ● Integrated and better quality of information (33%) ● Y2K readiness (33%) ● Multiple systems, interfaces, vendors were difficult to manage (33%) ● Low reliability of older system (28%) ● Lowering costs of operations (low maintenance, higher efficiencies) (28%) ● Systems used or endorsed by a significant partner (28%) ● Higher functionality (22%) ● Improved decision making (17%) ● E-business enablement (17%) ● Standardizing business processes across the organization (17%)

Exploring perceived risks becomes more important in the light of statistics compiled by a market research company that 70% of ERP implementations fail to achieve their corporate goals and published horror stories of large scale implementation failures (Buckhout *et al.*, 1999, Bingi *et al.*, 1999). In our survey respondents were asked to list the major risks identified with ERP adoption (Table 12). Popularly identified risks were cost escalations and acute shortage of ERP skilled people that made retaining ERP skilled staff equally difficult. Some organizations proactively identified the following risks: massive process and technical changes, challenges of integration with other systems, and dependence created on the vendor for upgrading to new software versions. User acceptance and change management were considered less challenging by adopters in small organizations (classified as having less than 200 employees). One respondent described system performance and network reliability as a necessary condition for working with the new systems. The network and system failures were perceived as business risks.

“When the whole company migrates to one system if there is a failure, the company comes to a standstill.”

Interestingly, not many organizations proactively identified many of the risks listed in Table 12, while they later found some of them as major roadblocks (Table 24).

One of the respondents stated:

"I am a big supporter of the idea, I did not see very many risks in the ERP project but for those like time and cost escalation which are associated with every project."

Table 12. Identified Risks (n=16)

Risks Identified (percentage respondents)
<ul style="list-style-type: none"> ● Cost escalation (68%) ● Availability and retention of skilled people (50%) ● High degree of organizational change (25%) ● User acceptance (25%) ● Capability of organizational infrastructure to contend with new technology (12%) ● High Network Reliance (6%) ● Challenges of integration with other legacy systems (6%) ● Not completing implementation by Y2K (6%) ● Loss of control over software version migration (6%)

Respondents were also asked to list their organizational strategies for mitigating identified risks. Only a few replied to having formalized risk mitigation strategies. It is an interesting observation that many organizations do not proactively plan for project contingencies. Several authors have stressed that risk awareness and risk management must be of critical concern to project managers, as unmanaged or unmitigated risks are one of the primary causes of project failure (Royer, 2000). Planning and professional assistance, focus on change management, investment in human resources, and project planning were some of the mainly used strategies for mitigating risks (Table 13. Frequencies are not provided as only 5 organizations responded to having any formally planned strategies).

Table 13. Strategies for Mitigation of Risks (n=5)

Risk Mitigation Strategies used
<ul style="list-style-type: none"> ● Planning and professional assistance ● Focus on change management ● Make people accountable for savings ● Investment in human resources ● Project planning and ensuring adherence to schedule ● Establish ERP as the tool of choice across the enterprise ● Create awareness in the organization to update infrastructure

6.1.3 Product, Project Manager and Implementation Partners Selection Criteria

Davenport (1998) asserts that since ERP systems are generic in design, ERP adoption is largely a matter of compromises, in balancing the way a firm wants to work and the way the ERP system lets it work. The organizational approach to adopting ERP systems is important for achieving integration benefits (Bingi *et al.*, 1999; Markus and Tanis, 2000; Koch *et al.*, 1999). An organization may purchase only one module of the enterprise systems, or may allow its business units to adopt a different enterprise system, or may allow each unit to configure the same system the way it sees fit, overlooking the integration benefits. Conversely, implementing an ERP system without proper analysis may push a company towards full integration by imposing systems logic even when a certain degree of business unit segregation may be in its best interests (Davenport, 1998). Management's difficulty in evaluating ERP systems and deciding on their technological and change management imperatives is increased by the fact that many of the applications are new and the organization does not understand them and their implications at this early stage. Many of the organizations partnered with ERP vendors or consultants in their ERP adoption process (Table 14). A few organizations also involved hardware vendors in the process while a few went along with internal resources and support of parent/allied company employees. Selection of implementation partners is

very important because these organizations partner and facilitate the organizations in their adoption, implementation, and stabilizing of the applications. As well, even with today's state of the art, no single enterprise system meets all the information-processing needs of the majority of organizations (Davenport, 2000).

Table 14. Implementation Partners (n=12)

Implementation Partners (Percentage respondents)	
● Consultant	(83%)
● ERP Vendor	(42%)
● Hardware Vendor	(17%)

Respondents were asked to list the criteria used to select the ERP product and its vendor. Functionality, system reliability, and fit with parent/allied organizations were ranked as the three most important criteria (Table 15). Most of the crown corporations adopted systems acquired by a general Request for Proposals (RFP) raised by the Treasury Board of Canada under the shared systems initiative. Stress on the importance of fit with allied organization systems was distinctly visible. Some of the respondents adopted systems used by their parent organization. In one case the responding organization switched over to the systems used by the acquiring company abandoning its own ERP software. In many of these cases organizations faced challenges if the adopting organization had a business model which was different from that of its parent or significant partner. For example, one organization, which was spun off by a large company, found that its business model was not supported by the parent company's ERP systems it adopted. Another organization, a Canadian unit of a multi-national company had to develop add-ons to meet country and local business specific requirements when it adopted the systems used by its parent company.

Several respondents considered vendor reputation, support and service infrastructure, and availability of regular upgrades important. One of the respondents stated that lack of support from earlier systems vendor (which had gone bankrupt) was a key factor in justifying an investment in ERP. Learning from the past experience, his organization laid high stress on vendor reputation and support/service infrastructure when selecting their ERP systems.

Table 15. Product/Vendor Selection Criteria (n=14)

Product/Vendor Selection Criteria (Percentage respondents)
<ul style="list-style-type: none"> ● Functionality of the system (79%) ● Systems reliability (64%) ● Fit with parent/allied organization systems (64%) ● Available business best practices in the system (50%) ● Cross module integration (50%) ● System using latest technology (43%) ● Vendor reputation (43%) ● Availability of regular upgrades (29%) ● Compatibility with other systems (29%) ● Vendor's support/ service infrastructure (29%) ● Ease in customizing the system (29%) ● Lower costs of ownership (14%) ● Better fit with company's business processes (14%)

Interestingly, ease of use was not ranked as a selection criterion, and only a few considered total cost of ownership in selecting systems, while user acceptance and cost escalation were listed as perceived risks. The fact that a better fit with the company's processes was not being considered by many organizations also indicates that most of the organizations either modified the software to achieve the fit (29% of the respondents valued ease of customizing the systems) or re-engineered their processes or managed with systems not fitting well with their processes. This observation was interesting as achieving a fit between the systems and the business processes has been stressed to be crucial for realizing the potential benefits of ERP by several authors in the literature

(Henderson and Venkatraman, 1992; Davenport, 2000). The question of how the fit was achieved is further explored in section 6.2.6.

Enterprise-wide scope, and the implications of technological and process change significantly enhance the complexity of an ERP project. Some authors consider knowledge, skills, abilities and experience of an ERP project manager to be the single most decisive element in successful ERP adoption (Trepper, 1999). Respondents were asked to list the criteria used for selecting the project manager (Table 16). Project management skills and functional experience were listed as the most popularly used criteria for selecting ERP project managers.

Table 16. Project Manager Selection Criteria (n=14)

Project Manager Selection Criteria (Percentage respondents)
<ul style="list-style-type: none"> ● Project management skills (64%) ● Functional experience (64%) ● IT management experience (21%) ● Clout in the organization (14%) ● Initiator of the project (14%)

Since ERP implementation demands multiple product specific and business skills, the importance of and dependence on consultants as implementation partners greatly increases. Because the ERP market has grown so fast, aided by non-negotiable deadlines set by Y2K issues, many firms have moved largely towards outsourcing special skills rather than investing and developing them internally (Bingi *et al.*, 1999). Services of consultants were used by 83% (Table 14) of the respondents, while the other 17% organizations used skills of employees of parent or allied organizations. The challenges of ERP adoptions are compounded if the firms end up partnering with unsuitable consultants, which makes selection criteria for consultants very important. Respondents were asked to list the criteria for selecting management and technical consultants (Table

17). As many organizations hired the same consulting company for both technical and management skills, or in some cases did not hire a management consultant at all, the same set of criteria were used for their selection. Reputation and ERP experience came up as the most popular criteria. Interestingly, few respondents considered cost as a consultant selection criterion, while high consultant costs later became one of the prominent reasons for upward revision of project budget. Process engineering experience and industry specific knowledge were important criteria for some organizations which stressed re-engineering their processes.

Table 17. Consultant Selection Criteria (n=12)

Consultant Selection Criteria (Percentage respondents)
<ul style="list-style-type: none"> ● Reputation (75%) ● ERP experience (50%) ● Process engineering experience (25%) ● Industry specific knowledge (25%) ● Methodology / Approach (25%) ● Cost (25%) ● Partner of choice (8%) ● Partner of ERP vendor (8%)

6.1.4 Initial Project Plans and Communication to the Organization.

Respondents were asked how the ERP implementation project was planned and structured in their organization. About 69% of the studied ERP projects were phased by modules (single or multiple modules at a time) while 25% were franchised by business unit, site, or plant. Interestingly, the big bang approach (implementing all modules and functionality at once) was only followed in one case (Table 18). Matrix structure was commonly used as 56% of the respondents structured their ERP projects as a matrix.

About 32% organizations structured their ERP project within a function and 12% structured it under the corporate office (Table 19).

Table 18. Implementation Strategy (n=16)

Implementation Strategy (Percentage respondents)
● Phased By Modules (69%)
● Franchised by Business Unit, Site or Plant (25%)
● Big Bang (6%)

Table 19. Project Structure (n=16)

Project Structure (Percentage respondents)
● Matrix (56%)
● Under a Funtional Department (32%)
● Under the corporate Office (12%)

Enterprise-wide changes associated with ERP necessitate generating support and buy-in of the new systems within the organization from a pre-planning stage. Respondents were asked to list the strategies used for communicating the importance of ERP within the organization (Table 20). Popularly used strategies were meetings, information seminars, e-mails, and training key members on ERP. buy-in in the organization was needed at all stages of implementation; buy in from users was especially critical for successful institutionalization of the ERP systems. In one of the cases, the president initiated ERP as one of the recommendations coming from the employees for improvement. Communication and demonstration of the potential benefits and improvement were the main ideas in the buy-in approaches. Many organizations faced significant resistance from both users and managers despite their efforts to get their Buy-in for the new systems. One of the respondents felt that their efforts in getting a buy-

in from the users were inadequate. Users in this organization resisted the new systems for a long time and expressed that the ERP systems were forced from the top and did not meet their needs.

Table 20. Approaches for Buy-in in the Organization (n=14)
Approaches for Buy-in (Percentage respondents)

-
- Meetings (64%)
 - Information seminars (50%)
 - E-mail (50%)
 - Training key members (50%)
 - Newsletters (36%)
 - Surveys (14%)
 - Demonstrations (14%)
 - Senior management support (14%)
 - Business case (14%)
-

6.2 The Project Configuration Phase

The project configuration phase is comprised of activities intended to get the systems up and running in the organization. Many typical activities and key players (Table 21) characterize this phase. The time spent by responding organizations in implementing an ERP system varied from 3 to 26 months: on average the responding organizations spent 13 months in the project configuration phase.

We explored the typical activities by asking our respondents about their experiences. The research results in the project configuration phase and their implications are discussed in the following seven sub sections: Detailed Project Plans, Project Team, Ongoing Project Management, Training, Infrastructure, Software Configuration and Institutionalization, and Testing and Quality Assurance.

Table 21. Project Phase ("dollars to assets")

Phase Description, and Key Actors	Typical Activities
<ul style="list-style-type: none"> ● Activities designed to get system up and running in one or more organizational units ● Project manager, project team members, and variety of external technical and general management consulting resources, executives (in steering committee capacity), other organizational members (in consultative roles) 	<ul style="list-style-type: none"> ● Development of detailed project plan ● Selection and assignment of project team members ● Ongoing project management ● Training of project team members and acquisition of supportive skills ● Infrastructure upgradation ● Software configuration and "fit with the organization" <ul style="list-style-type: none"> - Current and/or future business process modelling and reengineering, if any - Execution of change management plan, if any - Software configuration - Software customization if any - System integration - Integration of software bolt-ons and/or legacy systems, if any - Data cleanup and conversion - Documentation ● Testing, bug fixing, and rework ● Executive and end-user training ● Rollout and startup

6.2.1 Detailed Project Plans

Project planning is key to the success of any large project. Complexity, large resource commitment, and enterprise-wide scope of ERP projects make them an intricate exercise in planning and project management (Radding, 1999). Many ERP analysts have stressed the importance of project management and planning for successful implementation (Davenport, 2000). Respondents were asked how the ERP project was planned. If they were planned in stages, what were the typical activities in those stages?

Not surprisingly, each project was planned in a number of stages. Each organization had its own nomenclature for stages. A similar planning approach was seen in some organizations, which was linked with having the same software product and using the implementation methodology proposed by the vendor. These organizations

adopted ASAP methodology proposed by SAP. Interestingly, not all SAP adopters used ASAP. There were about 6 stage models, which emerged and which are provided in Appendix IV. All the stage models reported could be clubbed into four broad phases of planning, configuration, testing, and implementation (Table 22). There was a difference in precedence of activities and the stage a common activity undertaken. For example, User training was initiated in some organizations parallel with the configuration efforts. While some projects started user training when configuration was being done, others waited till the testing stage or going live. The differences in the approaches were mainly due to variation in the organizations and their strategies to efficiently achieve project objectives. Interestingly, many of the activities were not sequential; some of these were executed through more than one phase. For example, in some projects benefits analysis was completed in the chartering phase, while some did benefit analysis in the planning stage of project configuration phase.

Table 22. Main Project Planning Stages

Stage	Major Activities
● Planning	● System Planning, Benefit Analysis (sometimes done in Chartering phase), Project Scoping
● Configuration	● Architecture, Configuration, Design, Building
● Testing	● User Training, Product Testing
● Implementation	● Go Live, Training and documentation

6.2.2 Project Team

Success of any project depends critically on its team members. An ERP project requires a cross-functional and multi-skilled implementation team because of its enterprise-wide scope (Davenport, 2000). Respondents were asked about the composition of project teams (Table 23). All the responding organizations went along with cross-

functional implementation teams. About 90% of the respondents had a strong IT and functional representation on the teams. Top management was closely involved in about 50% of the implementation projects. Management and IT consultants, the ERP vendor, and parent company employees were the other key constituents of the project team. The constitution of the team varied from organization to organization. Knowledge transfer from the parent company was significant in cases where the organizations acquired the same systems used by their parent organizations or head office. Parent company employees were the key people in implementation teams in these cases.

Interestingly, a few responding organizations also had hardware vendors in the implementation team. These were mainly very large, geographically spread organizations, where cumulative investment on hardware was very high. Critical ERP requirements such as reliable maintenance and compatibility of hardware with the ERP systems made having hardware vendors in the team a suitable proposition for the organization. The hardware vendor was benefited as it thus was assured a sole supplier status for a large account.

Consultants were hired for both management and IT skills. In one case the consultants substituted functional representative in the team because a function person was not available. One organization invested heavily in training their key business users to develop them as internal ERP consultants.

Table 23. Key People in the Implementation Team (n=12)

Key People in the Implementation Team (Percentage respondents)
<ul style="list-style-type: none"> ● Functional personnel and management (92%) ● IT personnel and management (92%) ● Top management (50%) ● IT consultants (50%) ● ERP vendor (42%) ● Parent company employees (33%) ● Management consultants (33%) ● Hardware vendor (17%)

6.2.3 Ongoing Project Management

Respondents were asked about the major obstacles they faced in the ERP implementation project. Problems in transition to new systems, unavailability of skilled people, high turnover of key project persons, cost escalations, and difficulties in estimating the project requirements came up as major obstacles faced by the organizations. Organizations also faced various problems in data-conversion, user acceptance of new systems, and time lag in attaining comfort levels in operating with new systems and processes (Table 24).

There was significant resistance from staff in about 25% of the responding organizations and about 10% of the organizations also faced resistance from managers. Co-ordination between functional groups was a larger challenge as the new systems were based on a process view of the organization and necessitated ample cross-functional co-ordination. In-house resource constraints were faced by most of the organization. Y2K motivated many organizations to implement ERP with non-negotiable deadlines, which created a short supply of ERP resources such as skilled consultants and hardware. However, the shortage of ERP skills and resources has subsided as one respondent stated:

"It is much easier to hire ERP programmers now and at much lower prices."

Lack of top leadership supported created challenges for the project team such as buy-in from users and adequate project resources. A knowledge gap between implementers and users was a significant roadblock for a few organizations. One respondent put it as follows:

“The ability of the business users to aid the configuration process was limited. Meeting user requirements satisfactorily was a challenge as while the implementers understood the systems, they could not comprehend the business needs.”

Unclear strategic direction and vision for the use of ERP systems was a challenge for 25% of the respondents. Interestingly, one respondent commented that he did not see any return on investment from the new systems. The systems would only replace the outgrown old ones.

In one organization where the project was managed with the support of Parent Company employees, the respondent felt getting adequate support from parent company employees was a major roadblock. The organization also found that since their business model was different some of the critical needs were not fulfilled by the adopted systems.

Table 24. Road Blocks (n=12)

Project Road Blocks (Percentage Respondents)	
●	Difficulties in changing to new from old system (50%)
●	Unavailability of skilled project people (42%)
●	Turnover of key project persons (42%)
●	High costs of implementation (42%)
●	Difficulties in estimating project requirements (42%)
●	Significant resistance from staff (25%)
●	In house resource constraints (25%)
●	Unclear strategic direction and vision for the use of ERP (25%)
●	Knowledge gap between implementers and users (25%)
●	Co-ordination between functional groups (25%)
●	Lack of commitment from top leadership (25%)
●	Significant resistance from managers (8%)
●	Technical difficulties in configuration (8%)
●	Incompetent consultants (8%)
●	Bugs in the software (8%)
●	Support and training from parent (8%)

Respondents were asked if there were any revisions in the ERP project's schedule, scope, and budget. Project scope was rarely revised, whereas about 37% of the responding organizations revised their budget and 50% revised their schedules. The main reason stated for budget revisions was the high costs of consultants. Consulting dollars also represented as high as 70% of the total project costs in one project. Training costs were next on the list of reasons for exceeding budget (Table 25). Training was costly and retraining was often required due to high turnover of employees and changes in the systems. Extended project schedules, reported in 50% of the cases, also contributed to budget revisions. Some companies had to add hardware capacities and change some existing hardware which was not budgeted for initially.

Table 25. Budget Revisions (n=6)

Main Reasons for Revisions in Budget
<ul style="list-style-type: none"> ● Consultants costs were very high ● Project schedule extended ● Training costs were higher ● Hardware resizing

Project schedules were revised in 50% of the organizations (Table 26). The main reasons stated were that organizations under-estimated work volume. The packaged software was not plug and play; many customizations and modifications were needed. Sometimes the companies re-engineered their processes along with implementing ERP, which took more time than expected. One consumer goods company decided to go an extra round of running the ERP and legacy systems in parallel to gain confidence with new systems and avoid risks of business disruption.

Table 26. Schedule Revisions (n=9)

Main Reasons for Revisions in Schedule
<ul style="list-style-type: none"> ● Underestimated work volume ● Took too long in BPR and development activities ● Unrealistic project schedule ● One round of parallel run ● Decided midway to roll one module later

Measuring project success is an important aspect of ongoing project management. In information systems research, it is branded a difficult proposition because of problems in defining project success (Markus et al., 2000). Success depends on the point of view from which you measure it. People mean different things when they talk about ERP success. For example, project managers often define success in terms of completing the project on time and within budget. Business executives may look at it from the angle of

achieving business results, while a user's perspective may be influenced by ease of use and work enhancements achieved.

We asked our respondents who were mostly project managers about the success criteria used for evaluating project success (Table 27). On time and within or under budget were the popularly used project success criteria. Two organizations linked project success with realization of key performance indicators, which were built into the scope of their project plan. These organizations linked project success with the delivery of target key performance indicators such as reduced inventory turns and reduced time to complete a sales order. One organization hired an external reviewer to get a third party evaluation of project success.

Table 27. Project Success Criteria (n=12)

Project Success Criteria (Percentage Respondents)
<ul style="list-style-type: none"> ● On time(50%) ● On or below budget (50%) ● Key performance measures e.g. time to complete a sales order, inventory turns (17%) ● Did it work when switched (17%) ● External reviewer (8%)

6.2.4 Training

Shortage of ERP skills and radical process changes brought about by ERP implementation made providing enough and timely training to project persons and users a critical requirement in ERP implementation (Davenport, 2000; Markus et al., 2001). Importance of training was echoed by many of our respondents. ERP skills were in acute shortage because of high demand for people with good understanding of business and ERP systems. Organizations had to conduct ERP training for the project team and users.

While it took time and resources to train people, it was very hard to retain trained employees. One of the respondents stated that:

“Some of my staff have become ERP consultants which we expected as their knowledge, training, and skills increased.”

Respondents were asked how training was organized and what the main challenges in providing training were (Table 28). Project teams were mainly trained by sending them to vendor’s training centers, while for training executives and users, organizations used vendor-training facilities and developed in-house programs, courses, and facilities. Some organizations developed key users in different work groups to train and assist other users in their respective groups. This approach was identified as the “train the trainer” model. The stress on in-house course development was more in large and multi-site organizations where a franchising strategy was mainly used. These organizations leveraged their investment in training by transferring it to other parts of the organization. One organization used the key users and the key user training sessions to develop training manuals for the organization. The key users were required to document their experience, which was effectively used to develop organizational ERP training manuals.

There were many challenges in training the project team members as well as the users. Organizations found difficulty in finding enough good people from their functional groups to serve on the project team and as key users. One of the respondents commented:

“It was tough finding enough knowledgeable people from the business to serve as project persons and trainers.”

About 38% percent of the organizations found that they ran out of training budget. Training being expensive, underestimating training requirements and not budgeting sufficient resources were the stated reasons for exceeding the training budget. Some of the organizations found that lack of computer savvy users slowed down the training and adoption process. Popular IT magazines and analysts have highly criticized ERP training mechanisms and methodology as inadequate and deficient (CIO magazine, 1999). About 25% of respondents found that getting the right people as trainers was difficult, while another 25% said that not enough detailed information and quality-training material was available from vendors. It was very hard to explain the integrated nature of the process and the consequences of individual actions on the downstream processes in the new work processes supported by the new systems. This was also because training was mostly focused on helping the users learn how to use the software. One of the respondents stated:

“Most of the training provided focused on how to carry out an operation with the new systems. Users were not told why to use the systems, which resulted in situations like an human resource clerk generating an employee number without understanding the significance of the project and sometimes getting the whole process wrong.”

Having a large number of users across Canada created logistical challenges for some large organizations in scheduling trainers, employees and training facilities. Organizations also found that due to a high demand for ERP skills a number of skilled employees switched jobs, leading to unusually high turnover. Training new employees was almost a continuous effort. Some implementations evolved and changed with time, so the course content was hard to nail down. Meanwhile the non-negotiable deadlines like the one posed by Y2K and tight project time schedules created pressure on the organization to go live. Some organizations found that as the systems were evolving,

course content was hard to nail down and retraining was required which also accounted for exceeding the training budget.

Table 28. Challenges in Training (n=16)

Challenges in Training (Percentage Respondents)
<ul style="list-style-type: none"> ● Insufficient budget (38%) ● Logistics: Scheduling trainers, trainees, setting up classrooms (38%) ● Lack of computer savvy users (38%) ● Getting the right people as trainers (25%) ● Not enough detailed, quality information (25%) ● Difficult to understand impact on downstream activities (25%) ● Canadian geography (25%) ● High turnover of both project persons and users (25%) ● Tight project time scales (12%) ● Hard to nail course content (12%)

6.2.5 Infrastructure

Respondents were asked about the challenges they faced in upgrading the infrastructure to support the new systems (Table 29). About 50% of the organizations deployed new infrastructure to support their ERP systems. About 25% of the respondents redesigned their IT architecture; most of them made a shift from mainframe based legacy systems to client server architecture. About 15% of the respondents found significant difficulties due to incompatibilities between existing infrastructure and the new systems. All the systems across the organization needed to be compatible with the software. One respondent observed that:

“All printers across the country must be recognized centrally for printing an ERP report.”

Some organizations found that it was hard to estimate the requirements placed by new systems. One of the respondents commented:

“Hardware capacity and equipment needed to support the ERP was highly underestimated. We needed all new PC’s. We faced problems in archiving. There was a lack of understanding of basic maintenance and growth of the system, so although we had an initial equipment budget we forgot that as the years go by we need extra disc space. There was a lack of projection of the life cycle needs.”

A few respondents also found that Client Server technology was relatively less matured than the mainframes it replaced. One respondent said that despite going through many hardware-sizing exercises, it was still hard to estimate the requirements of new systems and support them on full load. The performance tuning required further investment into hardware. Political issues between departments on ownership of the project surfaced in one of the implementation projects, where the systems were driven functionally and the project team faced lack of support from IT department. One of the respondents put it this way:

“As ERP project was totally managed by Finance with IT and functional employees. The IT shop management felt threatened as they considered that their mandate was being delivered by someone else.”

Table 29. Challenges in Upgrading Infrastructure (n=12)

Challenges in upgrading infrastructure (Percentage Respondents)
<ul style="list-style-type: none"> ● New infrastructure deployment (50%) ● Finding enough qualified people with both business and ERP specific knowledge (50%) ● Re-design (25%) ● Non negotiable deadlines Y2K (25%) ● Incompatibility of new systems with existing infrastructure(25%) ● Difficulty in estimating requirements (15%) ● Technology less mature (15%) ● Political issues (8%)

6.2.6 Software Configuration and Institutionalization

ERP systems are software packages, generically designed, keeping the industry-wide needs and best practices in mind. One of the major challenge in adopting

organization faces while configuring an ERP system is that software does not fit all their requirements (Davenport, 1998). Even in today's state of the art technology, organizations find that not all their requirements are provided by the ERP systems they adopt. We asked the respondents about incompatibilities between the software and organizational needs (Table 30). About 44% were organization specific where the software did not support the way the organization worked. For example, the software did not support many legislated procedures required by the public sector organizations. About 37% of the respondents reported few business specific incompatibilities. For example an organization in the semiconductor industry found that the systems they had implemented did not support yield management requirements. About 37% found country specific incompatibilities. For example, the system did not support bilingual requirements (French support was lacking for some applications) posed by some departments.

Table 30. Observed Incompatabilities (n=16)

Observed Incompatabilities (Percentage Respondents)
● Organization specific (44%)
● Business/trade specific (37%)
● Country specific (37%)

Respondents were also asked to list the limitations of their ERP systems (Table 31). Sophistication of the software and availability of limited industry specific versions was considered as a limitation by 33% of the respondents. Some respondents found that ERP systems had limited reporting capabilities and it was difficult for business users to generate customized reports. A few crown corporations found that many legislated features were not supported by the ERP systems.

Table 31. Limitations of ERP (n=12)**Stated Limitations of ERP (Percentage Respondents)**

- Sophistication of the software (33%)
- Limited industry specific versions (33%)
- Limited reporting capabilities(25%)
- Sub-optimal system performance (15%)
- Standstills due to failures (15%)
- Some legislated procedures not supported (15%)

We further asked the respondents about their strategies to meet the limitations of ERP and the incompatibilities between the software and their business needs (Table 32). Firms took more than one strategy in many cases. About 65% of the organizations responded that they made some modifications in the software, 50% developed add-ons, while 30% said they re-engineered their processes accordingly to match those supported by the software. Interestingly, 15% also said they are living with some shortfall. A high response on making software modifications was interesting in the light of many reported woes of modifying ERP software such as high costs, difficulties in upgrades, and increased introduction of bugs due to modifications (Davenport, 2000).

Table 32. Strategies to Meet Incompatibilities (n=12)**Strategies to Meet Incompatibilities(Percentage Respondents)**

- Software was modified (65%)
- Add-On's developed (50%)
- Business Processes Re-engineered (30%)
- Living with the shortfall (15%)

The challenges in meeting the incompatibilities included deciding the extent of the customization required. One of the respondents stated:

"It is difficult to determine whether custom development is really warranted or whether the user group is resisting change."

Organizations found that not only were customizations very costly, but also process leaders had limited ability to effectively participate in the customization process.

6.2.7 Testing and QA

Assuring that the new systems will work well when they go live is a challenging task. Respondents were asked about the testing and quality assurance activities they carried out (Table 33). About 50% of the organizations carried out unit testing for desired functionality and identifying software problems. About 38% of the organizations carried out integration testing to validate the performance of the systems in the integrated environment. Some organizations ran pilot testing by populating the systems with organizational data. A few organizations also tested their systems for scalability and performance on load.

Table 33. Testing (n=12)

Testing (Percentage Respondents)
<ul style="list-style-type: none"> ● Unit testing (50%) ● Integration testing (38%) ● Pilot testing(38%) ● Scalability or load testing (25%)

Organizations employed varied strategies for assuring the quality of their systems (Table 34). About 30% of the organizations set-up a dedicated QA environment which continued to operate even after implementation to ensure accuracy and preciseness of data. Reconciliation of accounts and data clean up and conversion was another major challenge faced by the adopting organizations. Organizations used test scripts written for unit and integration testing. Some 20% ran full conference room pilots where key

business users on the new systems with organizational data validated the working of all the processes. A few organizations said that given their size organizations, a conference room pilot, although desired was not possible. About 10% of the organizations responded that they focused heavily on validation of data in the new systems. Interestingly, two organizations ran their ERP systems in parallel with the legacy applications till confidence was achieved with the new systems to minimize business disruptions.

Table 34. Quality Assurance Strategies (n=10)

Quality Assurance Strategies (Percentage Respondents)	
•	Dedicated QA technical environment (30%)
•	Interaction with principal pertaining to problems they encountered (30%)
•	Test script (30%)
•	Conference room pilot testing of all the organization data for all modules (20%)
•	Complete validation/verification of data between old and new systems (10%)
•	Reconciliation of old accounts (10%)

6.3 Shake Down Phase

Shakedown is a critical phase in ERP experience as it is in this phase the organization comes to grip with their ERP systems (Markus and Tanis, 2000). Shakedown is a transition stage associated with all projects. However, the difficulties in institutionalizing new systems and potential business disruption in this transition phase make it a critical phase for an ERP project. The Shakedown phase has been defined to continue till the normal operations are restored. Many typical activities and key actors (Table 35) characterize the Shakedown phase.

The time spent by responding organizations in the shakedown phase varied from 4 to 30 months; on an average the responding organizations spent 14 months in the shakedown phase. A few large organizations had an extended shakedown phase as long

as 21 to 30 months. Interestingly, one of these organizations completed ERP project configuration within 3 months while they had an extended shakedown period. The organization followed a focused Accelerated SAP implementation strategy suggested by the vendor (SAP) and configured plain vanilla systems (without any modifications). An extended shakedown following a condensed project configuration phase suggests that while focused implementation methodologies have reduced time for going live with ERP, the organization may still have to go through a long shakedown in stabilizing the new systems. The observation is interesting, as criticism by analysts of long project time and high costs incurred of adopting ERP is one of the key reasons that prompted ERP vendors to introduced focused implementation methodologies (Burns, 1999).

We explored these typical activities by asking our respondents about their experiences. The research results in shakedown and their implications are discussed in the following three sub sections: Shakedown Challenges, Problem Resolution Strategies, and Organizational Change.

Table 35. Shakedown ("assets to impacts")

Phase Description, and Key Actors	Typical Activities
<ul style="list-style-type: none"> ● Period of time from "going live" until "normal operation" or "routine use" has been achieved ● Operations managers, and users, remnants of the project team, IT support personnel, external technical support personnel 	<ul style="list-style-type: none"> ● Challenges <ul style="list-style-type: none"> - Bug fixing - Rework - System performance tuning ● Problem resolution <ul style="list-style-type: none"> - Adding hardware capacity - Process and procedure changes - User acceptance, retraining, additional training ● Organizational changes to accomodate learning and shakedown needs

6.3.1 Shakedown Challenges

Exploring major challenges and issues in shakedown becomes more important in light of the fact that many ERP projects have been terminated during the shakedown phase, incurring large losses for the adopting organizations. Respondents were asked to list the major challenges during Shakedown (Table 36). There were many shakedown stage specific challenges, which resulted in reduced productivity or business disruption.

About 50% of the organizations found that their end users were not ready to use the systems. Various reasons were given for end users not being ready. Some of the reasons included new processes not being communicated, inadequate training, lack of user education, lack of support documentation, high user turnover created confusion, training new hires a continuing challenge, and users took time in getting adjusted to the new systems and processes. Interestingly, one respondent said:

“The organization has grossly underestimated the training requirement. They could not get more money and faced a lot of challenges while another division in our organization wisely diverted more money into training from other divisional accounts during shakedown and they have been successful in reducing the shakedown period significantly.”

It was hard to determine the extent of customization required by 36% of the respondents as business users in their organizations demanded system customization for many processes. There were also problems of bugs in the software and inconsistency of data in some cases. As all the relevant historical data has to be converted; data conversion was a major activity for some organizations. Reconciling data between old and new systems was a big challenge. Challenges in concurrently running the old and new systems and project problems created stressful situation for project teams. One of the respondents stated:

“ In times of system malfunctioning it was very hard to maintain the morale of the project team.”

Hardware reliability and maintenance was a concern. The critical nature of the systems required 100% network and system reliability. Network or system failures resulted in a standstill in the organization. Business disruptions due to these failures added significant pressure on the project team. Interestingly, organizations found behavioral problems such as user acceptance, and training challenges more challenging than technical issues such as bugs in the software or hardware challenges.

Table 36. Challenges in Shakedown (n=14)

Challenges (Percentage Respondents)
<ul style="list-style-type: none"> ● End Customer not ready (50%) ● Extent of customization (36%) ● Bugs in the software (36%) ● Limited extent of implementation (28%) ● People could not by-pass procedures, ad-hoc activities were not possible (28%) ● Confusion persisting due to changes brought about in the organization (21%) ● Inconsistency of data (21%) ● Hardware reliability, capacity and maintenance issues (21%) ● Keeping up employee morale in tricky situations of system malfunctioning (21%) ● Concurrently running with legacy systems (21%) ● Distinguishing between what people thought was a problem and the real problem(21%) ● Reconciliation of data between new and old was a challenge (14%)

6.3.2 Problem Resolution Strategies

Effective resolution of challenges in shakedown was important to reduce business disruption. User acceptance was a major challenge for all the organizations. One question focused on understanding the issues in user acceptance and the strategies for their resolution (Table 37). A commonly used strategy to increase user acceptance was training the users. Most organizations provided basic training to make users comfortable with the systems. Some organizations provided advanced training further to develop the help the

business users to utilize full system capabilities. User awareness was created by increased communication, developing user guidelines, and demonstration of potential benefits. Systems were continuously improved and support was provided for various problems that surfaced.

Table 37. User Acceptance (n=12)

Strategies for increasing user acceptance (Percentage Respondents)

-
- Training and counseling (75%)
 - Developing user comfort level in basic and essential activities
 - Further support and training to utilize full system capabilities
 - User awareness (50%)
 - Demonstration of potential benefits
 - Increased communication
 - User guidelines
 - Improvement in systems (33%)
-

Various other strategies were used, depending on the problem, for minimizing business disruption during shakedown (Table 38). About 60% of the organizations resorted to manual workaround on problematic processes. Frequent communication was made with the customers and suppliers to seek their patience and co-operation. About 50% of the organizations resolved to debugging and testing of the software during shakedown. About 38% maintained old systems in parallel till major issues were resolved. Software was modified in some cases to resolve problems. New hardware was added in a few cases to add capacity and build redundant capacity for added reliability.

Table 38. Resolving challenges in shakedown (n=12)**Strategies for Minimizing Business Disruption during Shakedown (Percentage Respondents)**

-
- Manual workaround problematic processes (58%)
 - Testing and debugging errors (50%)
 - Frequent communication with customers and suppliers (50%)
 - Maintaining old systems in parallel (33%)
 - Changing business processes (25%)
 - Software modification (17%)
 - Added Hardware (17%)
-

6.3.3 Organizational Change

ERP implementation has been referred to as an “organization wide revolution” due to the large number of changes it brings to an organization (Hammer, 1999; Bingi et al., 1999). Benjamin and Levinson (1993) state that many organizations face problems in implementing advanced information technology projects because they put inadequate stress on the management of change brought about by the technology.

Respondents were asked about their change management initiatives for institutionalizing ERP in the organization (Table 39). Training of the employees for change management was popularly done. Some 50% of the responding organizations reported changes in organization structure to support the new systems. For example, a new supply chain group was added in one organization, and a process management group was added in another. Some new positions were also created within the existing departments. Some respondents said that the changes in organizational structure have not taken place but are expected to take place. About 42% of the responding organizations found that the roles and responsibilities of many employees changed and job definitions had to be rewritten. Counseling of employees was done to adapt them to their new roles in a few cases. High tolerance for mistakes was maintained. One organization also reported firing people with negative attitudes towards the systems. Few organizations

reported developing new business performance and control measures. For example, with new systems product delivery deadlines were crashed with improved information. Budgeting was made more accurate with drill down capabilities provided by the systems. A few organizations introduced new key performance indicators like reduction in inventory turns, time reduced in executing sales order and reduction in number of disputed accounts (receivable/payable).

Table 39. Organizational Changes (n=12)

Changes (Percentage Respondents)
<ul style="list-style-type: none"> ● Training for change management (50%) ● New positions and departments created (50%) ● Job definitions rewritten (42%) ● Counselling (25%) ● New business performance and control measures (25%)

Respondents were asked if there were some cases where the old procedures were maintained in their organization despite being supported by the new systems and what were the reasons. Many organizations reported continued workarounds during the shakedown. One of the respondents reported:

"Yes, there are workarounds continuing; they (users) don't trust the data on ERP. The system cannot accommodate some aspects of academic life; there have to be shadow systems for that and they find it easier."

Another organization found that:

"There was a surge of shadow systems (Spread Sheets, Small Access Databases) cropping up as the systems were plugged in as many users were not properly trained and system complexity intimidated them, particularly some of the key users felt that they did not have sufficient training. However the situation has improved as more and more users are getting more comfortable with the systems."

System reliability was a concern for few organizations; manual workaround was essential in those cases to reduce business disruption when the system was down for a significant period of time.

7 CONCLUSION

This study is focused on exploring the ERP experience of Canadian organizations in the first three phases of the ERP experience cycle and providing empirical evidence around the main concerns in managing the organizational innovation process of ERP adoption. This chapter provides a conclusion for the study by discussing some of the key research findings, benefits and limitation of the study, and implications for future research.

7.1 Key Research Findings

We found that each organization had a different experience with its ERP project, but across the variations many similarities in challenges were observed. Differences in experience can be attributed to the organization's inherent characteristics,⁸ strategies, and objectives for the ERP systems.

7.1.1 Chartering ERP

Top management initiated the ERP adoption in most of the cases (75%). Interestingly, in one case it was a stipulation from the venture capitalists to have an ERP system in place before the initial public offering (IPO). Resolving Y2K related issues along with other ERP benefits such as improving functionality and replacing multiple outgrown legacy systems with advanced integrated systems, was important for justifying the ERP in organizations adopting ERP 3-5 years ago. Whereas, enabling E-business and

⁸ The inherent characteristics include organizational capabilities, previous experience, infrastructure, type of business etc.

growth along with other ERP benefits, was considered important for justifying the ERP project in organizations which adopted ERP within the last three years. The observation signifies evolution of system needs of an organization as Y2K challenges were no longer important for organizations lately and there was increased stress on e-business capability in organizations implementing ERP in the last 3 years.

Several authors have stressed that risk awareness and risk management must be of critical concern to project managers, as unmanaged or unmitigated risks are one of the primary causes of project failure (Royer, 2000). Interestingly, only a few organizations comprehensively identified the project risks associated with ERP projects and formalized mitigation strategies during the project-chartering phase. Most of the organizations viewed cost escalation and unavailability of ERP skilled people as major risks. Very few respondents considered a high degree of organizational change and user acceptance as project risks although these were identified as major challenges in the project configuration and the shakedown phases.

7.1.2 Implementation Partners

Most of the responding organizations partnered with consulting organizations (83%) and ERP vendors (42%) for implementing the systems. System functionality and reliability, fit with parent/allied organization systems, cross module integration, supported best practices, technology, vendor reputation, and service/support were the major criteria used for ERP product/vendor selection. Most of the organizations valued reputation and ERP experience as important in selecting ERP consultants. Interestingly, costs were considered important by only very few organizations in selecting both their

ERP consultants (25%) and the ERP system (14%) itself, while high consultant costs were often given as the reason for a revision in the budget by many organizations.

7.1.3 Project Planning

Interestingly, only one organization adopted the big bang approach (implementing all functionality and modules at once), which has been cited as a high-risk approach in the literature (Bingi *et al.*, 1999). Most organizations (69%) planned their ERP projects by modules; a few organizations (25%) also franchised their projects by business unit, plant, or site. Each configuration project was organized in phases. The typical activities in phases were similar even though the organizations had their own nomenclature for the typical activities. As well, the precedence of typical activities and the number of stages used varied across organizations. Many of the project activities such as training and upgrading of infrastructure were not sequential; many of these activities were done in parallel and ran through more than one phase.

The precise structure of project teams varied across organizations. Most organizations used cross-functional teams. Project managers responsible for most of the organizations were selected because of their project management skills (64%) and functional experience (64%).

7.1.4 Managing Change

Managing the change from old to new systems brought many challenges for the ERP adopting organizations. This involved getting a buy-in from the organization, training project persons and users, upgrading the infrastructure, configuring new systems, and converting data. ERP projects that were initiated 3-5 years ago faced an acute

shortage of ERP skilled personnel and hardware components, as during that time span many firms adopted ERP motivated by Y2K challenges. Other major challenges included significant resistance to change from users, and high cost of implementation. Interestingly, fewer organizations found technical challenges such as bugs in the software important.

7.1.5 Training

Training project persons and users was a major challenge. Training issues included logistical problems such as scheduling a large number of users to be trained in large organizations. Insufficient training budget and poor quality of training material and resources were other major training challenges. Many organizational users were not experienced in the use of computers which enhanced the training needs and challenges.

7.1.6 Infrastructure

Upgrading hardware infrastructure was another major challenge for most of the ERP adopting organizations. Many organizations redesigned or deployed new infrastructure. Compatibility of existing infrastructure with the software systems was a problem for many organizations. Less mature technology and difficulty in estimating requirements posed downstream problems including frequent hardware failure.

7.1.7 Incompatibilities between organization and the systems

Organizations found many incompatibilities between the ERP systems capabilities and their needs. Software modifications, add-ons, and process re-engineering were commonly used by organizations to bridge the gap between software capabilities and

business needs. Interestingly, a few organizations also replied to be living with the shortfalls.

7.1.8 Project Success

Measuring success is an important aspect of any project. Most of the responding organizations used project cost and completion time as metrics for evaluating configuration project success. Interestingly, few organizations linked project success to delivery of key performance indices such as reduced inventory turns or reduced time to complete a sales order, which they had defined in their project scope document. A few organizations hired independent observers for project success evaluation.

7.1.9 Lessons Learnt

We asked the respondents to list what would they do differently if they were to implement an ERP again. About 75% of the respondents said that they would focus more on project management activities of scheduling, budgeting and planning. One of the respondents commented:

“We would set a less aggressive time frame and stick to it.”

More attention on training was the next popular advice (42%). One of the respondents commented that they would dramatically increase training, while some others said they would allow users to practice time with dummy scenarios and significantly increase training budget. Some organizations faced major problems because of inexperienced consultants and advised strongly on ensuring the quality of consultants. Other popular suggestions were increased in-house skill development to have more

control on the project, avoiding any other major organization changes such as merger or restructuring, and not doing any modifications in the systems. Interestingly, one organization observed that the re-engineering process after configuring ERP delayed and complicated the ERP adoption process; they thus recommended doing re-engineering upfront. It was hard for one organization to manage change management without sufficient top management support, while some complimentary systems adopted by one organization created problems, as they did not run with ERP well. One organization suggested that involving key users early would have reduced many changes in the system.

Table 40. Lessons Learnt (n=12)

Lessons Learnt (Percentage Respondents)

- More attention and time to project planning (75%)
- More attention on training(42%)
- Better consultants(25%)
- Develop more in-house resources(25%)
- Would not customize(25%)
- Avoid other organizational changes in middle of the ERP project (17%)
- Early use of change management practices(17%)
- Do re-engineering upfront(8%)
- Get more senior management support to change business processes
- Involve Key users early in the project(8%)
- Ensure that complimentary systems run well with ERP(8%)

7.1.10 Shakedown challenges

The transition phase of shakedown is critical for the successful adoption of ERP in an organization because of the high probability of business disruption due to problems in stabilizing the systems. Many technical and behavioral problems surfaced in this phase as the organizations came to grips with the new systems. More than 50% of the organizations found that their end users were not ready because of reasons such as

inadequate training and high user turnover. Some organizations (36%) found that the extent of customization required was hard to determine while users demanded it continuously. In some cases (36%) there were many serious technical problems such as bugs in the software that caused repeated system failure.

Efficient resolution of shakedown problems was important as these problems caused business disruptions. Most of the responding organizations resorted to manual workaround problematic processes. Testing and debugging was done to resolve technical issues. Frequent communication was made to customers and suppliers to seek their support and patience during stabilization. Interestingly, some organizations maintained old and new systems in parallel till increased confidence level with the new systems was achieved.

7.1.11 User acceptance

User acceptance was a challenge faced by all responding organizations. Commonly used strategies for user acceptance were training, counseling of users, and creating awareness of the benefits of the new systems. User acceptance was a greater challenge for large size organizations because of the sheer number of users and complexity of the organization. Some organizations also made changes in the organization structure such as adding new positions or a new department, changing job descriptions to support the institutionalization of change, and designing new processes supported by ERP systems.

7.1.12 Respondent's perception of success

To assess their satisfaction with the ERP adoption process in the organization respondents were asked to rank their perception of their organization's success in various phases of ERP experience on a scale of 1-7 where 1 stood for failure, 4 for satisfactory, and 7 for highly successful. Interestingly, none of the respondents ranked their organization as highly successful in any of the ERP experience phases (Table 41). The average scores slightly over 4 indicate that there is a scope for improvement of the ERP adoption process. The observation, although not generalizable due to a small and varied sample size, is important for ERP adoption and implementation process research. It indicates avenues for improvements in the management of an ERP adoption process.

Table 41. Perceived Success in ERP Experience Phases (n=12)

Phase	(Average Scores on a scale of 1-7)
● Project chartering	4.58 (1-6)
● Project configuration	4.83 (4-6)
● Shakedown	4.45 (1-6)

7.2 Benefits and Limitations

7.2.1 Limitations

The major limitation of the study is that the observations cannot be generalized as only 19 firms could be considered within the time constraints of the study. There was also a large variation in the responding organizations in terms of size, business operations, and the extent of ERP experience. The small sample size and large variance in the

organizations restricted any valid statistical analysis. However, this reasonably representative sample provides valuable insights into the process of adoption and implementation of ERP.

7.2.2 Benefits of the Study

This study was focused on exploring and identifying concerns and strategies used by ERP adopting organizations in various stages of ERP experience. The prime benefit of the study is that it provides empirical evidence and valuable insight on key issues in adoption and implementation of ERP. The results presented will be valuable knowledge for managers of the organizations adopting and implementing ERP systems. For managers of organizations who have already adopted and implemented ERP, the results provide a base to benchmark their practices with some of the leading Canadian organizations.

The study also provides a strong base for further detailed research by identifying major concerns around typical activities in the organizational innovation process of ERP adoption and implementation.

7.3 Implications for Future Research

A number of avenues for future detailed research can be identified based on organizational concerns found in this study. A natural extension of this study could be to explore the organizations which have stabilized their ERP systems and have moved to the Onwards and Upwards stage, a stage where the organization realizes business benefits.

The following comment by one of the respondents testifies to the scope of research organizations in the onward and upward phase:

“ERP is a gigantic system; we do not have the staff to explore every corner of ERP to see what all the capabilities of ERP are. There are not many ERP delivered reports, we have to create our own reports; we have not done a lot much of that, we haven’t implemented all the reporting.”

Sector specific studies of ERP will be valuable for understanding the business specific concerns and benchmarking the processes in these domains. The research revealed certain sectors such as Museums and Fab-less (virtual manufacturing) Semiconductor do not have industry specific ERP solutions. A detailed study of the information needs of these sectors will aid the development of ERP solutions for these sectors.

A valuable and interesting study could be carried out of organizations going through merger and acquisition. How can ERP systems be used to reduce the cost and effort in making transition of two disparate organizations into one coherent unit? The study revealed a number of organizational concerns that need to be explored. One such issue is problems in training. A study is needed to ascertain how effective ERP training can be carried out and propose better models for ERP training.

References

- Al-Mashari, M. and M. Zairi, "Creating a fit between BPR and IT infrastructure: A proposed framework for effective implementation," *International Journal of Flexible Manufacturing Systems*, (Oct 2000).
- Alsène, Eric, "The Computer Integration of the Enterprise," *IEEE Transactions on Engineering Management*, 46 (February 1999).
- Nolan, R. L. and R. D. Austin, "Manage ERP Initiatives as New Ventures, Not IT Projects," *Working Paper 99-024*, Harvard Business School (1998).
- Baldwin, S., J. Everett, P. Frampton, M. Wainwright and R. Stteinmaier, *ERP's second wave: Maximizing the value of enterprise applications and processes*, Deloitte Consulting, (1999).
- Bancroft, N. H., H. Seip, and A. Sprengel, *Implementing Sap R/3 : How to Introduce a Large System into a Large Organization*, Manning Publications Company(1997).
- Bedian, A. G. and R. F. Zammuto, *Organizations: Theory and Design*, New York, Dryden Press, (1991).
- Bingi, Prasad, Sharma, Maneesh K., and Godla, Jayant K., "Critical Issues Affecting an ERP Implementation," *Information Systems Management*, (Summer 1999) 7-14.
- Broadbent, M., P. Weill, and D. St Claire, "The Implications of Information Technology Infrastructure for Business Process Redesign," *MIS Quarterly*, 23(2)(June 1999).
- Buckhout, Scott, Frey, Edward, and Nemec Jr., Joseph, "Making ERP Succeed: Turning Fear into Promise," *IEEE Transactions of Engineering Management*, (1999) 116-123.
- Bulkeley, W. M., "A Cautionary Network Tale: FoxMeyer's High Tech Gamble," *Wall Street Journal Interactive Edition*, (1996).
- Burns, M. (1999), "ERPs: a Buyers' Market," *Camagazine*, (September 1999).
- Chan, Y. E. and S. L. Huff, "Investigating information systems strategic alignment," *Proceedings of the Fourteenth International Conference on Information Systems*, Orlando, Florida (1993).
- Clemens, E., and Row, M., "Sustaining IT Advantage: The Role of Structural Difference," *MIS Quarterly*, (September 1991) 275-292.
- Cooper, R. B., and Zmud R. W., "Information Technology Implementation Research: A Technical Diffusion Approach," *Management Science*, 36(2) (1990) 123-139.
- Cray, D., G. H. Haines Jr. and G. R. Mallory, "Programmed strategic decision making: the view from Mintzberg's window," *British Journal of Management*, 5 (1994) 191-204.

- Daft, R. L., "A Dual Core Model for Organizational Innovation," *Academy of Management Journal*, 21(2) (1978), 123-139.
- Dahlen, Carl, and Elfsson, Johan, *An Analysis of the Current and Future ERP Market with Focus on Sweden*, Stockholm, The Royal Institute of Technology, (1999).
- Davenport, Thomas H., "Putting the Enterprise into the Enterprise System," *Harvard Business Review*, (July-August 1998).
- Davenport, Thomas H., *Mission Critical: Realizing the Promise of Enterprise Systems*, Boston, MA, Harvard Business School Press, (2000).
- Davis, F. D., R. P. Bagozzi and P. R. Warshaw, "User Acceptance of Computer Technology: A comparison of Two Theoretical Models," *Management Science*, 35(8) (1989).
- Dean Jr., James W., "Decision Processes in the Adoption of Advanced Technologies," *Working Paper, Center for the Management of Technologies and Organizational Change*, The Pennsylvania State University, (1986).
- DeSanctis, G. and M. S. Poole (1994), "The meaning of the interface: A functional and holistic evaluation of a meeting software system," *Decision Support Systems*, (May 1994) 319-335.
- Fichman, R. G. and S. A. Mosses (1999), "An incremental Process for Software Implementation," *Sloan Management Review*, (Winter 1999) 39-52.
- Grant, G., "Strategic alignment in global ERP implementation: the case of Metalco," *Working Paper*, School of Business, Carleton University Ottawa, (2000).
- Gumaer, B., "Beyond ERP and MRPII: optimized planning and synchronized manufacturing," *IIE Solutions*, 28(9) (1996) 32-35.
- Hammer, M. and S. Stanton, "How process enterprises really work," *Harvard Business Review*, (November-December 1999) 108-118.
- Hammer, M., *Beyond Re-engineering*, Harper Business, (1996).
- Harrison, D. A., Mykytyn Jr., P.P. and C. K. Riemenschnieder, "Executive decisions about adoption of information technology in small business: Theory and empirical tests," *Information Systems Research*, 8(2) (1997) 171-195.
- Henderson, J. C. and N. Venkatraman, "Strategic alignment: A model for organisational transformation through information technology" in *Transforming Organisations*, Kochan, T.A. and M. Useem (eds), Oxford and New York, Oxford University Press (1992).

- Henderson, J. C., Venkatraman, N. and S. Oldach, "Aligning business and IT strategies," *Competing in the Information Age: Strategic Alignment in Practice*, J. F. Luftman (eds). New York, Oxford University Press, 21-42 (1996).
- Holland, C. P. and B. Light, "A critical success factor model for ERP implementation," *IEEE Software*, (May/June 1999) 30-35.
- Joshi, Kailash, and Lauer, Thomas W., "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)(1999).
- Kalakota, R. and M. Robinson, *e-Business: Roadmap for success*, Addison Wesley Longman, Inc., (1999).
- Kerr, S., "IS trims down," *Datamation*, 34(19) (1988).
- Keller, Eric L., "Lessons Learned," *Manufacturing Systems*, 15th Anniversary edition, (November 1999).
- Kling, J. L., "Centralized versus Decentralized Computing: Organizations, Considerations and Management Options," *ACM Computing Surveys*, 15(4) (1983) 319-349.
- Koch, Christopher, Slater, Derek and Baatz E., "The ABCs of ERP," *CIO Magazine ERP research Center*, accessed at http://www.cio.com/forums/erp/edit/122299_erp.html (August 1999).
- Kumar, Kuldeep, and Hillegersberg, Jos Van, "ERP Experiences and Evolution," *Communications of the ACM*, 43(4)(April 2000) 23-26.
- Kumar, Vinod, Murphy, Steven A., and Loo, Steve C. K., "An Investment Decision Process: The Case of Advanced Manufacturing Technologies in Canadian Manufacturing Firms," *Int. J. Prod. Res.*, 34(4) (1996) 947-958.
- Lassila, Kathy. S., and Brancheau, James C., "Adoption and Utilization of Commercial Software Packages: Exploring, Utilization, Equilibria, Transitions, Triggers and Tracks," *JMIS*, 16(2) (Fall 1999) 63-90.
- Lee, R., "An enterprise decision framework for information system selection," *Information Systems Management*, (Fall 1998) 7-13.
- Markus, M. Lynne, and Tanis, Cornelis, "The Enterprise System Experience: From Adoption to Success," in *Framing the Domains of IT Management: Projecting the Future through the Past*, Zmud R. W. (ed.), Pineflex Educational Resources Inc., (2000).

- Markus, M. L., S. Axline, D. Petrie and C. Tanis, "Learning from adopters' experience with ERP: problems encountered and success achieved," *Journal of Information Technology*, 15(15) (2000) 245-265.
- Markus, M. L. and D. Robey, "Information Technology and Organizational Change: Causal Structure in Theory and Research," *Management Science*, 34(5) (1988) 583-598.
- Mintzberg, H., D. Raisinghani, and A. Theoret, "The structure of unstructured decision processes," *Administrative Science Quarterly*, 21(5)(1976)1043-1057.
- Mohr, L. B., *Explaining Organizational Behavior: The Limits and Possibilities of Theory and Research*. San Francisco, Jossey-Bass, (1982).
- 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.
- Noori, Hamid, "Factors that Promote the Adoption of Advanced Manufacturing Technologies," *Management of Technology III*, Khalil, T. M. and Bayraktar, B. A. (ed.), Institute of Industrial Engineers, (1992).
- Orlikowski, W. J. and D. Robey, "Information Technology and the Structuring of Organizations," *Information Systems Research*, 2(2) (1991) 143-169.
- Pliskin, N. and M. Zarotski, "Big-Bang ERP Implementation at a Global Company," *Annals of cases on information technology*, 2000
- Powell, T. C., and Dent-Micallef, A., "Information Technology as Competitive Advantage: The Role of Human, Business and Technology Resources," *Strategic Management Journal*, 18(5) (1997) 375-405.
- Radding, Alan, "ERP: more than an Application," *Information Week* (April 5, 1999).
- Rogers, Everett M., *Diffusion of innovations*, New York, Free Press, (1983, 1996).
- Ross, Jeanne W., "The ERP Path to Integration: Surviving vs. Thriving," *eAI Journal*, accessed at <http://www.eaijournal.com/ERPIntegration/ERPPath.asp> (1999).
- Royer, P. S., "Risk Management: The Undiscovered dimension of Project Management," *Project Management Journal*, (March, 2000).
- Russell, Roberta S., and Taylor III Bernard W., *Production and Operations Management: Focusing on Quality and Competitiveness*, Englewood Cliffs, NJ, Prentice-Hall Inc., (1995).
- Siegel, Donald S., Waldman, David A. and Youngdahl, William E., "The Adoption of Advanced Manufacturing Technologies: Human Resource Management Implications," *IEEE Transactions on Engineering Management*, 44(3) (August 1997).

- Soh, Christina, and Markus M. Lynne, "How IT Creates Business Value: A Process Theory Synthesis," *Proceedings of the Sixteenth International Conference on Information Systems*, Degross, Janice et al. (ed.), Amsterdam, (December 1995) 29-42.
- Soliman, F. and M. A. Youssef, "The role of SAP software in business process re-engineering," *International Journal of Operations and Production Management*, 18(9/10) (1990).
- Thornburg, B., "How to Assure Success in ERP Implementations," *ERP world accessed at http://www.erpworld.org/proceed98/nfiles/n450/n450.html#_Toc421700663*, (1998).
- Trepper, Charles, "ERP Project Management is Key to a Successful Implementation," *ERP Hub*, accessed at http://www.erphub.com/strategy_990816.html (August 1999).
- Tushman, M., Newman, W. H. and Romanelli, E., "Convergence and Upheaval: Managing the Unsteady Pace of Organizational Evolution," *California Management Review*, 29(1) (1986) 29-44.
- Van Der Zee, J. T. M. and B. De Jong, "Alignment is not enough: Integrating Business and Information Technology Management with Balanced Business scorecard." *JMIS*, 16(2)(1999).
- Watson, Edward E., and Schneider, Helmut, "Using ERP in Education," *Communications of the AIS*, 1 (February 1999).
- Weston, F. C. J, *Dynamic BPR: the future of ERP software*, Colorado State University, Fort Collins, (1999).

APPENDIX I
Sample Questionnaire

A study of ERP adoption and implementation experience of Canadian organizations

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 document. The respondent and the organization will not be identified in any part of the study. Your response is valuable for research and is greatly appreciated.

Our preference will be to get about 45-minute in-person/telephone interview from you, which can be scheduled as per your convenience. Alternatively you may answer the questionnaire and fax your response at (613) 520-2532 or mail them to us: Prof. Vinod Kumar, 810, Dunton Tower, 1125 Colonel By Drive, Ottawa, Ontario, Canada K1S 5B6

If you have any questions or concerns, please feel free to contact the researchers listed below.

Thank you, for your interest and support.

Dr. Vinod Kumar
Professor and Director
School of Business
Tel: (613) 520-2379
Email- vkumar@ccs.carleton.ca

Bharat Maheshwari
Research Associate
School of Business
Tel: (613) 523-8634
Email- bmaheshw@business.carleton.ca

Instructions

We use the “Enterprise System Experience Cycle” framework (Figure1) for our study (Markus and Tanis, 2000). The framework divides an ERP adoption experience into four phases explained and characterized in the Figure1. Our survey is focused on the first 3 phases of the framework as most Canadian ERP adoptions are recent and have not moved into the Phase IV. A follow up study is proposed to explore the post implementation benefits and efforts made to optimize them by organizations in the Onwards and Upwards phase in the coming year.

Figure1: Enterprise System Experience Cycle
(Markus and Tanis Model)

The questionnaire consists of 5 sections.

- The first section seeks information about the current status of ERP in your organization.
- The sections two, three, and four seek organizational experience in of the project chartering, project configuration, and shakedown phases.
- The last section seeks some background information.

As the research on ERP is still at an exploratory level, the questionnaire has many open-ended questions. Our preference will be to take about 45-minute inperson/telephone interview, which can be scheduled as per your convenience. Alternatively you may answer the questionnaire and fax your response at (613) 520-2532 or mail them to us:

Prof. Vinod Kumar
810, Dunton Tower
1125 Colonel By Drive
Ottawa, Ontario, Canada K1S 5B6

Please specify wherever you had others as a choice for an answer, as well in case you find the space provided is insufficient, please feel free to use extra paper by indicating the question number you are answering on it. Your views are extremely important for research. Please answer all the questions applicable to your experience as best as you can. You may consult your colleagues concerned for questions not relevant to your experience.

Again, thank you for your support and interest

Section I - Status Information

1. Which of the following categories best represent your organization's current status with respect to ERP systems? (Check ✓ one only)

☐ Evaluating whether to adopt ERP	☐ Chartering ERP systems project
☐ Configuring ERP systems	☐ Stabilizing the ERP systems
☐ Onwards and upwards stage	

2. Please estimate the time-span (in months) that was taken (or is expected to be taken) by your organization in the following phases of ERP experience.

Project Chartering (Decisions defining the business case and solution constraint) _____ months

Project Configuration (Getting systems up and running, training end users etc.) _____ months

Shakedown (Stabilizing, eliminating bugs, getting to normal operations) _____ months

Onwards and Upwards (Maintaining systems, supporting users, upgrading) _____ months

3. Which of the following descriptions best characterize your ERP systems? (Check ✓ one only)

☐ Legacy software	☐ Multi-vendor off the shelf package
☐ New specifically developed package	☐ Single vendor off the shelf package
☐ Others (please specify) _____	

4. What would best describe the structure of ERP systems in your organization? (Check ✓ one only)

- ☐ Single enterprise wide system for the whole organization.
- ☐ Multiple ERP systems (independent systems for business units or subsidiaries)
- ☐ Others (please specify) _____

5. Please indicate the status of ERP systems in the functional areas of your organization. Also indicate the level of integration of these systems (Integrated means the systems can share information, co-ordinate, and collaborate with other functional systems). (Check ✓ all that apply and fill in the blank)

Functional area	Status	Integration level
☐ Manufacturing and Planning	☐ Using → If using, for how many months? _____ ☐ Implementing ☐ Considering ☐ Not applicable	☐ Integrated ☐ Partially integrated ☐ Not integrated ☐ Not applicable
☐ Human Resources	☐ Using → If using, for how many months? _____ ☐ Implementing ☐ Considering ☐ Not applicable	☐ Integrated ☐ Partially integrated ☐ Not integrated ☐ Not applicable
☐ Finance and Accounting	☐ Using → If using, for how many months? _____ ☐ Implementing ☐ Considering ☐ Not applicable	☐ Integrated ☐ Partially integrated ☐ Not integrated ☐ Not applicable
☐ Engineering	☐ Using → If using, for how many months? _____ ☐ Implementing ☐ Considering ☐ Not applicable	☐ Integrated ☐ Partially integrated

	☐ Implementing ☐ Considering ☐ Not applicable	☐ Not integrated ☐ Not applicable
☐ Purchasing	☐ Using → If using, for how many months? _____ ☐ Implementing ☐ Considering ☐ Not applicable	☐ Integrated ☐ Partially integrated ☐ Not integrated ☐ Not applicable
☐ Sales and Distribution	☐ Using → If using, for how many months? _____ ☐ Implementing ☐ Considering ☐ Not applicable	☐ Integrated ☐ Partially integrated ☐ Not integrated ☐ Not applicable
Others (please specify) _____ _____ _____ _____ _____	_____ _____ _____ _____ _____	_____ _____ _____ _____ _____

6. Please provide your best estimate of information technology (IT) Infrastructure in the organization before and after ERP implementation.

IT infrastructure	Before ERP Implementation	After ERP Implementation
a) No. of employees in IT(estimate only) i) In IT operations ii) In IT application development iii) In IT research and development	_____ _____ _____	_____ _____ _____
b) Hardware systems used (Check ✓ all that apply)	☐ Mainframes ☐ Client-server computing ☐ Thin-client computing ☐ Personal computers ☐ Network computers ☐ Others(please specify)_____	☐ Mainframes ☐ Client-server computing ☐ Thin-client computing ☐ Personal computers ☐ Network computers ☐ Others (please specify)_____
c) Database management system used(Check ✓ all that apply)	☐ Multiple databases ☐ Single Relational ☐ Data-warehouse ☐ Others (please specify)_____	☐ Multiple databases ☐ Single Relational ☐ Data-warehouse ☐ Others (please specify)_____
d) Data communication system Used(Check ✓ all that apply)	☐ LAN ☐ WAN ☐ EDI ☐ Internet ☐ Diskette/tape exchange ☐ Others (please specify)_____	☐ LAN ☐ WAN ☐ EDI ☐ Internet ☐ Diskette/tape exchange ☐ Others (please specify)_____

7. Has your organization implemented any other complimentary technologies /add-ons (other software applications that was not implemented as part of your standard ERP package) to extend the capabilities of your ERP systems?

☐ No

☐ Yes → if yes, what are they? (Check ✓ all that apply)

☐ Supply chain	☐ Business Intelligence	☐ E-commerce
☐ Knowledge management	☐ Data mining	☐ Data warehouse
☐ Decision support systems	☐ Customer relationship	☐ Groupware
☐ Other software (please specify)_____		

Section II - Project Chartering Phase

1. Please indicate approximately how long ago did your organization consider evaluating ERP systems? (Check ✓ one only)

☐ More than 10 years ago	☐ More than 7 years ago	☐ More than 5 years ago
☐ More than 3 years ago	☐ More than 1 years ago	☐ In the last one year

2. How was the idea of adopting ERP initiated? (Check ✓ all that apply)

☐ From top management	☐ From specific functions
☐ From IT management	☐ Suggested by consultants
☐ A stipulation from the major customers	☐ Others (please specify)_____

3. Was any analysis of systems requirement/capabilities done at the initiation of ERP adoption process?

- ☐ No
- ☐ Yes → if yes, a) what were the major reasons that justified an investment in ERP?

b) Were any risks identified as associated with ERP systems? If yes, what were they?

c) What were the key factors in mitigating the risks?

4. Who were the key players involved in developing the business case for justification of ERP adoption? (Check ✓ all that apply)

☐ Senior management	☐ Functional operating personnel	☐ IT Management
☐ Middle management	☐ IT consultants	☐ IT personnel
☐ Management Consultants	☐ Others (please specify)_____	

5. a) Who were the implementation partners for ERP systems in your organization?

(Please specify names)

- ☐ Management consultants _____
- ☐ Technical consultants _____
- ☐ ERP Vendors _____
- ☐ Others (please specify) _____

b) What criteria were used to choose the management consultants? (Check ✓ all that apply)

- ☐ ERP experience ☐ Consulting skills ☐ Process engineering experience
- ☐ Reputation ☐ Quality of resources ☐ Industry specific knowledge
- ☐ Global coverage ☐ Methodology ☐ Cost
- ☐ Others (please specify) _____

c) What criteria were used to choose the technical consultants? (Check ✓ all that apply)

- ☐ ERP experience ☐ Technical resources ☐ Customization skills
- ☐ Reputation ☐ Quality of resources ☐ Industry specific knowledge
- ☐ Global coverage ☐ Methodology ☐ Cost
- ☐ Others (please specify) _____

d) What criteria were used to choose the ERP vendor/product? (Check ✓ all that apply)

- ☐ Functionality of the systems ☐ Underlying business model (best practices)
- ☐ Cross module integration ☐ Less system complexity/user friendliness
- ☐ Lower costs of ownership ☐ Better fit with company's business processes
- ☐ Quick implementation ☐ Better multi-site planning and control
- ☐ Advanced technology ☐ Availability of regular upgrades
- ☐ Compatibility with other systems ☐ Vendor's support/ service infrastructure
- ☐ Consultant recommendation ☐ Vendor reputation
- ☐ Systems reliability ☐ Data standardization
- ☐ Ease in customizing the systems ☐ Systems scalability
- ☐ Fit with major customer's systems ☐ Fit with parent/allied organization systems
- ☐ Others (please specify) _____

6. How was the idea sold to the organization? (Check ✓ all that apply)

- ☐ Meetings ☐ Newsletters ☐ Information seminars
- ☐ E-mail ☐ Surveys ☐ Internet
- ☐ Demonstrations ☐ Training key members ☐ Others (please specify) _____

7. On the given scale of 1-7 (where 1 indicates Weak, 4 Strong, 7 Very Strong and NA Not Applicable), please indicate the strength of the following as motivators for adopting ERP systems in your organization. (Please circle your choices).

A) Systems improvement		Weak							Strong	Very
Strong		1	2	3	4	5	6	7		
1.	Improving functionality of information systems	1	2	3	4	5	6	7	NA	
2.	Solving Y2K related problems	1	2	3	4	5	6	7	NA	
3.	Improving information quality	1	2	3	4	5	6	7	NA	
4.	Improving ease of use of information systems (User-friendly, ease of accessing data etc.)	1	2	3	4	5	6	7	NA	

5. Elimination of cost and complexity associated with custom application development	1	2	3	4	5	6	7	NA
B) Operational improvement	Weak		Strong		Very Strong			
6. Attaining cost benefits (e.g. reduced inventory, operating costs of systems etc.)	1	2	3	4	5	6	7	NA
7. Automation of key business processes	1	2	3	4	5	6	7	NA
8. Providing better inventory management and planning	1	2	3	4	5	6	7	NA
9. Providing better order tracking and fulfillment.	1	2	3	4	5	6	7	NA
10. Providing effective cash management	1	2	3	4	5	6	7	NA
11. Achieving overall improvement in organization efficiency	1	2	3	4	5	6	7	NA
C) Work effectiveness								
12. Supporting group/team work	1	2	3	4	5	6	7	NA
13. Attaining work enhancement (Employees can take on additional responsibility)	1	2	3	4	5	6	7	NA
14. Eliminating redundant data entry and accompanying errors	1	2	3	4	5	6	7	NA
15. Reducing bureaucracy in the organization	1	2	3	4	5	6	7	NA
D) Strategic								
16. Increasing integration of business processes/functional groups	1	2	3	4	5	6	7	NA
17. Standardizing business processes	1	2	3	4	5	6	7	NA
18. Supporting collaboration with customers, partners and suppliers	1	2	3	4	5	6	7	NA
19. Supporting e-business initiatives	1	2	3	4	5	6	7	NA
20. Downsizing/ Rightsizing the organization	1	2	3	4	5	6	7	NA
21. Providing better enterprise management	1	2	3	4	5	6	7	NA
22. Providing global networking/ sharing of capabilities	1	2	3	4	5	6	7	NA
23. Meeting global or industry standards	1	2	3	4	5	6	7	NA
24. Developing new business opportunities.	1	2	3	4	5	6	7	NA
25. Providing for expected business growth	1	2	3	4	5	6	7	NA
E) Other motives (please specify)								
_____	1	2	3	4	5	6	7	NA
_____	1	2	3	4	5	6	7	NA
_____	1	2	3	4	5	6	7	NA

Section III - Project Configuration Phase

1. Which would best represent your organization ERP implementation? (Check ✓ one only)
 - ☐ Big Bang (implementing complete application package and its functionality in a single effort)
 - ☐ Mini Bang (implementing a skeletal version of the software package, then gradually adding extra functionality, while the system is operating and as users get familiar with it)
 - ☐ Franchising strategy (implementing by: business processes, country or region, site or plant,)
 - ☐ Phases by module (implementing independent functional modules and then integrating them)
 - ☐ Greenfield (a new company with no history of IS, whereby the IS structure is created from scratch)
 - ☐ Others (please specify) _____

2. How was the ERP implementation project structured in the organization? (Check ✓ one only)
 - ☐ Under the corporate office
 - ☐ Under a functional division e.g. finance, manufacturing
 - ☐ As a matrix: a project team representing all functions and reporting to both functional and corporate management.
 - ☐ Others (please specify) _____

3. Who were the key people involved in implementing ERP in your organization? (Check ✓ all that apply)

☐ Top management	☐ IT personnel	☐ Functional operating personnel
☐ Functional management	☐ IT consultants	☐ Management consultants
☐ IT management	☐ ERP vendor	☐ Others (please specify) _____

4. If a project manager was made responsible for managing the implementation project, what were the criteria used in selecting the project manager? (Check ✓ all that apply)

☐ Project management skills	☐ IT management experience	☐ Prior ERP experience
☐ Functional experience	☐ Programming experience	☐ Clout in the organization
☐ Others (please specify) _____		

5. Were any documents (e.g. project charter, project plan) drawn to define objectives, scope, deliverables and guidelines for the project?
 - ☐ No
 - ☐ Yes → If yes, Please list the project documents drawn and their objectives.

6. What obstacles has your organization faced while implementing ERP? (Check all that apply)
 - ☐ Significant resistance from staff
 - ☐ In house resource constraints
 - ☐ Significant resistance from unions
 - ☐ Unavailability of skilled project people
 - ☐ Lack of commitment from top leadership

- ☐ Turnover of key project persons
- ☐ Significant resistance from managers
- ☐ Technical difficulties in configuration
- ☐ Unclear strategic direction
- ☐ High costs of implementation
- ☐ Midstream scope changes
- ☐ Incompetent consultants
- ☐ Bugs in the software
- ☐ Difficulties in changing to new from old systems
- ☐ Lack of clear vision for ERP systems use
- ☐ Knowledge gap between implementers and users
- ☐ Difficulties in estimating project requirements
- ☐ Co-ordination between functional groups
- ☐ Others (please specify) _____

7. How was training organized to provide employees with skills to use and maintain the ERP systems? (Check ☒ all that apply)

- ☐ Outsourced to third party training provider
- ☐ Sending employees to ERP Vendor's training centers
- ☐ Developing in-house training course and program
- ☐ Others (please specify) _____

8. What were the main challenges in training the employees?

9. Were there any challenges faced in upgrading existing infrastructure to support requirements imposed by the new systems? Please list the significant challenges faced.

10. Were any incompatibilities misfits observed between organizations requirement and capabilities of ERP package did not match?

- ☐ No
- ☐ Yes → If yes,
 - a) were they? (Check ☒ all that apply)**
 - ☐ Organization specific (organizational structure, management styles, procedures)
 - ☐ Business/trade specific (specific requirements of the products and services offered)

- ☐ Country specific (accounting practices, specific statutory reporting etc.)
- ☐ Infrastructure specific (difficulties in interfacing with other systems, hardware etc.)
- ☐ Others (please specify) _____

b) What was done to meet these incompatibilities? (Check ✓ all that apply)

- ☐ Software was modified/customized to meet organizational requirements
- ☐ Business processes were re-engineered to meet the software requirements
- ☐ Certain add-ons were custom developed to fulfill organizational requirements
- ☐ The organization is living with the shortfall
- ☐ Others (please specify) _____

c) What were the significant challenges in meeting these incompatibilities?

11. Were any testing/quality assurance activities carried out during implementation to minimize errors?

- ☐ No
- ☐ Yes → If yes, please list the activities.

12. Was the ERP implementation divided into stages (like planning, pilot, testing etc.)?

- ☐ No
- ☐ Yes → If yes, what were the main stages and key activities in those stages?

Stages	Key Activities
1. _____	_____
_____	_____
2. _____	_____
_____	_____
3. _____	_____
_____	_____
4. _____	_____
_____	_____
5. _____	_____
_____	_____

13. Was there any success criteria to review the project performance in general or implementation stages specifically?

☐ No

☐ Yes → If yes, what were they? Please also indicate the stage if the criteria were stage specific.

14. Was there any success criteria to review the project team performance?

☐ No

☐ Yes → If yes, what were they?

15. Were any changes made in the organizational structure (e.g. reduced hierarchies, decentralized decision making, virtual organization etc.) due to (or to support) the new systems?

☐ No

☐ Yes → If yes, please list the changes.

16. What would be the approximate investment break up for the following in percentage of the total costs incurred in the project? (Please give your best estimate)

a) Total investment (approximate figure in Canadian Dollars) \$ _____

b) Break up in percentage (approximate)

Hardware	_____ %	Software	_____ %
Training end users	_____ %	Software customization	_____ %
Training IT staff	_____ %	Implementing new business processes	_____ %
Technical consultants	_____ %	Management consultants	_____ %
Others (please specify)	_____		

17. During implementation was there any major revision in the following:

a) Budget ☐ No

☐ Yes → **If yes, what reasons were associated with it? Please list the reasons.**

b) Project ☐ No

Scope ☐ Yes → **If yes, what reasons were associated with it? Please list the reasons.**

c) Project ☐ No

schedule ☐ Yes → **If yes, what reasons were associated with it? Please list the reasons.**

18. What would your organization do differently if it were to implement ERP systems again?

Section IV – Shakedown Phase

1. Were there any problems faced in stabilizing the ERP systems?

☐ No

☐ Yes → if yes, what were the significant problems faced in stabilizing the system?

2. What was done to minimize the impact of problems faced in stabilizing the systems?
(Check ✓ all that apply)

☐ Manual workaround problematic processes	☐ Maintaining old systems in parallel
☐ Testing and debugging errors	☐ Building redundancy (spare capacities)
☐ Software modification	☐ Adding plug-ins (additional software)
☐ Changing business processes	☐ Training system users for change management
☐ Others (please specify) _____	

3. What was the organization's strategy with customers/suppliers to minimize business disruption during shakedown? Please outline the strategies.

i) Customers:

ii) Suppliers:

4. Did the ERP implementation bring about changes in roles and responsibilities of employees?

☐ No

☐ Yes → If yes, what measures (training, counseling, job design etc.) were taken to assure smooth transition of employees into their new roles and responsibilities?

5. Has your organization observed under utilization or non-utilization of the new systems especially in the shakedown phase?

☐ No

☐ Yes → **If yes, what efforts were made to encourage increased utilization of new systems?**

6. Are there are any examples in your organization where old procedures are yet maintained or manual workaround of systems is continued, despite being supported by the new ERP systems?

☐ No

☐ Yes → **If yes, why? Please list the main reasons.**

7. Was any post implementation assessment (e.g. investment/performance audit etc.) conducted to assess the impact of ERP systems on the organization?

☐ No

☐ Yes → **if yes, please list the significant assessment observations.**

8. Were any new business performance and control measures developed?

☐ No

☐ Yes → **if yes, what were they? Please list them.**

9. Were there any limitations of the ERP system in addressing your organization's business needs (like some needs not supported by the software)?

☐ No

☐ Yes → **If yes, please list the limitations?**

10. On the given scale of 1-7 (Where 1 indicates hardly realized and 7 fully realized) please rate how well these were realized with your organization's ERP systems. (Please circle your choices)

A) Systems improvement	Hardly Realized						Fully Realized	
1. Improving functionality of information systems	1	2	3	4	5	6	7	NA
2. Solving Y2K related problems	1	2	3	4	5	6	7	NA
3. Improving information quality	1	2	3	4	5	6	7	NA
4. Improving ease of use of information systems (User-friendly, ease of accessing data etc.)	1	2	3	4	5	6	7	NA
5. Elimination of cost and complexity associated with custom application development	1	2	3	4	5	6	7	NA
B) Operational improvement								
6. Attaining cost benefits (e.g. reduced inventory, operating costs of systems etc.)	1	2	3	4	5	6	7	NA
7. Automation of key business processes	1	2	3	4	5	6	7	NA
8. Providing better inventory management and planning	1	2	3	4	5	6	7	NA
9. Providing better order tracking and fulfillment.	1	2	3	4	5	6	7	NA
10. Providing effective cash management	1	2	3	4	5	6	7	NA
11. Achieving overall improvement in organization efficiency	1	2	3	4	5	6	7	NA
C) Work effectiveness								
12. Supporting group/team work	1	2	3	4	5	6	7	NA
13. Attaining work enhancement (Employees can take on additional responsibility)	1	2	3	4	5	6	7	NA
14. Eliminating redundant data entry and accompanying errors	1	2	3	4	5	6	7	NA
15. Reducing bureaucracy in the organization	1	2	3	4	5	6	7	NA
D) Strategic								
16. Increasing integration of business processes/functional groups	1	2	3	4	5	6	7	NA
17. Standardizing business processes	1	2	3	4	5	6	7	NA
18. Supporting collaboration with customers, partners and suppliers	1	2	3	4	5	6	7	NA
19. Supporting e-business initiatives	1	2	3	4	5	6	7	NA
20. Downsizing/ Rightsizing the organization	1	2	3	4	5	6	7	NA
21. Providing better enterprise management	1	2	3	4	5	6	7	NA
22. Providing global networking/ sharing of capabilities	1	2	3	4	5	6	7	NA
23. Meeting global or industry standards	1	2	3	4	5	6	7	NA
24. Developing new business opportunities.	1	2	3	4	5	6	7	NA
25. Providing for expected business growth	1	2	3	4	5	6	7	NA
E) Other motives (please specify)	Hardly Realized						Fully Realized	
	1	2	3	4	5	6	7	NA
	1	2	3	4	5	6	7	NA

	1	2	3	4	5	6	7	NA
	1	2	3	4	5	6	7	NA

11. On a scale of 1-7 (where 1 stands for Failure, 4 stands for Satisfactory, and 7 stands for highly successful) Please provide your perception of your organizations success (were the process carried out soundly and increased probability of realization of business benefits) in the following phases with respect to ERP.

ERP Project Phases	Failure		Satisfactory			Highly Successful	
Project Chartering	1	2	3	4	5	6	7
Project Configuration	1	2	3	4	5	6	7
Shakedown	1	2	3	4	5	6	7

Section V - Background Information

1. I would you like to receive the summarized results of the study? ☐ Yes ☐ No

2. Your Organization: _____

3. Your Position _____

4. Approximate number of employees in your organization _____

5. Please provide us with your contact information:

Name: _____ Phone: _____

Fax: _____ Email: _____

Address: _____

6. In case of any follow-up study/clarification¹, would you like us to contact you?

☐ Yes ☐ No

Thank you very much for your time and support.

Your views are extremely important for research.

APPENDIX III
Sample Covering Letter

January 17, 2001

Kind Attn:

Dear Sir,

We are writing to you as an adopter of Enterprise Resource Planning (ERP) systems, to ask you to participate in our study. We define an ERP system as an integrated enterprise computing system (SAP, Oracle, JD Edwards, People Soft, Baan, QAD, Great Plains are some of the ERP system vendors).

Enterprise Resource Planning (ERP) systems are viewed as one of the most complex, challenging but important systems innovation in organizations due to enterprise-wide implications, high resource commitment, high potential business benefits and risks, which also makes them important for research. Unfortunately, there is only mixed evidence of realization of potential ERP benefits and empirically supported research is not available. This has motivated us to study the ERP adoption and implementation process empirically.

Our study will lead to identification and analysis of the major issues, challenges, and successful strategies in adopting and implementing ERP systems. It will be valuable for management knowledge of ERP systems and identify both the significant challenges and the most successful strategies of implementing an ERP system. We will provide the summarized results to the participating organizations, which will be precise and valuable information regarding ERP strategies and best practices of leading organizations.

The questionnaire mailed to you examines critical success factors in both the planning and implementation phases of ERP adoption. The questionnaire is directed to ERP project/program managers or managers closely involved in the process of adoption and institutionalization of ERP. We would very much appreciate, if you would participate in our study or direct the questionnaire to the right person in your organization or provide us their contact information so that we can request their participation directly.

Please be assured all answers will be aggregated and treated as confidential, by the researchers. Individual company results will be aggregated in the analysis. Specific respondents and organizations will not be identified in any part of the published results from the study. If you have any questions about the study or require any clarification, please feel free to contact us. Thank you for your interest in our study.

Dr. Vinod Kumar
Professor and Director
(613) 520-2379 vkumar@ccs.carleton.ca

Bharat Maheshwari
Research Associate
(613) 523-8634 bmaheshw@business.carleton.ca

APPENDIX III
Description of Responding Organizations

Responding Organizations

Organization	Organization Location	Size	ERP Status	Time of ERP Adoption	System	ERP Status
Org A	A City Government	Large	Onwards and Upwards	3 to 5 years ago	Single Vendor	Single ERP
Org B	A Small Semiconductor Company	Small	Shakedown	In the last one year	Multi Vendor	Single ERP
Org C	A leading Agriculture Company	Large	Onwards and Upwards	3 to 5 years ago	Single Vendor	Single ERP
Org D	A Govt. Agency	Large	Onwards and Upwards	More than 7 Years	Multi Vendor	Multiple ERP
Org E	A Govt. Agency	Large	Shakedown	3 to 5 years ago	Multi Vendor	Multiple ERP
Org F	A Canadian IT consulting company	Large	Chartering	In the last one year	Single Vendor	Multiple ERP
Org G	A leading consumer goods company	Large	Onwards and Upwards	5 to 7 years Ago	Single Vendor	Single ERP
Org H	Canadian Unit of a Consulting Company	Large	Configuring	3 to 5 years ago	Multi Vendor	Multiple ERP
Org I	A Small Electrical Equipment Manufacturer	Small	Shakedown	3 to 5 years ago	Multi Vendor	Single ERP
Org J	A leading Auto Parts Co.	Large	Shakedown	3 to 5 years ago	Single Vendor	Single ERP
Org K	A Govt. Agency	Large	Onwards and Upwards	3 to 5 years ago	Single Vendor	Single ERP
Org L	A SME in semiconductor	Small	Evaluating	In the last one year	Multi Vendor	Single ERP
Org M	A Govt. Agency	Large	Shakedown	3 to 5 years ago	Single Vendor	Single ERP
Org N	A Small Public Institution	Small	Chartering	1 to 3 years ago	Single Vendor	Single ERP
Org O	A Public Institution	Large	Onwards and Upwards	5 to 7 years Ago	Single Vendor	Multiple ERP
Org P	A Govt. Agency	Large	Onwards and Upwards	5 to 7 years Ago	Multi Vendor	Multiple ERP
Org Q	An Engineering Goods Manufacturing Company	Large	Shakedown	5 to 7 years Ago	Single Vendor	Single ERP
Org R	A leading Metal Company	Large	Onwards and Upwards	3 to 5 years ago	Multi Vendor	Multiple ERP
Org S	A Government Owned Manufacturing Organization	Large	Shakedown	3 to 5 years ago	Single Vendor	Single ERP

APPENDIX IV

Project Configuration Models

Model 1

Stages	1.Planning	2. Conference room pilot	3.Re-engineering	4.Analyse	5.Build	6.Deliver
Typical Activities	Project Planning	Base configuration and Identify Gaps	Re-engineer systems and processes to achieve a fit	Testing	Final Touch up and preparation to go live	Go Live

Model 2

Stages	1.Scoping	2. Planning	3.Design	4Implementation
Typical Activities	System- Business fit Assessment Implementation Strategy	Define Deliverables Determine Schedule Team Steering committee	System Design	Code the system Go Live Train Users

Model 3

Stages	1.Pre-plan	2. Planning	3.Configuration	4.Testing	5.Implementation
Typical Activities	Charter High level scope	Detailed Plan High Level Design	Configuration	Testing	Training Documentation

Model 4

Stages	1.Project Plan	2. Conference room pilot	3.Business room pilot	4.Go live
Typical Activities	Project Team Requirement Planning	Configuration Key User Training Dummy Trials	Start-up the system with live data	Stop legacy system

Model 5

Stages	1.Prelim. analysis	2.System analysis	3.Development	4.Test	5.Implement
Typical Activities	Benefit analysis Planning	Architecture	Configuration Design and Build-up	Mainly Integration Testing	Data Conversion Go Live Train

Model 6 (ASAP)

Stages	1.Project Preparation	2.Business Blueprint	3.Realization	4.Final Preparation	5.Go Live
Typical Activities	Project Objectives Introductory Training Kick-off	Business Specifics and Software Fit Define Key Success Factors Level 2 training Hands-on	Configure Base Systems Level 3 Training Build Expertise	Testing User Training Preparation for Going live	Go Live, Support and Service