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**THE STRATEGIC IMPACT OF ENTERPRISE
SYSTEMS:
A DYNAMIC CAPABILITIES STUDY**

By

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

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Abstract

The emerging trend of adopting commercial IT application packages, such as enterprise systems (ES), presents a challenge to traditional strategic IT research because it departs from previous analytical assumptions with regards to technological and process heterogeneity. This research examines the strategic impact of ES from the dynamic capability perspective. Dynamic capabilities are the set of organizational routines and management processes by which firms integrate, coordinate, reconfigure, and transform internal resources to achieve congruence with business requirements. While strategically important, dynamic capabilities are necessary but not sufficient to create competitive advantage.

From the dynamic capability perspective, ES by itself does not create business value. Competitive advantage thus lies in creative ES deployment and utilization to achieve congruence with business requirements. Taking this view as a basis, this research assesses the capabilities dimension of ES in terms of technology and business process. Three fundamental dimensions of ES capabilities are proposed: IT infrastructure capability, business process reengineering, and knowledge management. IS management capability, comprising strategic alignment, organizational learning and competence building, and organizational transformation, is further identified as a higher-order mechanism guiding the evolution of ES capabilities. If appropriately applied, ES management is expected to moderate the outcome of all other ES capabilities.

This research employs both qualitative and quantitative research methods to examine the strategic impact of ES capabilities on ES outcomes. The quantitative analysis suggests a positive relationship between three dimensions of ES capabilities and ES outcome. However, the moderating effects of IS management on the three dimensions of ES capabilities are not significantly supported. In order to develop a further understanding of the strategic role of IS management capability, we then examine the role of IS management by conducting seven interviews. Our qualitative data provides ample evidence to capture the strategic implications of IS management capability for ES deployment and utilization.

This research is important: practically, the research findings enhance our understanding of the strategic implications of ES deployment and utilization; theoretically, such an approach advances the resource-based paradigm to the extent that it contributes to and operationalizes the theory.

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CHAPTER 1. INTRODUCTION

The move to enterprise systems (ES) is one of the key trends in the field of information systems (IS). ES is a process-based application package that aims to integrate transactional information and business processes in a distributed business environment. In the past decade, a significant number of major players from different industries have adopted enterprise systems (ES) and many are moving to extended ES business applications. Market analysis by CIO magazine (2002) provides statistical evidence about the size and growth of the ES market in the year 2001. According to the analysis, the ES market reached \$19.8B in 2001, an increase of 4% over the \$18.8B recorded for 2000. Sales of extended ES software, such as customer relationship management (CRM), supply chain management (SCM), procurement, and B2B commerce platforms are expected to reach a compound annual growth rate of 10% by 2006 (Surmacz, 2002). Although there has been some recent contraction in the market, IS investment in IT-based systems will continue to grow in the future, albeit at a more moderate pace.

The characteristics of ES explain the popularity of the system. ES is an integrated transactional system that encompasses several interconnected modules covering major functional areas of an enterprise. Its implementation influences business operations in two significant ways. First, featuring a central database and open-system architecture, ES comprises an application information technology (IT) infrastructure that integrates information flows across functional information systems (IS) (Weill and Broadbent, 2000). The modularized and client-server

architecture enhances IT infrastructure flexibility in terms of scalability, connectivity, compatibility, and integrity (Byrd and Turner, 2001). The deployment and use of ES thus affects the scope and flexibility of long-term information support and IT infrastructure capability. Second, being a process-oriented system, ES is a major catalyst for business process reengineering (BPR). The enterprise systems provided by such firms as SAP, Oracle, PeopleSoft, and J.D. Edwards embed industry “best practices” regardless of the idiosyncratic business processes of the firm. Although customization of ES is feasible, the complexity of the integrated architecture often forces adopters to redesign operational processes to fit the ES-imposed business model, even in cases where their previously customized process is strategically critical. The resulting and increasing ubiquity of ES, then, indirectly homogenizes operational processes within industries and opens new avenues for electronic inter-organizational interaction (Kumar and Van Hillegersberg, 2000; Davenport, 2000a).

The ES-imposed generic processes and the trend toward a single industrial IT application have caused great concern to researchers and practitioners alike. Thomas Davenport, one of the pioneers of ES and BPR research, speculates that homogeneous best practice in a single industry might lead to a lessening of the value of innovation in business process design (Davenport, 1998). Weill and Broadbent (2000) also question the strategic impact of standardized IS packages. While these questions imply that the pervasiveness of ES creates hardly any extraordinary advantage, empirical research has revealed various outcomes of ES

adoption (Markus and Tanis, 2000; Davenport, 2000a; Bermudez, 2002; Shang and Seddon, 2002). Some firms seem better at capturing the business opportunities enabled by ES, while others suffer from a fatal misfit between their organizational processes and the ES-imposed business model (Scott and Vessey, 2000a; DeSanctis and Price, 2001; Sarkis and Sundarraj, 2003). Yet despite increasing concerns about the business value associated with ES investment, strategic research into ES is still in the emerging stage and only a few attempts have been made to measure the success of ES (Gable, Sedera, and Chan, 2003). Most research on ES consists of anecdotal case studies that focus on critical success factors of system implementation, or deal with the multi-faceted impact of ES on business operation (Hirt and Swanson, 1999; Ross, 1999; Markus and Tanis, 2000; Ross and Vitale, 2000; Soh, Kien, and Tay-Yap, 2000; Hall, 2002; Hitt, Wu, and Zhou, 2002; Krammergaard and Rose, 2002). Seldom, however, does the research apply strategic theory to systematically reveal the value-creating process of ES deployment and utilization.

The current study applies dynamic capability theory (Teece, Pisano, and Shuen, 1997; Eisenhardt and Martin, 2000) as an analytical lens to explore the underlying driving factors leading to outstanding outcomes from ES investment. Our research focuses on the organizational practices that offered effectiveness in ES deployment and exploitation. The research context is the corporation. With the theoretical emphasis on how firms adapt to and even capitalize on a rapidly changing environment, dynamic capabilities provides a comprehensive

framework for the study of the impact of organizational positions (e.g., complementary assets and specialized assets), managerial processes (e.g., coordination and integration, learning, and reconfiguration and transformation), and paths (e.g., historical evolutionary path and technological opportunities) on ES deployment and utilization (Teece, Pisano, and Shuen, 1997). This capabilities approach not only provides great flexibility in exploring the role of ES within diverse business contexts, but also is believed to be a key to understanding both the successes and failures of the deployment and use of ES.

To develop a dynamic capabilities perspective on ES, it is necessary to establish a theoretical link between organizational routines and ES deployment and utilization. To this end, this study focuses on the strategic dimensions of ES and their underlying driving forces. Observing that ES implementation involves ramifications for the way organizations manage both information technologies and business practices, this research investigates several processes and aspects of ES deployment and use, in particular:

1. The capability of IT infrastructure in supporting organizational information services and enabling innovative strategic initiation.
2. The capability of business process reengineering in institutionalizing and integrating ES into business processes.
3. The capacity of knowledge management for developing ES knowledge infrastructure and enhancing user efficacy in innovative system usage.

4. The IS management capability in ensuring the alignment of system deployment and business needs, organizational transformation, and organizational learning and competence building.

A capability model illustrating the relationship between these four ES-related capabilities and ES outcome is proposed. The research model identifies IS management capability as a higher-order capability coordinating and configuring the ES-associated IT infrastructure capability, BPR capability, and knowledge management capability. Our position in this research is that ES is a competitive necessity. The value of ES stems from system deployment and utilization to support organizational needs and to create a platform for strategic initiatives. Such a proposition complies with the dynamic capabilities perspective to the extent that organizational routines play a vital role in capturing the business value of ES.

This research is based on a sample of Canadian and American firms compiled from publicly available sources such as the Financial Post, Information Week, and Ottawa Center for Research and Innovation. To acquire knowledge from both business and IT perspectives, data was collected from top executive managers and chief information officers, middle managers, line managers, and IT professionals by means of a questionnaire. In addition, personal interviews were conducted with three chief information officers, two ES project managers, one global manufacturing manager, and one financial manager to supplement the quantitative outcome obtained from the questionnaire survey. The qualitative study is

important in capability research because it provides rich information that may not be easily captured by the questionnaire.

Because it clarifies the impact of ES on the creation of strategic value, this research is important in several ways. First of all, most adopters of ES are in the operational stage and anxious for benefit realization. As such, the investigation of strategic implications of ES is important for two reasons. On the one hand, understanding the strategic dimension of ES capabilities may enhance the effectiveness of system deployment and exploitation and consequently enable the firm to capture the strategic value of ES. On the other hand, in light of the fact that ES and its extended applications will continue to dominate IT investment decisions, a comprehensive understanding of the capability dimension of ES and the driving factors should yield valuable knowledge for long-term IT governance and strategic deployment.

Secondly, by integrating ES research with the dynamic capabilities perspective, this research contributes to an enhanced understanding of the contextual issues driving flexible and responsive deployment of ES to match the requirements of a volatile environment. Indeed, the dynamic capabilities theory invites fundamental consideration of such issues as strategic alignment, organizational learning and knowledge accumulation, and organizational transformation in configuring and integrating ES with business strategy (Venkatraman, 1991; Venkatraman, 1994; Ross, Beath, and Goodhue, 1996; Markus and Benjamin, 1997; Teece, Pisano,

and Shuen, 1997). It is believed that such a socio-technical investigation should enhance the understanding of the value-creation process of ES.

Thirdly, research applying the resource-based paradigm has been criticized as lacking in balance between conceptual development and empirical verification. Such asymmetrical research has raised the concern that the resource-based paradigm, though strong in descriptive analysis, fails to prescribe strategy *a priori* (Williamson, 1999). The comparatively little quantitative research using the resource-based paradigm signals the need to develop an operational mechanism to advance the state of the art (Dosi, Nelson, and Winter, 2000). In fact, some recent IT research studies have attempted to conduct quantitative measurement of the causal relationship between IT capability and organizational performance. For example, Bharadwaj (2000) employed secondary financial data as a proxy to measure the impact of IT resources. The contribution of this research is limited, however, because of the lack of a replicable measurement construct. Thus, Santhanam and Hartono (2003) have called for empirically-derived IT capability measurement. By developing a measurement instrument and by applying quantitative methods in ES capability research, this study should contribute to the evolution of the resource-based paradigm through enhanced operational ability (Dosi, Nelson, and Winter, 2000).

Following the introduction, this research proceeds as follows. Chapter 2 comprises a two-part literature review. In the first part, previous research on ES is

reviewed to identify the critical issues in the implementation journey of ES. The second part focuses on a theoretical review of dynamic capabilities, providing an explanation of its salient characteristics. Chapter 3 describes in depth the relevant literature and ES implementation cases that facilitate the derivation of a capability approach to research on ES. Based on the literature review and case analysis, a research model, a set of hypotheses, and measurement constructs are proposed. Given that the dynamic capabilities view is centered on organizational context and management processes, the secondary empirical data offer a significant opportunity to compare and contrast the driving forces of effective ES deployment and their consequent impact across adopting firms. Chapter 4 comprises the discussion of both quantitative and qualitative research methods. Part I discusses the quantitative research method in terms of data sample, process of data collection, survey questionnaire, and statistical method. The second part explains the qualitative research method in term of research informants, interview process, interview themes, and data coding. Chapter 5 presents statistical procedures and findings from quantitative data analysis. Chapter 6 analyzes the qualitative data. Chapter 7 discusses the research findings and their implications for both academics and practitioners. Finally, chapter 8 concludes this study and discusses the implications for future research.

CHAPTER 2. LITERATURE REVIEW

This chapter is divided into two parts. The first part focuses on ES analysis, providing background information about enterprise systems. An overview of the system is followed by a review of the research on ES. The second part deals with generic capability theories, including resource-based theory, evolutionary economics theory, and dynamic capability theory.

PART I. ENTERPRISE SYSTEMS

2.1. ES Context

During the past decade, the widespread application of ES in business has had an unprecedented impact on business operation and interaction. ES are configurable, transaction-based application packages that enable companies to streamline business processes and information flows across enterprise entities (Davenport, 1998; Markus and Tanis, 2000). Enterprise systems have become very popular because they offer a common technical platform that enhances data visibility, information integrity, organizational responsiveness, and IT flexibility (Davenport, 2000a). Observing the ubiquity of ES across industries, Kumar and Van Hillegersberg (2000) argue that ES is a business necessity for surviving in the emerging network economy. Indeed, the transition to ES has signaled a new stage in the use of IT to develop and support organizational strategy. In order to explore the strategic implications of ES, it is necessary to understand the characteristics and architecture of the system.

2.1.1. Definition of ES

There is no exact definition for ES as these systems tend to co-evolve along with software development techniques and contemporary business requirements (Klaus, Rosemann, and Gable, 2000). The commonly accepted view is that ES is comprised of integrated software packages in which multiple functional applications share a common database (Markus and Tanis, 2000, p. 174). Originally derived from Manufacturing Resource Planning Systems II (MRP II), ES began as Enterprise Resource Planning Systems (ERP). The scope of the current generation of the system has been extended from manufacturing and logistics management to cover almost all the major functional areas of an enterprise. The current state of system evolution and functional expansion over such a wide spectrum, Davenport (2000a) suggests, is appropriately reflected in the name 'enterprise systems' (ES). As such, throughout the literature, ES is referred to as a software package that integrates the major functional areas of an enterprise into a coherent structure.

It is important to note that ES is different from systems integration that achieves enterprise coherence by connecting the islands of automation (Alsene, 1999). ES achieves coherence of organizational activities through a common database and a set of interconnected modules. ES constructs an application infrastructure that enables firms to harmonize and coordinate functional activities and information flow across organizational entities. As such, ES is a type of integration mechanism, but one that delivers an immense impact on business operation. In

order to understand the business implications of ES, it is necessary to appreciate the unique features of the system.

2.1.2. ES Overview

In the past decade, ES has become a popular business solution with the potential to overcome the limitations of fragmented and incompatible legacy systems. ES differs from traditional IS packages to the extent that ES provides a flexible IT infrastructure, integrated information flow, and industrial best practices, enabling companies to manage multiple operations in a distributed environment. For many organizations, the transition to ES promises to provide a fully integrated environment and the technological flexibility to exploit the potential of contemporary information technology. For example, Digital China used ES to serve as a technical platform to construct an electronic-based network organization. By pursuing ES-enabled organizational transformation, Digital China significantly enhanced its productivity and business flexibility (McFarlan, Chen, and Peimers, 2002). Similarly, Cisco integrated ES with Internet and Intranet applications to construct an electronic platform to effectively manage its supply chain and customer service (Nolan, 2001).

Both technological and business features constitute the unique attributes of ES. Enterprise systems are developed using object-oriented fourth-generation language. The systems are based on a multi-layer client-server architecture consisting of an independent database server, application server, presentation

server, and Internet server (Buck-Emden, 2000). These servers are connected in a communication network, which allows them to integrate data and conduct real-time processing. Together, the system architecture, open-system environment, and object-oriented system development tools offer great flexibility, scalability, and expandability of IT infrastructure. Indeed, the ES phenomenon is often considered to be a complete renewal of IT infrastructure involving the replacement of hardware and software and the development of new technological and business knowledge and skills. As ES is classed as an application package, its development is based on the mandate to provide a flexible and universal platform to satisfy the common industrial requirements.

While the technological features of ES enable strategic and technical flexibility, the ES-embedded business blueprint is a technical breakthrough in the evolution of information software and process management (Markus and Tanis, 2000; Davenport, 2000a). The ES business blueprint, also known as the business reference model, contains sets of business templates from different industries that are intended to represent the best practices of contemporary business. Such a feature enables ES to be used as a modeling tool to assist in the redesign of enterprise value-added processes (Scheer and Habermann, 2000). Because of the unavoidable impact on business process, ES projects are considered as business projects involving changes in organizational structure, culture, and job content (Davenport, 1998; Hall, 2002). As such, the level of fit between ES and specific business processes and the management approaches to change management and

system configuration and deployment influence the outcome of ES (Soh, Kien, and Tay-Yap, 2000; Davenport, 1998; Scott and Vessey, 2000a; Scott and Vessey, 2002b).

For researchers and managers, the IT infrastructure and business processes often manifest the organization's IT and business strategies. ES, which serves as both IT infrastructure and BPR catalyst, is considered to be a unique system -- one that is capable of aligning both IT and business strategies through system deployment. Yet the technological and operational progress comes with a standard infrastructure and business model that makes the strategic implications of ES an intriguing issue (Davenport, 1998; Weill and Broadbent, 2000). In measuring the success of an ES project, Markus and Tanis (2000) argue that the strategic outcome of ES is not necessarily a predictable consequence that comes with the package. Rather, favorable outcome is an open concept that will be determined by a wide variety of interacting issues arising from system implementation and environmental context throughout the phases of ES implementation (Soh and Markus, 1995; Markus and Tanis, 2000). Thus, an understanding of the process of ES implementation and the issues raised in system implementation may shed light on the implications of ES deployment and use.

2.2. ES Research Literature

As organizations have accumulated ES implementation experience over the past two decades, a growing body of academic research has described and analyzed

the phenomenon of ES. Tracing the path of ES implementation and deployment, Markus and Tanis (2000) propose a research framework that comprehensively covers the experience cycle of ES implementation (Figure 2.1). This framework, comprising the sequential steps of project chartering, project configuration and rollout, shakedown, and onward and upward, has been empirically tested (Markus, Axline, Petrie, and Tanis, 2000) and applied academically in ES research (Parr and Shanks, 2000; Krammergaard and Rose, 2002). The ES experience cycle is used in this research to frame the discussion of the ES research literature. It is important to note that the research classification reflects the comparative importance of research issues in corresponding with each stage of ES implementation only. It does not imply the activities occur in linear fashion. In fact, some issues may need to be taken care of throughout the process of ES implementation.

Figure 2.1: Enterprise system experience cycle adapted from Markus and Tanis (2000, p. 189)

In this section the literature will be documented, explored, and analyzed for each project phase. Recognizing that the current state of ES research discussion has moved beyond the conference level to professional journal publications (Esteves and Pastor, 2001), the research review will focus mainly on journal papers where the research results tend to be relatively more influential in ES research and practice.

2.2.1. Project Chartering

The project chartering phase is a planning stage that addresses the issue of vendor selection, project scope determination, and business case modeling. With vendor selection, the primary activity is the fit-gap assessment between system functionalities and business requirements. Project scope addresses the size and complexity of the ES project, whereas business case modeling focuses on the ES-associated business process design. For example, the University of Nebraska conducted extensive fit-gap analysis to ensure the process fit of the SAP R/3 (Sieber, Siau, Nah, and Sieber, 1999).

In the research on project chartering, three major streams have been identified. These include system analysis, risk factor analysis, and ES challenges. Research on system analysis focuses on comparing and contrasting ES features with traditional integration methods, analyzing ES architecture, and consolidating market information for ES vendor assessment and selection. Risk factor analysis

emphasizes critical managerial and technical factors having potential impact on ES outcomes. The ES challenges approach highlights the crucial issue of strategic alignment.

System Analysis

Researchers focusing on system analysis have investigated the context of ES (Klaus, Rosemann, and Gable, 2000), ES architecture and criteria for system integration (Sprott, 2000), and overview of the ES market (Everdingen, Hillegersberg, and Waarts, 2000). These studies provide background information about the technological and business characteristics of enterprise systems that is essential in the early stage of project evaluation and preparation. Klaus, Rosemann, and Gable's (2000) study, for example, endeavors to reduce the conceptual ambiguity of ES in IS research by comprehensively reviewing the evolutionary path of ES, analyzing the major focus of ES in IS research, and consolidating the experts' perspective on ES impact and future evolution. Focusing on the issue of system integration, Sprott (2000) conducted a thorough evaluation of the infrastructure characteristics of ES. According to him, system integration is an important yet ignored issue that has profound implication for the success of system implementation. Organizations wishing to capture the integrated benefit of ES should evaluate the system architecture in terms of applicability, integrity, adaptability, and upgradability.

Despite the technological capability, the understanding of ES market and common system selection criteria is also essential in the early stages of project planning. Van Everdingen, Van Hillegersberg, and Waarts (2000), for example, conducted a large-scale survey of ES to investigate system penetration in the European market, criteria of system selection, and criteria of vendor selection. Their study provides overview of market share in European countries. In addition, the empirical findings underline both functional fit and system functionalities as two major issues directing the decisions of ES investment.

In general, these studies tend to be practically oriented, providing comprehensive information for effective ES evaluation and selection. Furthermore, despite diverse research foci, there seems to be an emerging consensus that ES architecture represents a contemporary advanced IT design concept. The deployment and utilization of ES as such determines organizational flexibility and responsiveness in the emerging network economy.

Risk Factor Analysis

Research on risk factor analysis tends to outline the prerequisites for effective ES project management, such as organizational fit, skill mix, managerial support, user involvement and training, and technical competence (Sumner, 2000), which cover both the historically recognized IS project issues and factors unique to ES systems. In an effort to provide project management guidelines for ES implementation, Sumner (2000) identified a set of unique issues associated with

ES implementation, among which business process design, business knowledge, and ES skills are frequently highlighted. Par and Shanks (2000) identified the critical risk factors to each phase of ES implementation. Their research findings shared the same insight generated by Sumner (2000) but highlighted the lack of post-implementation audit mechanism in assessing organizational transformation. Willcocks and Sykes (2000) identified the challenge of ES implementation and proposed a set of ES implementation capabilities, including IT leadership, business systems thinking, relationship building, IT architecture planning, technology fixing, informed buying, contract facilitation, contract monitoring, and supplier relationship development. In addition, they highlight the importance of user buy-in, flexibility for continuously learning and innovation, high-level of project sponsorship, and project risk control. Indeed, the long list of risk factors and frequently cited social issues reflects the complexity of ES and implicitly outlines the scope of ES impact.

ES Challenges

The research on ES challenges focuses on the issue of the strategic alignment of the organization's needs with ES functionalities (Davenport, 1998; Rolland and Prakash, 2000) and conditions preceding ES implementation (Adam and O'Doherty, 2000; Francalanci, 2000; Markus, Tanis, and Van Fenema, 2000).

Alignment research highlights the social complexity of ES and addresses the diverse strategic implications of ES implementation (Grant, 2003). A case study

conducted by Grant (2003), for example, highlighted the execution of strategic alignment as a multi-faceted issue and its effectiveness is largely determined by organizational ES and business visions, IT governance model, operational alignment of ES and business processes, and ES project delivery. Seeking an operational mechanism to assess the fit between ES and business process, Rolland and Prakash (2000) proposed a mapping scheme to detail tasks, conditions, and information routing paths for process modeling.

While alignment research addresses issues of ES and business process integration, implementation research focuses on the complexity of project execution. The latter stream of research suggests measuring the ES project in terms of scope, size, and complexity. Scope is defined as the degree to which ES will change the organizational structure, culture, and work content (Markus, Tanis, and Van Fenema, 2000); size refers to the number of implemented modules; and complexity refers to the organizational size and number of users involved (Francalanci, 2000). The research findings indicate that firms that adopt broad-scope, multiple-module, and complex ES approaches tend to experience a high level of risk and turmoil in the transition process. These findings support the assertion that ES is a major business project rather than simply an IT one, but offer little insight beyond the conventional wisdom.

Summary

Table 2.1 summarizes the research contributions to the project chartering phase. In general, research in this phase provides an overview of ES architectures, project management methods, and system implementation approaches. It also reflects the evolutionary path toward integrated IT infrastructure and business processes. By articulating the general issues of ES initiation and implementation, these studies provide actionable guidelines for ES evaluation and project planning and monitoring. Indeed, these research unfold the critical issues that are essential to initial stage of project management. Some issues, such as strategic alignment, fit-gap analysis, and risk control, are important throughout the life cycle of ES project. What the research does not address sufficiently is the strategic implications of IT governance with regard to sourcing strategies and contract negotiation and management with system vendors and service suppliers. In addition, more need to be known about the consequences and strategic implications of integrated business processes and their impact on distributed organizational design.

Table 2.1: Research chartering phase of ES implementation

Chartering phase	Strategic decision to adopt ES		
	Vendor selection		
	System evaluation		
	Business case determination		
Authors	Research method	Scope of research	Contribution
Rolland and Prakash (2000)	Analysis: Materials management module of SAP	Strategic alignment	The authors develop a goal-oriented map concept to achieve a better alignment of the organizational needs with the functionalities offered by ES.

Davenport (1998)	System and business analysis	Organizational implications of ES adoption	The author argues that the ES challenge is a business issue requiring the reconciliation of the technological imperatives of ES with the business needs of the enterprise itself
Adam and O'Doherty (2000)	Case studies	Examines the characteristics of ES adopters in Ireland	Research findings indicate that the duration of ES implementation is related to the size and complexity of the adopting firm. In addition, ES implementation is a socially complex issue that involves managerial and political issues.
Klaus, Rosemann, and Gable (2000)	Historical analysis, meta-analysis of representative IS literature, and research survey	Characteristics and evolution of ES	<ul style="list-style-type: none"> • The authors characterize ES as a pre-configured generic software package with great potential for customization to support all business functions. • Meta research analysis reveals a common view of ES as a complex system involving complex organizational issues. • The ES research lag is increased because of the technological, evolutionary, multi-disciplinary nature of ES implementation, high cost of ES teaching and research, and competence gaps. • ES evolution is influenced by both technological and business dynamics. • The authors predict the future movement of ES, including intra- and inter-organizational connectivity, e-business, and CRM.
Willcocks and Sykes (2000)	Case study	IT capabilities to ES implementation	To meet the ES challenge, the authors identify a set of IT capabilities, including IT leadership; business systems thinking; relationship building; architecture planning; technological competence; and supply/consultant contract development and monitoring. In addition, the authors also highlight the importance of project management and implementation capabilities.
Markus, Tanis, and Van Fenema (2000)	Descriptive case analysis	Identify methods of ES project planning and delivery	The authors compare and contrast various methods and designs to multi-site ES implementation.
Parr and Shanks (2000)	Two case studies	Issues of ES project planning and monitoring	The author combines ES implementation model with critical success factors to identify the major issues driving to project success.
Sumner (2000)	Case studies	Identify major risk factors associated with ERP projects	The author suggests organizational fit, skill mix, management structure and strategy, user involvement and training, and technology planning/integration as key risk factors in ES transition.

Sprott (2000)	Technological analysis	ES architecture	<p>The author highlights the benefits of component-based systems and suggests the criteria of componentization in terms of:</p> <ul style="list-style-type: none"> • Applicability • Integrity • Adaptability • Upgradability
Everdingen, Hillegersberg, and Waarts (2000)	Large-scale European multi-country/multi-industry survey	ES market analysis, criteria of system selection, and criteria of vendor selection	<p>ES penetration:</p> <ul style="list-style-type: none"> • In 1998, 27% of midsize European companies had installed ES software in one or more functional areas, with 13% of adopters using ES software in just one functional area, and 70% in more than three functional areas. • By mid-2000, the expected market penetration was about 56% • The electronic industry is the major market. <p>IS selection Criteria</p> <ul style="list-style-type: none"> • The best fit with current business procedures • Other important criteria are flexibility, cost and user-friendliness of the system, scalability, and supplier support <p>ES supplier selection criteria:</p> <ul style="list-style-type: none"> • Product characteristic is the top priority
Grant (2003)	Case study	Investigating the issues of strategic ES alignment	<p>The author explains the social complexity of strategic alignment and highlights the importance of:</p> <ul style="list-style-type: none"> • Comprehensive corporate vision for the role of ES • Operational alignment of IT and business processes • Strategies of IT investment • Integrated IT governance • IT management capabilities
Francalanci (2000)	Quantitative research: empirical testing of 43 SAP/R3 projects	Investigates the impact of technical size and organizational complexity of SAP/R3 projects on implementation efforts	<p>Project size is measured in terms of the number of SAP modules and sub-modules implemented. Complexity is defined as the organizational scope of the project in terms of users' involvement and overall company size (measured by total revenue and total number of employees). The research findings conclude that both the technical size and organizational complexity of projects are relevant drivers of implementation efforts.</p>

2.2.2. Project Configuration and Rollout

The project configuration and rollout phase is concerned with the activities designed to get the system up and running in one or multiple organizational entities. Typical activities include project management, system configuration and customization, and knowledge accumulation and user training. For example, to accumulate experience and knowledge in global process reengineering, Dow Corning used its UK division for a pilot ES deployment (Ross, 1999). In contrast, perceiving the phase approach as time consuming and financially very risky, NIBCO adopted the big-bang approach, implementing ES through careful control of project ownership, user training, change management, and process knowledge (Brown and Vessey, 2001).

Research on project implementation tends to explore the organizational issues influencing ES implementation. Two particular streams of research can be identified: studies of the ES implementation process and studies of organizational impact. The former focuses on the issues surrounding ES implementation; the latter explains the outcome of ES by identifying and examining the consequences of events over the life span of ES projects life cycle.

ES Implementation Process

Research on the ES implementation seeks to explain ES outcome by examining the path of ES project delivery and monitoring. Researchers in this stream tend to conceptualize the ES implementation process as a set of connected phases

(Krumbholz, Galliers, Coulianos, and Maiden, 2000; Markus, Axline, Petrie, and Tanis, 2000; Markus and Tanis, 2000; Ross and Vitale, 2000). For example, Markus and Tanis (2000) and Markus and Axline et al. (2000) recognize the ES project as a sequence of stages composed of the phases of “project,” “shakedown,” and “onward and upward.” They further identify measurement metrics (such as project cost, length of deterioration time of key performance indicators, and achievement of business results) as performance indicators to monitor the progress of ES transition. Similarly, Ross and Vitale (2000) depict the ES journey as design, stabilization, continuous improvement, and transformation. Their empirical findings indicate the causal link between the firm’s capability to traverse the technical and business hurdles in the ES journey and its success in capturing ES value. In addition to the research on the ES experience cycle, Krammergaard and Rose (2002) identify the range of managerial competencies across the spectrum of ES journeys. Their research provides an in-depth view of the behavior issues in ES management and identifies three dimensions of management competences, including business competences, technological competences, and personal competences.

In general, these models utilize the life cycle metaphor to describe ES implementation in a linear sequence of phases (Robey, Ross, and Boudreau, 2002). They share the common assumption that the overall success of ES is a cumulative outcome of each stage. While their metaphors vary, the process models all assume that the ES project passes through definable stages in which

progress is predictable. In particular, all stage models anticipate a short-term turmoil effect of ES implementation and expect a long-term ES-enabled transformation. As a family of theories, the stage model tends to describe, explain, and predict the relationship between the ES experience and ES outcome. Such models allow practitioners to anticipate the project challenges and formulate the responding strategies in advance.

While the stage model contributes to an understanding of the ES life cycle and major challenges in ES implementation, two theoretical limitations may hinder its predictive ability concerning the strategic implications of ES. First, there seems to be a tendency among researchers to view the ES project as organic in nature without exploring the fundamental enablers or inhibitors that regulate the evolving process of ES implementation (Robey, Ross, and Boudreau, 2002). Second, although these approaches recognize the possibility of unstable ES outcomes across the life cycle, they do not explain why and how some firms are capable of turning around an ES outcome from unstable to favorable in the later stages. In other words, the stage model fails to explore the underlying mechanism by which the organization applies the experience of the preceding to the succeeding phases.

Studies of Organizational Impact

Unlike process research, which approaches ES success from a project management perspective, organizational impact research investigates the social

and strategic impact of ES by analyzing the organizational context. In organizational impact research, ES is conceived as a socially complex project involving the issues of organizational culture and business process design (Krumbholz, Galliers, Coulianos, and Maiden, 2000; Scheer and Habermann, 2000; Soh, Kien, and Tay-Yap, 2000). On the basis of this assumption, the research effort is centered on the organizational norms, values, and practices associated with ES success. For example, Soh and her colleagues (2000) observed that a functional fit of the ES business model is associated with culture, economics, and industrial practice. Their case studies indicate that the ES business model does not serve as a universal solution for organizations whose business contexts differ significantly from those of Western firms. In the investigation of the cultural issues surrounding ES implementation, Krumbholz et al. (2000) found that ES success tends to be influenced by corporate rather than national culture.

In general, the application of social science theories in ES research opens a new avenue of ES investigation. Organizational impact research explicitly reveals the underlying contextual issues that contribute to the success of ES. Organizations benefit from recognizing and addressing the potential risks lurking in the gaps between organizational context and the ES business model.

Summary

Table 2.2 summarizes the research on the project configuration and rollout stage. Despite the different metaphors and terminologies employed to describe the ES life cycle, there seems to be a consensus that ES transition is a multi-faceted business project that includes the major phases of planning, execution, and transformation. Such a process analysis provides a framework for the charting of success indicators. While long-term ES value is expected, current studies are limited in their ability to identify the driving force in effective and efficient system deployment and utilization, leaving a gap in the research on ES-enabled transformation that invites further study. In addition to the understanding of the ES life cycle, the study of ES transition enhances the current understanding of the business implications of ES. The application of social science theories in ES research provides a theoretical foundation for the study of the contextual issues in ES adoption.

Table 2.2: Research on project configuration and rollout phase of ES implementation

Project configuration, integration, and rollout	<ul style="list-style-type: none"> • Project management • Activities designed to get the system up and running 		
Author	Research method	Scope of research	Contribution
Soh, Kien, and Tay-Yap (2000)	Case study: hospitals in Singapore	Explore the issues associate with functional misfit	The authors suggest that the misfit problem involves culture, economic, and regulatory context.
Markus and Tanis (2000)	Case study	Investigates ES experience cycle and success of ES	The author identifies the issues and problems in four phases of the ES experience cycle: chartering, project configuration, system rollout, and onward and upward.

Krumbholz, Galliers, Coulianos, and Maiden (2000)	Case comparison: Scandinavian and UK firms	Investigates the culture issues involved in ES implementation	This research synthesizes social science theories to model and predict the impact of culture on ES project implementation. The proposed research model is a meta-knowledge model which includes the factors of agent, action, observation, belief, value and norm. Research results support the issue of corporate culture in ES implementation but show no relationship between national culture and ES project.
Markus, Axline, Petrie, and Tanis (2000)	Qualitative interview	Discusses success of ES and its measurement at different points in time	The author proposes measures of success for each phase: <ul style="list-style-type: none"> • Project phase: project cost vs. budget; completion time vs. schedule; system functionality vs. original project scope • Shakedown: short-term deterioration in key performance indicators; length of time before business impacts return to normal • Onward and upward: achievement of planned business result; ES-supported decision making; ongoing business improvement; ease of further functionality expansion
Krammergaard and Rose (2002)	Five-year longitudinal study of a Danish production company	Discusses the managerial competences to success ES implementation	Managerial competences in stages of the ES journey: <ul style="list-style-type: none"> • Chartering: strategic competence, technology competence, project management competence, communication competence • The project: project management competence, business process competence, leadership competence, ES competence, communication competence, human resource competence • Shakedown: ES competence, human resource competence, leadership competence, communication competence • Onward and upward: business process competence, organizational competence, ES competence, technology competence, human resource competence, leadership competence, and strategic competence

Scheer and Habermann (2000)	Illustration of model-based customization	The business process model is the key to the success of e-business	The authors perceive ES as an instrument for improving business process. Therefore, designing the back office processes according to the new requirement is critical. Benefits of the business model include better communication, knowledge transfer, and conceptual support for value-chain design.
Ross and Vitale (2000)	Empirical study of 15 manufacturing companies that have completed a significant ES implementation	Examines the impact of ES on organizations	The authors depict the stages in the ES journey as design, stabilization, continuous improvement, and transformation. ES implementation can lead to a new organizational environment characterized by an increased emphasis on process, strategic vendor alliances, and constant change.

2.2.3. Project Shakedown

The shakedown phase covers the process of routine use of ES and continuous system enhancement (Markus and Tanis, 2000). As a class of process software, ES is often associated with business process redesign. Organizational change and knowledge transfer are two outstanding issues: the former deals with social-system interactions; the latter focuses on organizational learning and ES-associated knowledge management. For example, Scott and Vessey (2002) compare and contrast Dow Corning with Fox Meyer to identify the underlying factors leading to different ES outcomes. They point to Dow Corning's open and creative culture as the major factor facilitating the process of ES-associated organizational change and leading to survival on the rough road of successful ES deployment and utilization.

Organizational Change

Research on organizational change tends to explain the dynamics of ES deployment and use in light of the process of organizational change. This stream of research is usually based on four motors of change articulated by Van de Ven and Poole (1995). In this stream of thought, the diverse ES outcomes are a consequence of organizational culture, structure, learning, work content, and political power change (Hall, 2002; Robey, Ross, and Boudreau, 2002). For example, ES rollout often redefines the established business practice by imposing a pre-defined business model – an imposition which raises the issues of reducing the work force, changing work content, and redistributing political power (Hall, 2002).

While Van de Ven and Poole (1995) identified life cycle, dialectic, teleology, and evolution as the four major motors of organizational change, current ES research is focused on a dialectic approach where organizational change is perceived as a conflict-based interactive process (Robey, Ross, and Boudreau, 2002). Based on this view, ES rollout is seen as a competing force that challenges existing organizational practice, culture, and memory. In such a perspective, organizational resistance is predictable and expected, and successful ES outcomes depend upon a strategy of organizational conflict resolution and change management. In essence, dialectic theory provides a logical explanation of the social aspects of ES implementation. Organizations can benefit from predicting and anticipating internal and external reactions to ES adoption. However,

confined as it is to theoretical application, the dialectic approach offers limited insight into the roles of the project agent, organizational resources, and the evolutionary mechanism in the process of organizational change.

Organizational Learning

Research on organizational learning explores ES rollout from the aspect of knowledge transfer and management (Lee and Lee, 2000). Researchers in this stream of thought highlight the importance of technological and business knowledge management in ES implementation. Lee and Lee (2000), for example, suggested the ES-embedded business models and documentation as codified learning mechanisms through which comprehensive process knowledge is transferred. Better communication, enhanced cooperation, and processes overview are recognized benefits of the ES business model (Curran and Keller, 1998). The organization's adaptive capability and knowledge development capability are the major forces driving the institutionalization of the ES model (Lee and Lee, 2000). Indeed, this approach utilizes the concept of knowledge management to analyze the implications of business reference models. A key idea is that the user competence of operational processes leads to outstanding operational performance.

The research on knowledge management of ES supplements the current state of ES study to the extent that it identifies the underpinning mechanism driving the installation of ES to be a catalyst of business processes reengineering. This stream

of research unfolds the strategic implication of standard business rules, codified documentation, and technological knowledge in effective ES utilization.

Summary

Table 2.3 summarizes the ES research on system shakedown. This stream of research covers multi-faceted organizational issues critical to ES deployment and use. The application of change theories and knowledge management theories offers a novel perspective on the investigation of the organizational impact of ES. Yet, in this emerging stream of ES research, efforts are mainly concentrated on case analysis or qualitative survey. Seldom, however, does the research conduct quantitative testing to verify the generalization of proposed factors.

Besides the methodological concern, there are three issues need further exploration. First, the research regarding change management approaches the organizational change from a learning perspective. While such approach captures major operational mechanisms of organizational change, organizational change is a relatively broad concept that involves multi-faceted organizational and individual issues. Second, while the implementation of ES causes a research concern in change management, more research need to be conducted on the mechanisms that can lead to the stabilization of firms following the radical operational change. Third, while researchers offer diverse views on the question of how ES contributes to business competitiveness, the underlying driving force

that integrates and configures ES-enabled process change and knowledge transfer demands further exploration.

Table 2.3: Research on shakedown phase of ES implementation

Shakedown	<ul style="list-style-type: none"> • Period of time from “going live” until “routine use” has been achieved • System performance tuning or enhancing 		
Author	Research method	Scope of research	Contribution
Lee and Lee (2000)	Case study of University of Nebraska	Investigates ES implementation from a knowledge transfer perspective	This research suggests that an organization's adaptive capability and knowledge development capability influence its ability to internalize the standard business model into existing business routines.
Robey, Ross, and Boudreau (2002)	Comparative case study	Comparison of firms based on their dialectic learning process	<p>The author identifies two types of knowledge barriers: those associated with the configuration of the ES package, and those associated with the assimilation of new work processes.</p> <p>Configuration knowledge barriers are overcome by a strong core team and a carefully managed consulting relationship.</p> <p>Assimilation knowledge barriers are overcome by training and a phased implementation approach. Two major approaches include the incremental piecemeal approach and concurrent concert approach.</p>
Boudreau and Robey (1999)	Theoretical analysis	Proposes three dimensions of process theories used to explain organizational change: form, motor, and theoretical content	<p>The author propose three dimensions of change theories to guide ES-related organizational change:</p> <ul style="list-style-type: none"> • Form: deals with the amount and frequency of change • Motor: refers to the mechanisms explaining how and why change unfolds • Theoretical content: consists of specific constructs and their interactions that produce change.

Hall (2002)	Empirical study	Examines the effects of ES implementation on organizations	<p>The author suggests that ES is potentially associated with the following changes in the organization of work:</p> <ul style="list-style-type: none"> • Downsizing organizations • Decentralizing responsibilities for various tasks while further concentrating control • Increasing range and depth of skills for some jobs while deskilling and routinizing tasks inherent in other jobs • Intensifying work in many jobs.
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2.2.4. Onward and Upward

The onward and upward stage highlights the business benefits of ES. This is the stage where the value of ES investment materializes and the organization engages in system functionality enhancement. For example, Cisco Systems Inc. integrated ES with Internet and Intranet applications to revolutionize the existing process and create new end-to-end capabilities (Nolan, 2001). Similarly, IBM utilized ES as an integrated electronic infrastructure supporting worldwide common practice. In an effort to develop a virtual enterprise, IBM expanded the functionality of ES to support B2B interaction and cooperation (McAfee and Herman, 2000). Research contributing to the understanding of this stage focuses on ES capability analysis (Davenport, 2000c), the benefits of ES (Murphy and Simon, 2002; Shang and Seddon, 2002), and critical factors associated with successful ES implementation (Scott and Vessey, 2000a; Scott and Vessey, 2002b).

ES Capability Gap Analysis

Research on the ES capability gap assesses issues within the contemporary business environment and the functionality provided by ES vendors. Perceiving

ES as a technological platform enabling organizations to pursue long-term business value, capability gap analysis focuses on identifying the missing system capabilities that are imperative for long-term information support. For example, Davenport (2000) suggests that future ES functionality should incorporate extended application domains (such as customer relationship management, value-chain management, and knowledge management), capability of data analysis, and cross-firm data integration and disintegration to support changing business requirements. Markus and Petrie (2000) also highlight extended data application, communication, and interaction as the emerging trend of ES service provision. In essence, these analyses implicitly highlight the limitation of an internally focused ES database and suggest functional extension and external connection for maximizing the benefits of an integrated database. The research findings enable organizations to either identify the system requirements in the next wave of business competition or consider alternative solutions for enhancing competitiveness.

ES Benefits

Research on ES benefits is still in the emerging stage. Drawing on extensive case surveys, Shang and Seddon (2002) proposed five dimensions of ES benefits and the corresponding measurement criteria. These include operational, managerial, strategic, IT infrastructure, and organizational benefits. This analytic framework reflected the broad scope of ES impact, from operational effectiveness and efficiency to organizational transformation and business innovation. Such a

comprehensive framework not only recognizes the value that successful ES implementation can contribute to an organization, but also enhances current understanding about the various impacts of ES on business competitiveness. Murphy and Simon (2002) went a step further to investigate the business value of these strategic dimensions. According to them, certain intangible ES benefits, such as managerial and strategic benefits, are difficult to quantify in monetary terms. On the basis of this view, they challenged the adequacy of applying traditional cost-benefit analysis in IT investment assessment and highlighted the importance of incorporating intangibles in project evaluation.

ES Experience

At the current stage of ES research, the comparative case study conducted by Scott and Vessey (2000a, 2000b) is the only attempt offering a historical analysis of ES implementation experiences. Comparing and contrasting the ES experiences of FoxMeyer and Dow Corning, Scott and Vessey (2000a, 2000b) highlight open culture, open communication, piecemeal approach, project management, and responsiveness to change as major factors contributing to diverse ES outcomes. By proposing a risk management model, the authors provide a theoretical lens to investigate the interaction of project management and changing business requirements. According to their analysis, organizations capable of adapting to change and accumulating knowledge from preceding experience outperform those who fail to do either.

Summary

Table 2.4 lists research on the onward and upward stage of ES implementation. Based on the premise that ES is a strategic enabler, the research effort is focused on identifying the capability gap between contemporary information demand, benefits assessment, and strategic ES implications. The historical retrospective also contributes to an understanding of the common pitfalls of information system transition. Although the current state of research contributes to the understanding of ES benefits and future system development directions, more needs to be known about the underlying driving forces that lead to outstanding ES deployment.

Table 2.4: Research on the onward and upward phase of ES implementation

Onward and upward	<ul style="list-style-type: none">• Routine operation until system upgrade• Realizing and capturing business benefits from ES		
Author	Research method	Scope of research	Contribution
Davenport (2000b)	Theoretical and empirical analysis	Identifies ES capabilities and future gaps	<p>The author identifies challenges in the business environment:</p> <ul style="list-style-type: none">• Rapid responsiveness to changing market demand• Globalization of corporations, markets, and competition• Horizontal corporate realignment• Virtual organization <p>ES capabilities:</p> <ul style="list-style-type: none">• Business scope: ES support of internal activities, supply chain, and a set of collaborative peers• Information scope: transaction automation, process management and knowledge management <p>Future needs for ES:</p> <ul style="list-style-type: none">• New application domain: CRM, SCM, KM and new product development• Decision and analytical focus• Cross-firm data sharing• Application and information standard
Markus, Petrie, and Axline (2000)	Scenario planning	Investigates multiple scenarios of future ES	<p>Two scenarios of future ES development:</p> <ul style="list-style-type: none">• Continuity view of ES problems includes limited functionality, lack of

		development	<p>decision support, lack of extended enterprise support, implementation and upgrade difficulties, and high total cost of ownership.</p> <ul style="list-style-type: none"> Discontinuity view of outsourcing the information service to vendors and collaboration facilitators
Shang and Seddon (2002)	Qualitative research combines secondary case analysis and interviews	Investigates the benefits of ES	<ul style="list-style-type: none"> Proposes five dimensions of ES benefits: <ol style="list-style-type: none"> Operational: measured by cost, quality, productivity, and customer service Managerial: measured by decision-making, resource management, and performance improvement Strategic: measured by business transformation and innovation IT infrastructure: measured by flexibility and IT capability Organizational: measured by organizational change, learning, and vision building
Murphy and Simon (2002)	Case study: combined with structured and semi-structured interviews, business case modeling, internal document, and survey information	Investigates the intangible benefits that are important to ES projects	<ul style="list-style-type: none"> ES benefits incorporate both tangible and intangible features. ES success is based on the organization's acceptance of culture and process change. Such organization and strategically centered benefits are difficult to measure and quantify.
Scott and Vessey (2000a)	Case study: secondary data comparison of FoxMeyer and Dow Corning	Investigates the factors associated with successful ES implementation	<p>The authors apply their "learning from failure" model to two ES implementation cases and suggest:</p> <ul style="list-style-type: none"> Organizational learning is a process of adaptiveness and exploration Strategic planning and leadership is critical to success ES implementation Appropriate reaction to changes during implementation contributes to the success of ES transition Open culture, open communication, piecemeal approach, and change management constitute basic ingredients for successful ES implementation and deployment.
Scott and Vessey (2002b)	Case study: secondary data comparison of FoxMeyer and Dow Corning	Investigate the causal linkage between risk management and ES project	<p>The authors identify four levels of organizational change: external business context, organizational context, IT context, and ES project. The research model suggests:</p> <ul style="list-style-type: none"> The strategic factor is more likely to have far-reaching effects than the tactical factor.

		success	<ul style="list-style-type: none"> The changes in organizational culture, strategy, organizational structure, knowledge/skill, and IT infrastructure in response to environmental change demonstrate equally important impacts.
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2.2.5. Summary

The ES research discussed above reveals the techno-social issues encountered in ES transition. As indicated by ES research, the implementation of a commercial package directly changes the IT infrastructure and imposes new business processes and knowledge management skills. Such simultaneous structural and architectural changes dramatically increase the complexity of ES implementation and the risks for project management and control.

While some papers focus on the infrastructure aspects of ES, most of the research is grounded in the common logic that ES is a strategic-level business project involving extensive organizational issues. Important management skills, such as strategic planning, change management, organizational culture, and learning mechanisms are applied to explain ES outcomes. These social explorations not only contribute to the understanding of the underlying driving forces of ES implementation and deployment, but also construct a research foundation for further strategic exploration.

Based on the premise that ES is a strategic enabler, research efforts have focused on identifying the critical issues that distinguish success from failure, but seldom

(if at all) do they apply strategic theories to explain the strategic implications of ES. As successful IS implementation does not automatically translate to optimal IS utilization (Soh and Markus, 1995), there is clearly a need to supply the missing piece of the puzzle. The next section discusses the concept of dynamic capabilities as a tool to investigate the implications of ES.

PART II. DYNAMIC CAPABILITIES

One preoccupation of strategic IT research is to understand if, how, and why IT contributes to the superior performance of firms. Two schools of thought dominate strategic IT study. One, the positioning school, is represented by Porter's view that IT-enabled inter-organizational connectivity acts as an impediment to competitive forces, creating entry barriers, enabling low cost, and product differentiation, leading to outstanding operational performance (Porter and Millar, 1985; Teece, Pisano, and Shuen, 1997). This school of thought tends to downplay organizational characteristics while highlighting the strategic implications of IT deployment for industrial power redistribution. The other stream emphasizes the resource-based view of the firm (RBV) (Duncan, 1995; Mata, Fuerst, and Barney, 1995; Ross, Beath, and Goodhue, 1996; Jarvenpaa and Leidner, 1998). This school pinpoints the organization's resource repository, the result of historical managerial decisions and organizational learning, as a source of competitive advantage. By integrating IT analysis into the organizational context, the RBV paradigm provides a relatively subtle explanation of the implications of ES. In particular, the concept of dynamic capabilities, which

applies evolutionary economics theory to the process of organizational change (Barney, 2001), provides a promising framework for investigating the implications of a process-based transition to ES. The following section explores the origins as well as the characteristics of dynamic capabilities. Such an analysis will contribute to the understanding of ES characteristics and capabilities, and their impact on organizational performance.

2.3. Theory

In his overview of resource-based theories (RBV), Barney (2001) positions dynamic capabilities theory as a synthesis of RBV and evolutionary economics theory. Focusing on the strategic implications of organizational routine and structure, the theory of dynamic capabilities posits organizational capabilities directed toward resource coordination, integration, reconfiguration, and innovation as the source of competitive advantage in a rapidly changing environment (Teece, Pisano, and Shuen, 1997; Eisenhardt and Martin, 2000). This perspective supplements the strategic management theories in such a way that it highlights the importance of business routines and management processes within the context of strategic management. In other words, the process of resource coordination, integration, and configuration constitutes one of the major elements of strategic management. Such theoretical thinking contributes to the family of strategic management theories to the extent that it provides a logical basis by which we can explore the underlying driving forces of business outcome delivery. The following section reviews the literature on resource-based theory, evolutionary economics theory, and dynamic capabilities.

2.3.1. Resource-Based View of the Firm

In the past decade, the resource-based view of the firm (RBV) has been an influential theory for understanding the relationship between firm-level resources and competitive advantage. Conceiving the firm as a bundle of resources, the RBV postulates that firms are heterogeneous because of their unique combination of resource endowments and evolutionary path. Resources, capabilities, and competences are primary analytical factors. “Resources” refers to both tangible and intangible internal assets that are fundamental to organizational operation. Tangible assets, such as IT infrastructure, are acquirable from the market and are easy to convert to monetary value (Barney, 1991). Intangible assets, such as patents and know-how, are firm-specific properties or values that are not depleted through use. Resources, therefore, are durable stocks, and the process of their accumulation tends to be socially complex and path-dependent. “Capabilities” are the firm’s distinct capacity and managerial routines for manipulating and coordinating resources (McGrath, MacMillan, and Venkataraman, 1995). Operational and managerial processes are major mechanisms through which organizations achieve effective and efficient resource deployment and exploitation (Teece, Pisano, and Shuen, 1997; Eisenhardt and Martin, 2000). “Competences” represent a firm’s specific skills that not only distinguish it in terms of value delivery, but also construct the gateway to new markets (Bogner and Thomas, 1994; Hamel, 1994). Competences, which evolve from creative resource integration and coordination, are the substance of organizational

strengths that envision viable business opportunities for future expansion (Parahalad and Hamel, 1990). According to the RBV, these strategic endowments tend to be unique and immobile because of the irreversible trajectory of resource selection and accumulation (Parahalad and Hamel, 1990; Barney, 1991; Grant, 1991; Amit and Schoemaker, 1993; Peteraf, 1993; Wernerfelt, 1995). In this perspective, competitive advantages are conferred by organizational resources which are valuable, idiosyncratic, inimitable, and non-substitutable (Pahalad and Hamel, 1990; Barney, 1991; Peteraf, 1993; Grant, 1991; Amit and Schoemaker, 1993; Wernerfelt, 1995).

The RBV paradigm contributes in two ways to the understanding of how and why firms achieve competitive advantage. First, concerning the strategic implication of organizational resources, RBV supplements the positioning school by approaching strategic issues from the level of organizational analysis. This theory tends to be skeptical about the market ensuring profit-maximizing outcomes and proclaims the value of a unique resource repository in extraordinary rent creation (Amit and Schoemaker, 1993). Based on this assumption, firms having better insight into resource cultivation and accumulation stand a better chance of seizing competitive advantage (Barney, 1997). Second, the resource-based view of the firm enhances the understanding of the isolating mechanisms contributing to competitive advantage. By addressing the concepts of valuable, rare, inimitable, and non-replicable, the RBV theory positions the issues of organizational context, management skills, and resource complementarities in the light of strategic

management (Clemons and Row, 1991; Mata, Fuerst, and Barney, 1995; Ross, Beath, and Goodhue, 1996).

The IT field has considered IT to be a source of competitive advantage. For the past two decades, the increasing application of IT to support business processes and inter-organizational interaction has shown the strategic value of IT in business competition (Porter and Millar, 1985; Yetton, Johnston, and Craig, 1994). However, despite increasing dependence on IT-based information systems, the rapid pace of technological innovation and ease of reverse engineering have radically undermined the sustainability of IT-enabled competitive advantage (Duncan, 1995; Mata, Fuerst, and Barney, 1995). Based on RBV, IT researchers have identified IT management, IT infrastructure, IT know-how, and IS capabilities as idiosyncratic IT assets that are imperative for business competition (Duncan, 1995; Mata, Fuerst, and Barney, 1995; Ross, Beath, and Goodhue, 1996; Feeny and Willcocks, 1998; Jarvenpaa and Leidner, 1998; Bharadwaj, 2000). These assets are the source of enduring competitive advantage because they are heterogeneous, valuable, and difficult to replicate.

Yet, despite the enhanced analytical mechanism for assessing IT resources, the RBV is asymmetrically focused on the analyses of resources (Lengnick-Hall and Wolff, 1999). In essence, the RBV postulates that the value of firm-specific resources and capabilities will remain stable until exogenous changes, such as path-breaking technological and business process innovation, upset the balance of

the competitive landscape and the associated rules (Priem and Butler, 2001). This static view highlights the importance of maximizing business profits by matching resources with market requirements, but implicitly simplifies the implications of resource coordination, configuration, and integration. While the RBV is analytically rigorous and practically relevant in strategic IT research, critics have commented that such a static perspective is limited in its ability to explain a rapidly changing environment where resource and capability values are quickly depleted by innovative technology (Teece, Pisano, and Shuen, 1997). Within the changing business environment, organizational flexibility and responsiveness to innovative resource deployment is essential. As suggested by Mata et al. (1995), IT-based competitive advantage tends to rely less on technology and more on the process of IT utilization and governance. Such IT capabilities are often embedded in managerial decision-making processes and operational routines. Evolutionary economics theory, which views organizational routines and managerial know-how as the trajectory of capability development, provides a complementary theoretical foundation for unfolding the implications of organizational processes (Nelson and Winter, 1982).

2.3.2. Evolutionary Economics Theory

By applying the metaphor of biological evolution to economic analysis, evolutionary economics theory attempts to explore the underlying factors that bring about the heterogeneity of firms (Foss, Knudsen, and Montgomery, 1995; Levinthal, 1995). Variation, selection, and retention are three continuous steps in the evolutionary cycle (Foss, Knudsen, and Montgomery, 1995; Levinthal, 1995).

Variation arises from strategic attempts to pursue new advantage through enriching or transforming the existing repertoire. Technological innovation is the most obvious example of evolutionary variation. Such innovation comes from continuous organizational learning and innovative orchestrating of the repository of skills. The market is considered to be the major mechanism determining the value of new products and the need for corresponding organizational routines. Ultimately, the dominant products and routines are reinforced while inferior alternatives are expelled from the economic system (Nelson and Winter, 1982).

Proponents of the evolutionary perspective suggest that competitive advantage has a limited life, and concur that both market norms and resource deployment influence the level of performance among players (Levinthal, 1995; McGrath, MacMillan, and Venkataraman, 1995). From this point of view, firms are adaptive systems striking a balance between the refinement of existing processes and the exploitation of new technologies and new markets. Evolutionary modification is the cornerstone of business strategy (Levinthal, 1995). Because past experience contributes to present and future efforts, short-term learning impacts long-term competence-building and exploitation. Given the uncertainty and unpredictability of the market, strategic competence is demonstrated in the organization's capability of pursuing new advantages through taking initiative. As Foss et al. (1995) state, the evolutionary perspective has proved quite useful in explaining the strategic implications of continuous technological innovation.

The evolutionary perspective contributes to the study of ES by providing a theoretical foundation for the investigation of the nature of process transformation and organizational learning. The concepts of organizational learning, operational routines, and organizational change describe a logical path or process of ES deployment and utilization. Based on this perspective, organizational learning and knowledge are capability-induced mechanisms contributing to outstanding ES deployment. As such, the evolutionary theory enhances the understanding of three aspects of ES deployment and exploitation. First, ES implementation involves change in the technology platform that is often accompanied by change in organizational structure or operational routines (Davenport, 1998). Second, the institutionalization of ES is a complex procedure in which organizational learning and change are essential (Lee and Lee, 2000; Robey, Ross, and Boudreau, 2002). Third, ES outcome is a function of organizational capability and system utilization in capturing and creating opportunities. As such, organizational capability and routines are at the center of successful ES deployment and exploitation.

2.3.3. Dynamic Capabilities

The dynamic capabilities perspective, a theoretical extension of the RBV, combines ideas from resource-based theory and evolutionary economics theory to explore the source of competitive advantage in rapidly changing environments (Teece, Pisano, and Shuen, 1997; Barney 2001; Barney, Wright, and Ketchen, 2001). Eisenhardt and Martin (2000) define dynamic capabilities as the firm's

managerial and organizational processes for integrating, reconfiguring, and gaining and releasing resources to match or create market change. Such capabilities are identifiable and specific from the outset. For instance, the process of knowledge accumulation, learning, and transfer in research (Pisano, 1994) is a kind of dynamic integration capability. The knowledge creation process through which the organization develops cutting-edge knowledge and perspective is another capability of gaining new resources (Henderson and Cockburn, 1994). Indeed, the concept of dynamic capabilities highlights the importance of responsiveness – of orchestrating and integrating resources, competences, and processes towards effective dynamic fit with the changing competitive environment (Teece, Pisano, and Shuen, 1997; Eisenhardt and Martin, 2000).

Dynamic capabilities are endogenous and context-dependent capabilities that develop from the firm's assets (i.e., technological, financial, reputational, etc.), evolutionary path (i.e., internal learning), and managerial routines (Teece, Pisano, and Shuen, 1997; Zello and Winter, 2002). They are dynamic because they involve renewing skills, resources, and competences, which may eventually be deployed to either create or capture market opportunities. In this sense, the quality of dynamic capabilities varies among organizations and competitive advantage rises when innovative competence leverage and resource exploitation achieve congruence with changing competitive environments (Teece, Pisano, and Shuen, 1997).

Recent literature on dynamic capabilities explores the process of capability development. A longitudinal case study by Montealegre (2002) on an Ecuadorian company presents capability development as a cumulative and expansive process where the evolutionary path and long-term strategic architecture matter. According to Montealegre, leadership, organizational culture, information technology, social network, and strategic architecture are the major driving forces at the heart of dynamic capabilities. Zello et al. (2002) also identify deliberate learning and the knowledge development process as operational mechanisms underlying the evolution of dynamic capabilities.

With an analytical focus on flexibility, responsiveness, and innovation, the dynamic capability concept supplements the RBV in many ways. First, the RBV focuses on the issues of resource appropriateness and sustainability, whereas dynamic capability highlights the values of resource portfolio configuration and integration (Kogut and Kulatilaka, 2001; Makadok, 2001). The dynamic capability approach reflects the conventional premise that complementary interdependence augments the value of specialized resources (Hamel, 1994). In this view, the capabilities of resource management for innovative competence deployment and exploitation overshadow the characteristics of the resources (Lengnick-Hall and Wolff, 1999). Effective strategies, therefore, are conceptualized as the responsive and flexible management processes through which the organization integrates resources, fosters synergy, and exploits new areas of competence application (Barney, 2001).

Second, the characteristics of dynamic capabilities are idiosyncratic in detail yet common in key features (e.g., best practice), a notion that departs markedly from the common RBV regarding the idiosyncratic features of strategic resources and capabilities (Eisenhardt and Martin, 2000). According to the RBV, dynamic capabilities cannot create competitive advantage; rather they offer advantage to the initiator through timely and astute resource configuration and manipulation. In fact, advocates of this theory hold a relatively conservative view as to the value of organizational best practice. However, the identification of dynamic capabilities as organizational processes and routines lays out the operational foundation through which key issues can be empirically identified and measured.

Finally, in contrast to the RBV requirement of a constant fit between firm-specific resources and external opportunity, dynamic capabilities posits that the perpetually changing environment will frequently alter the strategic value of core resources and their life span (Eisenhardt and Martin, 2000; Teece, Pisano, and Shuen, 1997). In essence, this perspective recognizes the “stickiness” of organizational resources and competences, while emphasizing the pluralism of their configuration (Teece, Pisano, and Shuen, 1997). As such, traditional notions of sustained competitive advantage do not carry much weight in a strategic analysis (Eisenhardt and Martin, 2000). Instead, organizational flexibility and responsiveness are the essential starting points for creative, unconventional competence renewal and leverage. In this sense, dynamic capability is a broad

concept that incorporates perspectives of both evolution and revolution in strategic analysis.

The dynamic capabilities perspective therefore has two major implications for IT capabilities research. First, it repositions IT capabilities as competitive necessities. Rather than being the source of competitive advantage, IT capabilities are stepping-stones to the achievement of innovative IT deployment and strategic support (Tippins and Sohi, 2003). Second, the conceptual integration of RBV and evolutionary economics theory provides an overarching framework within which the competitive advantage can be achieved from flexible competence leverage, organizational learning, and business transformation (Porter and Millar, 1985; Clemons and Row, 1991; Venkatraman, 1994; Lee and Lee, 2000; Zello and Winter, 2002). Based on this concept, the implementation of ES clearly creates value since the system integrates business process, supports strategic decision-making, facilitates process knowledge transfer, and provides a common platform for electronic information exchange. However, the logic of dynamic capability implies that deployment and exploitation of ES is a socially complex issue where organizational vision, management process, and organizational context matter. As organizational routines and processes manifest dynamic capabilities, this theory provides theoretical basis for carrying out empirical research.

2.3.4. Summary

The theoretical analysis has identified the following assumptions. First, resources, capabilities, and competences are fundamental to the competitive advantage of the firm. Second, firms differ in resource development, deployment, and exploitation. Third, the method of resource combination makes a difference to the firm's competitiveness. Fourth, diversified expansion is a function of the firm's resource base.

Despite the common assumptions noted above, the dynamic perspective highlights two prominent abilities: the ability to learn and the ability to change (Barney, Wright, and Ketchen, 2001; Zello and Winter 2002). Organizational learning is a capability-developing mechanism through which the firm accumulates valuable knowledge from previous experience (King and Tucci, 2002; Zello and Winter, 2002). While learning and knowledge accumulation are associated with capability building, changes in competence deployment and resource exploitation are associated with strategic flexibility and organizational performance. Indeed, dynamic capability looks beyond the properties of resources and asserts that firms cannot garner economic rents merely by owning resources. They must be able to deploy, exploit, and explore these resources flexibly enough to seize business value in a dynamic environment.

While capabilities are commonly perceived as intangible and difficult to recognize at the outset, Eisendhardt et al. (2000) claim that dynamic capabilities

are sets of identifiable routines and processes by which a firm develops products or accumulates technology assets. This observation offers an operational foundation for identifying and eliciting the impact of management issues and factors (such as structure, knowledge, and resource comprehensiveness) (Henderson and Cockburn, 1994; McGrath, MacMillan, and Venkataraman, 1995) in ES research.

As the concept of dynamic capabilities refers to the firm's processes of manipulating, configuring, and integrating resources, it sheds light on strategic ES research to the extent that management competence and skills determine the pathway of ES deployment and exploitation. The following section discusses the logical link between ES deployment and exploitation and dynamic capabilities. Chapter 3 will further apply the concept of dynamic capabilities to the development of research models and measurement constructs for strategic ES analysis.

2.4. ES and Dynamic Capability

The dynamic capabilities theory enhances the understanding of ES by offering a substantial explanation of the strategic implications of organizational processes and routines in ES deployment. According to Eisenhardt and Martin (2000), organizational best practice is the generic representation of dynamic capabilities. While strategically important, best practice can hardly be a source of competitive advantage because of its commonality and equi-finality (Grant, 1996; Eisenhardt and Martin, 2000). The strategic value of dynamic capability resides in its

deployment and utilization to coordinate, integrate, configure, and transform organizational resources to leverage business strategies. In this sense, although the movement to integrated ES is important to compete in network business environments, the implementation of ES is not sufficient to create competitive advantage.

As a class of commercial standard applications, the key aspect of ES deployment and utilization includes the institutionalization of the exogenous best practice and the acquisition of technological knowledge from a service provider (Dosi, Nelson, and Winter, 2000; Dibbern, Brehm, and Heinzl, 2002). Such an externally imposed operational process often stirs up turbulence within existing practice and organizational norms, making ES deployment and utilization a socially complex issue. Researchers investigating the impact of ES frequently examine the strategic implication of ES from both technological and process aspects. Specific ES capabilities such as integrated IT infrastructure, business process reengineering, and knowledge transfer, they suggest, have causal links to business value (Lee and Lee, 2000; Weill and Broadbent, 2000; Davenport, 2000a; Dibbern, Brehm, and Heinzl, 2002). What is not clear is how firms develop and orchestrate these enterprise systems capabilities. Researchers proposing the dynamic capability perspective suggest exploring the organizational routines and practices that are essential for resources integration, configuration, and transformation (Teece, Pisano, and Shuen, 1997; Eisenhardt and Martin, 2000). With this in mind, the following chapter explores the capability dimensions of ES deployment.

CHAPTER 3. ES CAPABILITIES

ES deployment and utilization is a complex issue: its impact relies on the conversion of ES investment into IT infrastructure and the way the system is utilized to streamline the business process (Soh and Markus, 1995). In spite of the current understanding of the key issues in each stage of ES implementation, however, ES capabilities and their impact on organizational outcomes are a matter of conjecture. So far, our understanding of ES capabilities remains fragmented and limited. We often perceive ES from the perspectives of IT infrastructure, BPR, and knowledge transfer (Davenport, 1998; Lee and Lee, 2000; Sprott, 2000; Davenport, 2000a; Dibbern, Brehm, and Heinzl, 2002). In essence, these analyses tend to center on ES as a communication platform and operational tool. Since the impact of these factors may vary with such firm-specific capabilities as ES know-how, strategic ES deployment, organizational culture, and management process, a measurement construct for assessing the multiple aspects of ES capabilities is needed, but has yet to be developed (Santhanam and Hartono, 2003).

In order to provide a better understanding of ES capabilities and to create an operational measurement construct for capability assessment, this study examines the strategic impact of ES from the perspective of dynamic capabilities by exploring the managerial and organizational processes that may promote or inhibit the extent of ES impact on organizations. The research addresses the following questions:

1. What capabilities underlie the success of ES deployment?

2. What role do higher-order IS management capabilities play in orchestrating the application of ES capabilities?
3. In what ways do enterprise systems capabilities contribute to distinct ES outcomes?

The following section employed a qualitative analysis of secondary data to develop in-depth understanding of the research problems and to identify and verify the critical issues associated with the research constructs.

3.1. Analysis of Secondary Case Study Data

Case study is a context-rich and empirically valid approach in organizational research (Yin, 1994; Larsson, 1993). This method collects phenomenological data from on-site observation, internal document assessment, and in-depth personal interviews. By means of extensive access to organizational information, the case study seeks to describe and explore the context of the research object. Orlikowski (1993) suggests that such an interpretive and explorative approach provides an effective instrument for theory building and testing. Gable (1994) also highlights the contribution made by observational information to the identification of problems and issues in an area where important issues are relatively unexplored.

In order to develop background knowledge and a measurement construct to gauge organizational capabilities promoting effective ES deployment and utilization, the initial stage of the research design focuses on case analyses of published case

studies and descriptive research findings. In substance, the published ES cases represent a rich source of qualitative information about ES acquisition, deployment, and application that had not previously been available for research into information systems. These case studies present a detailed picture of the transition to ES. They include information on the business environment, organizational background, strategic intention, methods of project management, and contingency issues in system delivery. As such, the secondary data offer a viable mechanism to identify and verify the dimensions of ES capabilities and their implications.

It is important to note, however, that despite the effort to choose cases from a broad range of sources, two unavoidable issues may limit the potential generalizability of the results. First, because of the dependence on secondary data, the validity of the descriptive information may be subject to the knowledge and skill of the primary researcher. Second, subject to diverse research purposes and research perspectives, the secondary data may present a partial view of ES deployment and utility. In other words, some issues will tend to be emphasized over others. However, these limitations should not affect the findings concerning ES capabilities: the valuable information obtained about the process of ES implementation and deployment will more than compensate. Ultimately, regardless of the acknowledged limitations, the rich data source and broad scope of empirical coverage should overcome the data bias caused by the diverse themes

and provide reliable insights into how and where firms capture benefits from ES. The following sections discuss the data sample and research strategy.

3.1.1. Sample

To ensure the legitimacy and rigor of secondary data, the descriptive data were selected from a variety of sources, including peer reviewed journals, books, electronic journals, and electronic web resources. Three criteria were used for sample selection: (1) the case study had to be detailed enough to record the ES implementation journey and reflect the problems encountered from the users' point of view; (2) the case analysis had to cover the ES post-implementation stage and reflect the value of ES as identified by the user; and (3) the case publisher had to be well-known in the IS community to ensure the reliability and accuracy of the data source.

Following Eisenhardt's (1989) discussion of theoretical sampling, the sample cases represent the diversity of ES experiences (e.g. success vs. failure) and approaches to system implementation (e.g., phased vs. big-bang). By incorporating all the relevant evidence from the point of view of both practitioners and academics, the database reflects the experiences of a large number of companies. This case database should provide a research opportunity to capitalize on the various empirical investigations (Larsson, 1993) and therefore enhance the current understanding of the implications of ES.

The empirical cases, comprising fifteen descriptive case studies of North American firms or divisions, a Scandinavian firm, a Chinese firm, and a Middle Eastern firm, were collected from the *Journal of Information Technology*, *Communications of the Association for Information Systems*, *Information Systems Frontiers*, *Harvard Business Cases*, *Annals of cases in IS*, *CIO Magazine*, and *IT textbooks*. These cases share the common features of having used commercial ES packages (13 SAP R/3; 3 Oracle; 1 J.D. Edwards, and 1 other), took place in a similar period of time (1993-2000), and included system rollout, enabling cross-referencing on the basis of the similar ES functionalities and technological competences. Table 3.1 summarizes the subject and source of the selected case studies.

Table 3.1: Selected ES cases and their sources

Source: Journal of Information Technology		
Case Title	Case Background	Author
Adopting SAP at Siemens Power Corporation	The decision-making process and the organizational factors in Siemens Power Corporation's adoption and implementation of SAP's R/3 application suites.	Hirt and Swanson (1999)
Dow Corning Corporation: Business process and information technology	Dow Corning's experience in adopting SAP from the business process reengineering perspective.	Ross (1999)
SAP Implementation at Metalica: An Organizational Drama in Two Acts	Reconstruction of the social reality of Metalica during the first two years of SAP implementation.	Avital and Vandenbosch (2000)
International Multifoods	An overview of the organizational context, the plan of ES development, and the difficulties that arose during system implementation and rollout.	DeSanctis and Price (2001)
Source: Harvard Business School Case		
Case Title	Case Background	Author
Cisco Systems	The critical factors of ES implementation and	Cotteleer, Austin, and

Architecture: ERP and Web-enabled IT	the consequent impact on organizational process and functional interactions.	Nolan (1999); Nolan (2001)
Moore Medical Corporation	The decision-making process of extended ES system investment for organizational capability improvement.	McAfee (2001)
IBM Technology Group	The process of SAP R/3 implementation, with particular attention given to the issues and expected benefits of integrating business processes across business partners and issues of ES capability expansions.	McAfee and Herman (2000)
Digital China Holdings Limited: ERP as a Platform for Building New Capabilities	Management decisions and approaches in "big-bang" ES implementation and the impact after transition to ES.	McFarlan, Chen, and Peimers (2002)
Tektronix, Inc.: Global ERP Implementation	The process changes, issues, and hurdles encountered by a high-tech company during global ES implementation.	Westerman and Cotteleer (1999)
Source: Communications of the Association for Information Systems		
Case Title	Case Background	Author
Beginning SAP R/3 Implementation at Geneva Pharmaceuticals	The processes, strategies, and critical factors in Geneva's journey through ES implementation.	Bhattacharjee (2000)
NIBCO's "Big Bang"	The process of big-bang approach includes technology and organizational risks and how the leadership team deals with these issues over the life of the project.	Brown and Vessey (2001)
Source: CIO Magazine		
Case Title	Case Background	Author
Quantum's Leap	Quantum's experience of a 'big bang' approach to global ES rollout.	Radosevich (1997)
Nestle's ERP Odyssey	Nestle's ES implementation journey and important turning points as a failing project becomes successful.	Worthen (2002)
Source: Information Systems Frontiers		
Case Title	Case Background	Author
Managerial Competences for ERP Journeys	A five-year longitudinal study whose purpose was to identify the changes in managerial competences at different stages of ES implementation at a Danish production company.	Krammergaard and Rose (2002)
Implementing Enterprise Resource Planning Systems: The Role of Learning from Failure	Compares and contrasts two ES implementation cases--Fox Meyer and Dow Corning--to investigate the factors associated with successful ES implementation.	Scott and Vessey (2000a)
Source: Electronic Source (IS World)		
Case Title	Case Background	Author
Implementing SAP R/3 At the	The processes of system selection and implementation at the University of Nebraska.	Sieber, Siau, Nah, and Sieber (1999)

University of Nebraska (U of N)		
Source: Book: Managing Information Technology: What Managers Need to Know		
Case Title	Case Background	Author
Advantage 2000 at Owens Corning	The process of global system implementation at Owens Corning.	Brown (1999)
Source: Annals of Cases in IS		
Case Title	Case Background	Author
Big-Bang ERP Implementation at a Global Company (DSW)	The ES implementation process at an Israel-based international chemical company.	Pliskin and Zarotski (2000)

3.1.2. Case Analysis

Following the recommendations of Larsson (1993), Lacity and Janson (1994), and Klein and Myers (1999), this research applies both within-case and cross-case analysis to discover the critical issues contained in case reports. This research strategy is legitimate to the extent that the multiple cases and the cross-reference method comply with the logic of replication (Yin, 1994). In other words, the author treats each case as an independent experiment to elicit the major issues, to verify the key capabilities, and to reflect on the unexplored issues for further refinement. The method of using secondary case samples for issue identification was employed by Amit and Zott (2001) and Shang and Seddon (2002). Such an approach is especially useful in exploring issues or research topics when the analytical theory is still emerging. For example, Lee (1994) interpreted Markus's qualitative data to examine and verify the communication impact of e-mail (Lee, 1994). Despite using the secondary research data, the research finding enhances the understanding of how e-mail influences cross-functional communication in business operation. Using the same research strategy, Scott and Vessey (2000,

2002) also developed theoretical insight into risk management and organizational learning by comparing and contrasting the secondary data on Dow Corning's and FoxMeyer's ES implementation journeys. Indeed, the case study has proven to be an effective research strategy to gain empirical insight into research phenomena in a real-life context.

In order to capture the critical issues from multiple cases, the author performs both within-case and cross-case analysis (Eisenhardt, 1989; Yin, 1994). Based on Markus and Tanis's (2000) experience cycle of ES, the key issues and problems of each firm's ES implementation are summarized. Appendix 1 records the major activities of each firm's ES implementation. A set of preliminary capability indicators, developed by Grant and Hlupic (working document) through empirical qualitative research and IT literature, are used to guide the exploration of ES capabilities. The case analysis is an iterative process, moving back and forth between the case and the extant literature to detect and verify the salient issues that may unfold in the process of capabilities development (Lacity and Janson, 1994; Klein and Myers, 1999).

3.2. Core ES Capabilities

The value of ES lies in the system-enabled managerial, operational, and strategic support that it offers (Shang and Seddon 2002). The resource-based view of the firm suggests that the value of IT lies in the development of effective IT resource and capabilities (Feeny and Willcocks, 1998; Jarvenpaa and Leidner, 1998;

Bhattacharjee, 2000). Following this view, we believe that the ES capabilities are the key to answer how and why ES deliver values. Four dimensions of ES capability, namely, IT infrastructure capability, BPR capability, knowledge management capability, and IS management capability are derived from an extensive literature review (Lee and Lee, 2000; Markus and Tanis, 2000; Weill and Broadbent, 2000; Sprott, 2000; Davenport, 2000a; Dibbern, Brehm, and Heinzl, 2002). Table 3.2 summarizes the dimensions of ES capabilities, the corresponding indicators, and the assessment criteria used in cross-case referencing.

Table 3.2: Capabilities of the ES implementation

Capability dimension	Information Captured	Examples
BPR capability	<ul style="list-style-type: none"> Business process 	<ul style="list-style-type: none"> Identify the scope of BPR Identify process owner and responsibility
Knowledge management capability	<ul style="list-style-type: none"> Information and knowledge 	<ul style="list-style-type: none"> Well structured ES specific information and knowledge repository Develop documents in terms of business process and ES systems
IT infrastructure capability	<ul style="list-style-type: none"> IT human resource 	<ul style="list-style-type: none"> ES and process competence of IT professionals Interpersonal skills to train and support users
	<ul style="list-style-type: none"> IT infrastructure 	<ul style="list-style-type: none"> The IT abilities in terms of connectivity, communication, information access, and data sharing
IS management capability (a) Strategic alignment	<ul style="list-style-type: none"> ES strategy 	<ul style="list-style-type: none"> Clearly articulated ES vision and role in organization Executive management involvement in ES project
	<ul style="list-style-type: none"> ES performance and risk management 	<ul style="list-style-type: none"> Apply project management skills for ES delivery and performance control Early success to keep up project momentum
	<ul style="list-style-type: none"> Strategic Alignment 	<ul style="list-style-type: none"> ES configuration reflects the business requirement Business champions sufficient resources for ES project

	<ul style="list-style-type: none"> IT organization 	<ul style="list-style-type: none"> The structure of IT organization reflects both IT and business strategies The strategy of IT outsourcing and IT knowledge retention
(b) Organizational transformation	<ul style="list-style-type: none"> Organizational change management 	<ul style="list-style-type: none"> Top management champions ES project Modify HR policy and incentive system to reflect the importance of ES
	<ul style="list-style-type: none"> Organizational culture 	<ul style="list-style-type: none"> Organizational rules and process of adopting new technology
(c) Organizational learning and ES competence	<ul style="list-style-type: none"> Organizational learning 	<ul style="list-style-type: none"> Strategies, plans, or activities to capture ES knowledge Partnership with ES consultants and vendors for knowledge transfer Acquiring and diffusing ES knowledge
	<ul style="list-style-type: none"> ES competence 	<ul style="list-style-type: none"> ES performance tuning ES assessment, procurement, integration, and deployment

On the basis of a synthesis of prior research in IT and ES, we propose that the success of ES implementation encompasses the management of the IT infrastructure, business process, and organizational IT knowledge. Despite the identification of the major strategic dimensions of ES deployment and utilization, the concept of dynamic capabilities suggests that it is not just the existence of these factors that delivers value from ES; rather, it is how they are leveraged, integrated, and coordinated that determines the overall effectiveness of the firm's outcome throughout ES acquisition, implementation, and utilization (Clemons and Row, 1991; Mata, Fuerst, and Barney, 1995; Teece, Pisano, and Shuen, 1997; Feeny and Willcocks, 1998; Bharadwaj, 2000; Eisenhardt and Martin, 2000). Thus, the dynamic capability theory uncovers the importance of management issues in strategic ES implementation. Such a perspective provides an operational mechanism to explore the sphere of social activities underlying ES deployment and exploitation. We consolidate these social practices as IS management

capabilities, which are major integration mechanisms by which the homogeneous ES application delivers business outcome. Based on these arguments, a tentative research model is proposed in figure 3.1.

Figure 3.1: A framework for the analysis of dynamic ES capabilities

The proposed research model depicts the IS management capabilities as integrated and coherent such that each dimension of ES capabilities plays a part in ES outcome. Such a conceptual illustration reflects the essence of resources integration and coordination toward distinctive value creation. It also highlights the moderating role of IS management capabilities on the deployment and

exploitation of ES capabilities. In the current research, we test the main effect of three dimensions of ES capabilities on ES outcome and the interaction effect of IS management capabilities on IT infrastructure capability, BPR capability, knowledge management. In identifying all the relationships, we provide a theoretical foundation for future study. The following section reviews the extant literature and proposes hypotheses that link to each ES capability.

3.2.1. IT Infrastructure Capabilities

The fundamental implication of ES, as an operational backbone, rests with the IT infrastructure. The defining characteristic of the IT infrastructure is the enabling base of shared IT capabilities that provides a reliable foundation for evolving business information systems and services (Ross, Beath, and Goodhue, 1996; Weill and Broadbent, 2000). IT infrastructure differs from applications to the extent that it is designed to cope with long-term organizational information and technological requirements (Weill and Broadbent, 2000). From a review of the literature, this research identifies five key issues associated with IT infrastructure capabilities. These are architecture design, physical infrastructure, operational support, long-term IT investment, and IT sourcing strategies.

The defining characteristic of IT architecture is a set of policies and rules governing long-term organizational IT deployment and exploitation (Allen and Boynton, 1991; Ross, Beath, and Goodhue, 1996). By sketching a roadmap of organizational IT deployment, IT architecture defines the role of IT in business

operations. IT architecture also plays an important role in IT value delivery because it articulates the scope and rules of information integrating and sharing (Ross, 2003). While IT architecture elaborates the organizational vision of IT deployment, IS capability largely depends on the quality of the organizational hardware, software, and communication networks. This physical IT infrastructure constructs the technological platform influencing the flexibility and effectiveness of IS utilization. These are the major mechanisms by which firms can capture the operational, managerial, and strategic benefits of IS. Organizations that are capable of developing a flexible IT infrastructure are expected to capitalize on their IT investment to deal with changing business requirements.

While IT architecture and IT infrastructure determine the flexibility of IT deployment, the IT infrastructure capability also largely depends on the organizational strategies for IT investment and IT sourcing. Decisions about IT investment and IT sourcing are a primary mechanism governing the evolutionary path of the IT infrastructure. By determining the IT resource acquirement, the decision regarding IT investment and the practice of IT sourcing also shapes the adoption path for continuously evolving IT technologies and the network business environment. As a consequence, long-term IT investment and sourcing decisions influence organizational flexibility in dealing with changing business challenges and opportunities.

IT researchers have singled out IT infrastructure as one of the major resources contributing to outstanding firm performance (Duncan, 1995; Ross, Beath, and Goodhue, 1996; Broadbent and Weill, 1997; Broadbent, Weill, and Clair, 1999; Bharadwaj, 2000). Evidence from the case analysis points out that ES initiation is often driven by the demand for long-term organizational growth or the replacement of outdated legacy infrastructure. This is consistent with the assertion of the strategic implication of IT infrastructure. As ES design is based on advanced client-server architecture, an open-system platform, an integrated database, and module-based system architecture, the implementation of ES often provide companies with the renewal of IT infrastructure in hardware, software, and IT human skills to facilitate the effective rollout of ES and to maximize the benefit enabled by ES. Indeed, ES manifested as IT infrastructure to the extent that the system comprises an application platform integrating the functional applications that deliver enterprise information services. The deployment and utilization of ES thus determines the reach and range of integrated information services as well as strategic flexibility for long-term technological exploitation and functional expansion.

Indeed, the capability of IT infrastructure, which cumulatively determines a firm's flexibility in adding, modifying, and removing application systems, constructs an electronic platform that yields the benefit of long-term ES services in terms of time, cost, and feasibility of IT resource deployment and exploitation. For example, in the Digital China case, ES implementation is recognized as the initial

step in the firm's construction of an electronic platform to compete in the network economy (McFarlan, Chen, and Peimers, 2002). As such, IT infrastructure capability is essential because it influences the organizational flexibility to capture the ES-enabled process change and organizational transformation.

Following Weill and Broadbent (2000), the scope of IT infrastructure can be broadened. In addition to the technical aspects of ES, we recognize IT human resources as a major coherent force necessary for tailoring the generic ES functionalities to fit unique functional requirements and information services. As noted by Ross et al. (1996) and Bharadwaj (2000), the capability of IT human resources is multidimensional, involving technological competences and management skills. Technologically, the ES competence of IT staff provides expertise and technical support to effectively integrate ES to support specific business needs. For example, NIBCO (Brown and Vessey, 2001) put together a full-time IT team to implement and tailor the ES to ensure a functional fit. Managerially, the inter-personal and communication skills of IT staff are equally essential in facilitating system buy-in. For example, the make-up of Tektronix's core team included both strong business and IT leadership (Westerman and Cotteleer, 1999). In fact, the capability of IT human resources serves as a key infrastructure component that leverages ES deployment in support of organizational strategic needs. The preceding theoretical analysis suggests a link between IT infrastructure and ES outcome. This leads to the following hypothesis:

H1: The level of IT infrastructure capability is positively associated with ES outcome.

3.2.2. Business Process Reengineering Capability

Hammer and Champy (1993, p. 32) define BPR as “the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed” (Hammer and Champy, 1993). “Business processes” refers to the organizational structure and specific ordering of work. Its objective is to coordinate resources to deliver customer value. Reengineering is about creating process structure and eliminating steps that do not create value from the customer’s perspective. It is a powerful approach to achieving radical improvement. Indeed, BPR originated as a revolutionary program focusing on organizational change to make business processes more effective, efficient, and flexible (Grover, Jeong, Kettinger, and Teng, 1995; Stoddard and Jarvenpaa, 1995).

Proponents of BPR have convincingly highlighted the important role of IT infrastructure in cross-functional communication, coordination, and integration (Venkatraman, 1994; Rockart, Earl, and Ross, 1996; Broadbent, Weill, and Clair, 1999). As an infrastructure-related tool, ES is a fundamental enabler that reshapes business processes by designing and facilitating the flow of information across organizational entities and ensuring their consistency and availability (Davenport,

2000a). ES-based IT infrastructure entails a high level of IT and business process integration, a crucial function needed to achieve business process optimization and strategic resource leverage (Venkatraman, 1991).

The case data analysis suggests that implementation of ES involves many essential issues of business process design. As ES is a standard, transaction-based application, its implementation imposes industry best practices that often require extensive process change. As suggested by previous research, the alignment of IT and business processes is strategically essential if organizations are to capitalize on and maximize IT investment (Venkatraman, 1994; Broadbent, Weill, and Clair, 1999). Davenport (1998, 2000a) also highlights the critical impact of BPR on the success of ES deployment and utilization. In fact, 60% of the cases (including Quantum, Digital China, Nestle, International Multifood, Metalica, Tektronix, Geneva Pharmaceutical, University of Nebraska, Dow Corning, and Dead Sea Works) report business process reengineering as the major driving force for ES implementation.

It is important to note, however, that the institutionalization of ES-entailed best practice is a socially complex process that requires extensive organizational change and the involvement of functional professionals (Dibbern, Brehm, and Heinzl, 2002; Hall, 2002). Such a view is consistent with the empirical findings in the change and organizational culture literature where the implementation of ES often incorporates major changes in the way work is done, emphasizing changes to data format, methods of information processing, and management and

operational systems (Soh, Kien, and Tay-Yap, 2000; Robey, Ross, and Boudreau, 2002). In other words, the success of institutionalizing best practice relies critically on the firm's capability in process and job design and requires management skills in cross-functional coordination and integration. Ultimately, strategic vision is also essential for leveraging business processes with IT and business strategies. Firms that are capable of developing process thinking and are proficient in implementing appropriate change strategies are expected to deploy ES relatively effectively and efficiently. As such, the empirical finding suggests that BPR is an important variable in ES deployment and utilization. The success of BPR should account for a major share of ES value. This argument leads to the following hypothesis:

H2: The level of BPR capability is positively associated with ES outcome.

3.2.3. Knowledge Management Capability

Knowledge management capability is the third form of ES capability. It is derived through organizational learning and user training and presented by codified information and knowledge repositories. Knowledge management and transfer are essential for institutionalizing ES and ES-induced business process redesign. Two distinguishing characteristics of knowledge management capability are: (1) knowledge codification and accumulation; and (2) knowledge application, which focuses on integrating, combining, and innovatively applying existing knowledge towards increasing an entity's capacity for effective action (Zander and Kogut, 1995). Empirical research conducted by Lee and Lee (2000) showed that ES-

enabled knowledge transfer and management is, in fact, an important domain wherein ES delivers business value.

The systematic recording and cataloging of best business practices in the form of reference models is a major feature of ES. According to the secondary case data analysis, the business reference model effectively transforms the tacit knowledge of industry best practice into a comprehensive pragmatic code, providing a knowledge repository that heightens employees' engagement in operational process learning (Buck-Emden, 2000; Lee and Lee, 2000; Ross and Vitale, 2000). For example, the project manager of Quantum utilized a business reference model to depict the business process and system integration path (Radosevich, 1997). Such a practice enables the project team to visualize the problems of ES implementation and enhance problem-solving ability.

As the level of process exposure increases, the institutional mode of process knowledge is advanced, setting the stage for innovative knowledge refinement (Alavi and Leidner, 2001; Zello and Winter, 2002). Indeed, even though the standard business rules provide static process information only, the integration of the business model into the adaptive processes essentially captures the dynamic ability to disseminate, communicate, and reconfigure knowledge resources to develop new business processes (Alavi, Wheeler, and Valacich, 1995; Zello and Winter, 2002). For example, the University of Nebraska case study conducted by Lee and Lee (2000) demonstrated that an ES-enabled comprehensive business

documentation and communication platform greatly reduced the cost of knowledge transfer, and consequently enhanced the process redesign.

Second, as an integrated IT infrastructure, ES enables the building of a knowledge infrastructure, a knowledge-based network that facilitates cross-functional collaboration and interaction (Alavi, Wheeler, and Valacich, 1995; Thomas, Kellogg, and Erickson, 2001). By integrating with advanced application software such as decision support systems, ES provides an enterprise portal that enables organizations to control, manipulate, and convert unstructured operational information into useful and accessible knowledge. This in turn can accelerate the level of knowledge creation and exposure as communication processes and information flows drive knowledge transfer in and among organizations, beyond geographic limitations. By providing capabilities such as extended communication networks, ES implementation increases cross-functional interaction and encourages joint problem-solving and cross-learning. For example, by integrating transaction information with an electronic network, Cisco effectively used ES to serve as a technological platform for internal and external collaboration and communication (Nolan, 2001). Such information support not only enables users to assign meaning to and capture knowledge from daily routines, but also enhances their intellectual capacity for competence development and deployment.

Despite the strong support for knowledge management that constitutes a major part of strategic ES deployment, the ES-enabled knowledge creation and

dissemination feature is not easily captured since it depends on organizational practice surrounding information access, managerial practice in knowledge management, and organizational foresight in creatively deploying ES to create information for both operational and strategic purposes. In most of the cases reviewed, knowledge management is not a stand alone issue but involves the leverage of knowledge between functional owners and ES service providers. The observation that knowledge management plays a large part in ES utilization leads to the following hypothesis:

H3: The level of knowledge management capability is positively associated with ES outcome.

3.2.4. Summary

Table 3.3 depicts the results of the in-depth case-based analysis of the strategic dimension of ES. Three of the sample firms are represented by an analysis of their IT infrastructure, BPR, and knowledge management. Based on the theoretical analysis, these are three fundamental capabilities delivered by ES implementation. The supporting evidence is summarized to show the capabilities of IT infrastructure, BPR, and knowledge management of each firm.

Table 3.3: Strategic dimensions of ES of selected ES-adopting firms

IT Infrastructure Capability		
Cisco Inc.	NIBCO	Digital China
<ul style="list-style-type: none"> IT platform architecture is standardized throughout Cisco ES provides low-cost/high-value technology architecture All business functions 	<ul style="list-style-type: none"> Restructured customer master data Replaced mainframe systems with client/server architecture and re-skilled IT workers 	<ul style="list-style-type: none"> ES provides a standard platform for integrating with web technology and transaction systems Enhanced data integration across

utilize single application packages worldwide. All functions and processes are standard. <ul style="list-style-type: none"> The open system-based IT architecture provides a high level of flexibility to incorporate new technology such as Internet and Intranet. 		functional modules <ul style="list-style-type: none"> ES constitutes an electronic platform to support electronic network
BPR Capability		
Cisco Inc.	NIBCO	Digital China
<ul style="list-style-type: none"> Standard business process worldwide ES enabled Cisco to leverage the web to revolutionize existing process and create new, end-to-end capabilities. Cisco was able to use ES and Intranet to facilitate collaboration and communication. Network-based partner and supplier interaction 	<ul style="list-style-type: none"> Identified process improvement to fit SAP R/3 NIBCO conducted business process reengineering before the implementation of ES ES implementation was perceived as a process change 	<ul style="list-style-type: none"> Inventory and sales data are available in real time Improved operational process Attracted new customers by offering online information, ordering, and business services Create independent supply chain management platform
Knowledge Management Capability		
Cisco Inc.	NIBCO	Digital China
<ul style="list-style-type: none"> With online connection, the users can directly contribute information required to do business with Cisco or enrich Cisco's intellectual asset base. Cisco's employees interact on Intranet to address business issues and customer needs. The centralized database provides information needed to streamline processes, facilitate knowledge exchange and maximize employee productivity. Web-based network adds a channel for training 	<ul style="list-style-type: none"> Documented "as is" process as "to be" processes Documentation of input, output, triggers, business activity roles, change categories, training requirement Developed training materials Developed and documented specific knowledge of business process The project team acquired knowledge of business process and capability of reframing the old process into high-level generic processes Developed process documentation to facilitate organizational change 	<ul style="list-style-type: none"> Weekly user training by experienced users.

Despite the identification of these three fundamental dimensions of ES implementation, it is the concept of dynamic capabilities that highlights the importance of organizational routines in integrating, reconfiguring, and transforming these capabilities to fit the changing environment. Following Eisenhardt and Martin's (2000) suggestion, we further explore the IS management capability that facilitates the integration and coordination of other ES capabilities.

3.3. IS Management Capabilities

As Willcocks and Sykes (2000) suggest, improving how business is done is not just about integrating and creating more efficient transactional processes; rather, it is a socially complex issue that depends also on management practice and skills. Following this argument, this research posits that IS management capabilities are a higher-ordered capability constituting a dynamic process that transforms ES capabilities into outstanding organizational outcomes. Indeed, such advanced dynamic capability represents a moderating process through which ES capabilities are coordinated and innovatively employed. This section explains three dimensions of IS management capability: strategic alignment, learning and ES competence building, and organizational transformation (Lee and Lee, 2000; Markus, Axline, Petrie, and Tanis, 2000; Reich and Benbasat, 2000; Soh, Kien, and Tay-Yap, 2000; Willcocks and Sykes, 2000; Sabherwal, Hirschheim, and Goles, 2001; Grant, 2003).

3.3.1. Strategic Alignment

Using the concept of strategic alignment, many researchers have argued that IT deployment and exploitation must be guided by business strategies (Henderson and Venkatraman, 1993; Earl, Sampler, and Short, 1995; Ross, Beath, and Goodhue, 1996; Hirschheim and Sabherwal, 2001; Sabherwal, Hirschheim, and Gales, 2001). Strategic alignment refers to the state in which ES and organizational infrastructure and business visions are synchronized, enabling the exploration of new opportunities (Venkatraman, 1994; Broadbent, Weill, O'Brien, and Neo, 1996; Al-Mashari and Zairi, 2000; Markus, Axline, Petrie, and Tanis, 2000; Reich and Benbasat, 2000). The dominant principle is that the alignment between ES deployment and organizational strategies and infrastructure determines the value of ES and the economic performance of the firm. Under this assumption, ES deployment is not a discrete event, but a dynamic process of continuous adaptation and change. In other words, firms cannot capture business value by simply seeking to adopt the best practice embedded in ES; they must also consider the implications of ES deployment on business strategy, organizational infrastructure, and IT infrastructure.

In the literature on strategic IS management, two emerging streams of thought dominate the current body of alignment research. First, strategic alignment is multi-dimensional in that IS strategy, business strategy, organizational infrastructure, and IT infrastructure all play roles in establishing the value of IT (Henderson and Venkatraman, 1993). In this cross-sectional view, the “strategic

fit” between the internal competence arrangement and the external positioning, and the “functional integration” of business and IT domains, constitute dynamic strategic alignment (Henderson, Venkatraman, and Oldach, 1996). Such analysis is important in determining the strategic value of ES in organizational performance. Indeed, this approach examines ES deployment and utilization from a holistic perspective to the extent that the diverse impacts of strategic leadership and vision, technology architecture, IT governance, ES management and delivery, and change catalyst in value delivery are all highlighted (Grant, 2003).

Second, the pattern of achieving strategic alignment is dynamic and socially complex. For example, the empirical research conducted by Reich and Benbasat (2000) reveals shared domain knowledge, IT success, and management and strategic partnership as major driving forces for achieving short-term strategic alignment. Perceiving strategic alignment as organizational change, Sabherwal, Hirschheim, and Goles (2001) conducted empirical case analyses to demonstrate that the alignment process is a dynamic one involving evolutionary and revolutionary business structure change. In their exploration of the path of alignment, Hirschheim and Sabherwal (2001) suggested that strategic context, IT management, and organizational capability for risk control determine the outcome of alignment. In the discussion of the IT and business relationship, Ross et al. (1996) highlight the importance of building a partnership between IT and business units. By promoting the sharing of responsibility and risk between IT and business units, they argue, organizations should improve the effectiveness of IT

implementation and deployment through accelerated cross-functional communication and enhanced mutual trust and system buy-in.

In sum, because business environments and strategies are constantly changing, alignment is a dynamic concept. The capability of strategic alignment influences the outcome of ES to the extent that it affects the level of fit between ES deployment and business strategy requirements. Consistent with the research suggestions, the case data analysis also demonstrates the importance of strategic alignment. In most cases, organizations achieve strategic alignment by involving functional managers in the project team, articulating a clear business vision, formulating a sound ES delivery plan, and changing IT governance models. For example, the ES team of NIBCO included personnel with technical and business knowledge and skills to ensure strategic fit. As such, strategic alignment influences the level of value captured from ES deployment and utilization (Brown and Vessey, 2001).

3.3.2. Learning and ES Competence Building

That the business reference model represents codified process knowledge is widely recognized (Curran and Keller, 1998; Lee and Lee, 2000). With the ubiquity of ES and acceleration in the efforts to apply BPR, particular attention has been focused on opportunities associated with capturing and transferring ES-embedded best practices within and across organizations (Lee and Lee, 2000). Such a focus on knowledge and process institutionalization is particularly acute in

the context of ES deployment and exploitation, where the effectiveness of ES application and utilization depends greatly on user competence, i.e., the ability to realize the economic value of integrated transactional data and to enact ES-embedded best practice in compliance with business needs (Kapp, Latham, and Ford-Latham, 2001). The view of ES as a repository of process knowledge and a mechanism of knowledge diffusion suggests that best practice cannot be shared and transferred without deliberate learning and competence building (Tippins and Sohi, 2003). As such, both organizational learning and ES competence constitute the process of developing organizational capacity to enact ES-enabled knowledge resources.

Learning underlies the organization's capacity to absorb, integrate, and recombine existing knowledge and prior experience to create new knowledge and capabilities (Cohen and Levinthal, 1990). Learning is a purposive and recurring organizational activity at the very heart of knowledge management and organizational capability (Orlikowski, 2002; Zello and Winter, 2002). Organizational learning requires the presence of social assets such as shared context and technology-enabled ties within and across the firm. These, when applied, contribute to successful ES deployment and exploitation.

In reviewing the literature on knowledge management, we identified a repertoire of learning practices in the context of ES implementation and deployment. The first practice, system training, constitutes a knowledge base of ES functionalities

and best practice. As ES is a class of application software, its implementation often involves issues of consultation service and knowledge transfer (Dibbern, Brehm, and Heinzl, 2002). For example, 90% of the cases scanned reported the practice of seeking consultant assistance for ES implementation. In such cases, the method of developing user familiarity with ES and the new business environment is grounded in organizational learning and contract management (Lee and Lee, 2000; Willcocks and Sykes, 2000). For example, Geneva Pharmaceutical used an ES prototype to test and refine different aspects of a new business process (Bhattacharjee, 2000); and Siemen's Power negotiated a tough contract with their ES consultants to ensure the necessary knowledge transfer (Hirt and Swanson, 1999). The next two learning mechanisms, i.e., cross-functional collaboration and communication and knowledge leverage, constitute knowledge generation and diffusion through mutual trust, social interaction, and commitment (Zander and Kogut, 1995; Rockart, Earl, and Ross, 1996). For ES adopters, these learning mechanisms generate the social alliance needed to leverage and integrate technological and process know-how among IT professionals, ES consultants, and user groups. For example, Cisco connected ES to its Intranet to create a communication platform for electronic learning within and across organizational boundaries (Nolan, 2001).

While organizational learning consolidates and formalizes ES experience and knowledge into organizational memory, ES competence concretizes the knowledge assets as dynamic organizational capabilities, enhancing the level of

organizational ES proficiency and user competence. ES competence refers to how and to what extent specialized ES knowledge is developed and exploited for strategic system deployment. Such system competence underpins the organization's ability to capitalize on ES deployment and ensure effective system leverage. As noted by Ross et al. (1996), IT know-how is one of the key drivers of superior IT performance. Indeed, ES competence represents a higher level of organizational capability to integrate, transfer, and apply ES-enabled technological and business capabilities. As such, it moderates the relationship between the ES and organizational performance.

The case data analysis further reveals the relationship between ES competence and ES outcome. From the perspective of system adoption and implementation, ES often involves issues of system configuration, system customization, and adjunct software adoption to accommodate the company's business process. According to Dibbern, Brehm, and Heinzl (2002), these activities are complex and require understanding and integration of knowledge in terms of IT infrastructure, ES functionalities, standard best practice, and business process. Effective ES configuration thus requires extensive technological and business competences among consultants, IT professionals, and key users (Soh, Kien, and Tay-Yap, 2000). For example, Dow Corning created their ES project team with a mix of both ES consultants and IT professionals to ensure knowledge transfer and ES competence building (Ross, 1999). Indeed, organizational learning and ES

competence are major mechanisms by which organizations can capture a higher level of ES value.

3.3.3. Organizational Transformation

The motivation to seek outstanding business solutions and value has been a major driving force for ES adoption. Yet despite the fact that ES provides users with opportunities to redefine the rules of business practice, the organization's ability to do so may be limited; as such, redefinition depends on both the user's understanding of the properties and functionalities of ES, and the social practice and institutional context shaping the way ES is deployed and utilized. Indeed, IT-enabled organizational transformation is inherently dynamic and often causes a deep paradigm shift at the key levels—job, culture, structure, IT infrastructure, and incentive systems—of the organization (Stoddard and Jarvenpaa, 1995; Markus and Benjamin, 1997; Boudreau and Robey, 1999; Orlikowski, 2000; Willcocks and Sykes, 2000; Hall, 2002; Robey, Ross, and Boudreau, 2002).

Research on IT-enabled organizational transformation has focused on a descriptive analysis of organizational change management and culture change, and on understanding the relationship of those issues to outstanding IT deployment and use (Markus and Benjamin, 1997; Orlikowski and Hofman, 1997; Orlikowski, 2000; Soh, Kien, and Tay-Yap, 2000; Hall, 2002; Robey, Ross, and Boudreau, 2002; Scott and Vessey, 2002b). By analyzing the discrepancy

between the functionalities provided by IT and organizational outcomes, this stream of research focuses on how and why IT performance is heterogeneous across adopting firms. In this view, the acquisition, deployment, and usage of ES is perceived as a social process rather than an aggregation of hardware and software.

Organizational culture and change are two crucial issues in organizational transformation. Organizational culture refers to a firm's social institutions, the governance system that mediates the behavior of individuals by means of formal administrative methods, and often reflects shared value systems and structural elements, including management routines, business processes, and incentive systems (Kambayashi and Scarbrough, 2001). Organizational culture affects ES deployment and usage to the extent that it influences the "fit" between the functionality provided by ES and that required by the adopting firms (Soh, Kien, and Tay-Yap, 2000). For example, in their empirical investigation of ES implementation in a public hospital in Singapore, Soh, Kien et al. (2000) identified three types of misfits. These include data format and relationship, functional access and control, and output format and content. They attribute such functional misfits to the culture differences between Eastern and Western business practices and data management methods.

Change management, on the other hand, refers to the dynamic process of restructuring the organization's management routine and social systems to achieve coherence in the changing business environment (Tsoukas and Chia, 2002). This is a deliberate process using social interaction, organizational programs, and management championing to smooth the transition from the old process to ES-imposed best practice. Research on IT-associated organizational change has perceived change management as a process of conflict resolution. For example, Robey et al. (2002) applied dialectics theory to emphasize the interaction of multiple organizational issues and forces with the process of strategic ES adoption and deployment.

Although the dimensions of ES-enabled transformation cover major aspects of change management, other variations have also appeared. For example, focusing on the interaction between IT deployment and organizational context, Orlikowski and Hofman (1997) suggested that change management should reflect the flexible nature of IT. Orlikowski (2000) further distinguished between technology implementation and technology usage. In her empirical study, she demonstrated that the process of IT deployment and use is improvisational and emergent in that the evolving path of IT usage is paved by the frequent interaction between users and the properties of IT. Such dynamic social interaction is particularly pronounced when the implementation of ES involves unprecedented and uncertain process change that requires ongoing pilot testing and organizational learning. Indeed, the ES-enabled organizational transformation is a crafting

process, and the congruence of best practice and ES outcome depends on the compatibility of social systems and ES properties, a comprehensive understanding of business process and ES functionalities (Soh, Kien, and Tay-Yap, 2000; Davenport, 2000a; Krammergaard and Rose, 2002). Organizational transformation, therefore, represents configuration and integration of the IT infrastructure, business process reengineering, and process knowledge. In other words, the level of organizational transformation moderates the relationship between ES capabilities and organizational outcome.

In sum, the above discussion demonstrates that IS management capability is a multidimensional variable that has an essentially intervening effect upon homogeneous ES applications, leading to diverse outcomes. Such theoretical discussion reinforces the conventional view of the importance of IS management in innovative ES deployment and utilization. Hence:

H4: The association between ES capabilities and ES outcome, posited by hypotheses 1, 2, and 3, will be greater with higher levels of IS management capability.

3.3.4. Summary

Table 3.4 summarizes the major activities involved in IS management capability. The data analysis illustrates the theoretical discussion to the extent that the pathway of ES deployment and exploitation is determined by management

capabilities. The data also reveals how IS management capability moderates the interaction between ES and the organization.

Table 3.4: IS management capability of the selected firms

Strategic Alignment		
Cisco Inc.	NIBCO	Digital China
<ul style="list-style-type: none"> • Consistency of strategy, goals, organization, and management practice • The model of IT governance was restructured to reflect its contribution to IT users. • Heavy involvement of the business community • The standard IT infrastructure supported long-term organizational strategies such as ongoing acquisition and information integration • Great technical skills and business knowledge were the prerequisites for selecting project consultants 	<ul style="list-style-type: none"> • One-quarter of senior managers were dedicated to the project • ES project was led by both organizational strategy and IT strategy • ES module was evaluated by functional users • Allocated project bonus to encourage the success of ES implementation • Developed tool for project management and control • Formed new tactic team to handle problem areas 	<ul style="list-style-type: none"> • ES initiation was motivated by the demand to integrate business process and rebuild management system • ES was perceived as the only system that could support business strategy • Changed the project team composition when the ES project became stagnant • Changed reward system to reflect the importance of ES project • The project team members had strong technical and business skills
Organizational learning and ES Competence Building		
Cisco Inc.	NIBCO	Digital China
<ul style="list-style-type: none"> • ES project team built ES knowledge by leveraging the experiences of others. • Enhanced communication and distance learning 	<ul style="list-style-type: none"> • Used consultant for technology skill, knowledge transfer, and extra help • Knowledge transfer was part of the contract with consultant • Ensured all users and team members received sufficient ES training • Developed prototypes • User attendance at the training sessions was tracked as part of the organizational incentive scheme 	<ul style="list-style-type: none"> • The company offered ongoing training seminar and strictly monitored the user learning process
Organizational transformation		
Cisco Inc.	NIBCO	Digital China
<ul style="list-style-type: none"> • Used web-based technology 	<ul style="list-style-type: none"> • Project leader had prior 	<ul style="list-style-type: none"> • Extended ES

<p>to enhance collaboration and workflow management</p> <ul style="list-style-type: none"> • Network connection with suppliers and customers • Applied web-based technology to achieve high level of effectiveness of the organizational change • Used network application to remove the information barriers and increase the integration with its constituents and overall power of the supply chain. • Implemented Internet business solutions across all functional areas 	<p>experience that could have contributed to change management</p> <ul style="list-style-type: none"> • Assembled a change team • Business leader who had knowledge and experience of business process took charge of business process redesign • Power users are filled by those who have in-depth knowledge to capture operational details • Remodeling working environment to reflect the organizational change • Communication is part of organizational culture and constant feedback is provided to facilitate organizational change • Top management champions the organizational change • Distribute newsletters to those who will use SAP R/3 	<p>functionalities by integrating with online transaction systems</p> <ul style="list-style-type: none"> • Changed organizational structure to facilitate the new business process • One of the company's cultures is constant structure change. However, the complexity of ES makes the structural change a challenge work.
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3.4. Summary

This chapter has identified and analyzed ES capabilities, looking in particular at aspects of IT infrastructure, business processes, process knowledge, and three dimensions of IS management. On the basis of extensive theoretical discussion of the relationship between these capabilities and ES outcome, we suggest that the effectiveness and efficiency of ES deployment and utilization are predicted on organizational ES capabilities.

Although we discuss three ES capabilities separately, they are closely interlinked.

In essence, the infrastructure capability provides alternative options for

implementing BPR and knowledge management. In other words, IT infrastructure, knowledge management, and business process reengineering are mutually reinforcing and irrevocably linked, such that improvement in infrastructure capability can bolster the other two. For example, leveraging the IT infrastructure and business process increases the likelihood that effective knowledge-based communication and transfer will occur. Ultimately, ES management capabilities serve as the moderating channel through which the impacts of ES capabilities on overall organizational outcome and value are controlled.

Previous research also suggests that as acquired capabilities, the abundance of ES resources does not guarantee that the firm will excel in effective system application. Conversely, firms with limited internal resources may maximize their returns from ES through effective system application (Davenport, 2000a). When the multifaceted nature of capability and the involvement of contextual issues are considered, the connection between IS management capabilities and ES outcome becomes apparent (Krammergaard and Rose, 2002). For example, achieving a strategic fit between business processes and system configuration always demands managerial competence in effectively identifying the slack within the existing practice at the early modeling stage and the provision of strong leadership throughout the period of system implementation (Scott and Vessey, 2002b). Similarly, the essential effect of organizational learning and knowledge integration is to highlight the strategic importance of system training and

knowledge accumulation. Ultimately, the application of process knowledge to organizational transformation emphasizes the roles of project management, organizational culture modification, change management, and risk control in ES implementation and deployment. In the next chapter, we present the research methods and measurement instrument and propose quantitative and qualitative research methods to test the theory and research hypotheses.

CHAPTER 4. RESEARCH METHOD

The methodology proposed by this research attempts to combine the qualitative with quantitative analysis to enrich and generalize the current understanding of ES implementation and its impact on organizational performance. Traditionally, IS research is dominated by a single methodological paradigm and rarely explores the analytical benefits of a multi-method approach (Orlikowski and Baroudi, 1991). Yet despite the limited application, the value of utilizing a multi-method approach in a single research design is well-recognized (Kaplan and Duchon, 1988; Lee, 1991; Orlikowski and Baroudi, 1991; Gable, 1994). The qualitative and quantitative methods, while drawing on different sources of evidence and ideas, are complementary in research design and knowledge creation. As Kaplan and Duchon argue, “Collecting different kinds of data by different methods from different sources provides a wider range of coverage that may result in a fuller picture of the unit under study than would have been achieved otherwise” (1988, p. 575).

This research includes two major sequential phases. Quantitatively, we conduct a questionnaire survey to validate the proposed research constructs. Qualitatively, we carried out research interviews with three CIOs, one VP, two ES project managers, and one functional manager to supplement the quantitative findings. The combination of different methods, it is believed, will offer valuable insights

into the implications of ES adoption, deployment, and use. Figure 4.1 depicts the research processes and major activities in each stage.

The following discussion is divided into two parts. Part I explains quantitative research method in terms of data sample, process of data collection, and method of questionnaire development and data analysis. Part II provides an overview of the qualitative research method. In particular, the discussion is focused on the background information of the informants and method of data transcription and analysis.

PART I. QUANTITATIVE RESEARCH METHOD

4.1. Data Sample

This research focuses on firms which have implemented enterprise systems (e.g. ERP, CRM, SCM etc.) in the past few years. As a class of application package, ES is available with diverse software features from numerous software vendors. However, the heterogeneous system characteristics should not contaminate research data as the system architecture and major functionalities are relatively homogeneous across systems. Therefore, this research samples ES adopters without being concerned about the system suppliers.

Figure 4.1: Research Processes

The quantitative research is based on a survey of top business functional managers and IT professionals, because this group of people is most knowledgeable about the strategic issues of ES deployment and utilization. The research sample firms were drawn from North America only. A mailing list of senior functional managers was acquired from publicly available resources such as *Information Week*, *Financial Post*, and *Ottawa Center for Research and Innovation*. In general, the selected firms share common characteristics as medium- to large-sized operations who rely heavily on computer-based information technologies for data management and information processing. As such, these potential respondents were considered to be experienced and knowledgeable of ES deployment and use. A list of the names of top executives, e-mail address, telephone numbers, fax numbers, and mailing addresses was compiled from information sources and corporate websites.

The process of data collection followed the suggestion of Dillman (2000) to carry out multiple contacts with respondents. First, a questionnaire kit containing cover letter, questionnaire, and self-addressed return envelope was sent to top managers. The researchers also asked recipients to forward the questionnaire to the project leader responsible if they were not familiar with the ES project. The cover letter was signed by both the thesis supervisor and the researcher to increase the credibility of the research. Second, a thank-you letter followed to express our appreciation for the respondents' participation. It also served to remind and encourage participants to respond. All letters were written on official Eric Sprott

School of Business letterhead to provide legitimacy. Thirdly, a follow-up phone call to CEOs or an appropriate person designated by the CEO's office was made to further encourage participation. In some cases, the questionnaire was re-sent by fax to the chief IT officers (as suggested by the companies) to solicit participation. Also, a secured website protected by username and password was developed to facilitate electronic file downloading and e-mail correspondence. Finally, the researcher traveled to companies in the local regions, including Ottawa and Kanata, to deliver research kits in person and to invite research participation. The personal contact proved to be one of the most effective methods of data collection.

4.2. Survey Instrument and Pilot Study

The questionnaire is the major research instrument and therefore warrants considerable attention. The questionnaire is comprised of two sections: section A requests background information on the sample firm, and section B includes 14 subsections on capability assessment. A sample questionnaire is attached in Appendix 3.

Section A of the questionnaire captures background information about the respondent, including industry sector, corporation size, job title, head of IT department, and recent major IT projects. The purpose of this section is to develop organizational profiles of the respondents. The information is further used to conduct a statistical test for non-respondent bias control.

Section B of the questionnaire captures the capability variables influencing the outcome of ES deployment and utilization. This survey questionnaire is based on work initially done by Grant and Hlupic (working document) to study the IS capabilities of the firm. The measurement indicators were derived from the research literature and empirical qualitative research. The preliminary measurement instrument included 134 measurement items categorized into 15 constructs. As one of the initial attempts to test IT capabilities, this set of measurement constructs was not empirically administered. To ensure the applicability of the measurement indicators to ES implementation, deployment, and exploitation, the researcher reviewed the RBV, dynamic capabilities, and IT and ES literature, along with 18 empirical ES cases, by cross-referencing for item verification and missing item identification. As a result, sections on finance resource and partnerships and links were consolidated with ES performance and risk management. Furthermore, a new section regarding business process was developed to capture the process essentials of ES. The revised measurement instrument contained 129 items under 14 constructs. The questionnaire at this stage was still comprehensive, yet directly related to the ES capability assessment.

According to Carmines and Zeller (1979), construct validation involves three major steps: theoretical validation, empirical validation, and construct validity. In this research, the initial research construct was validated via cross-referencing between case studies of secondary data and academic research studies. In

addition, the research constructs and measurement questions were empirically validated through questionnaire pre-testing. The instrument was given to practitioners for completion and comments. Two top managers, three IT managers, five line managers, and seven IT professionals participated in the pre-test. These respondents were asked to fill in the questionnaire and provide comments on the overall design, appropriateness of the questions, and whether an important issue was missing in the design. Two respondents, one from the communications industry and the other from a public organization, provided very detailed comments in terms of length of the questionnaire, question wording, overlapping of questions, compounded questions, and placement of questions. These suggestions were carefully evaluated and further adopted to enhance the clarity and comprehensiveness of the questionnaire. The instrument after this stage had 94 items in 14 categories. Finally, the construct validity was conducted using exploratory factor analysis. Details of the analytical outcome are discussed in next chapter.

4.3. Capability Measurement

Structured dynamic capabilities of ES exploitation and deployment are captured by four capability constructs: IT infrastructure capability, BPR capability, knowledge management capability, and IS management capability. Some constructs are measured by several variables using multiple items derived from literature and secondary empirical cases. For each item, respondents are asked to use the 7-point Likert scale, where 1 denotes “strongly disagree” and 7 denotes

“strongly agree,” to assess the extent to which their companies perform the activities. In addition, a NA indicator is included to capture those practices that do not occur in sample firms. Ultimately, respondents are encouraged to provide suggestions at the end of the questionnaire.

IT infrastructure capability

IT infrastructure is the shared information technology that supports long-term information needs across functional areas (Broadbent, Weill, O’Brien, and Neo, 1996). Weill and Broadbent (2000) identified three major dimensions of IT infrastructure, including communication network and hardware, IT human resources, and application software. Following this suggestion, we measured IT infrastructure capability using these dimensions. First, following the suggestions of Byrd and Turner (2002), Weill and Broadbent (2000), and Duncan (1995), we measured IT infrastructure in terms of ES flexibility, information support, IT sourcing management, IT architecture, and IS capabilities. The ES research indicates the positive relationship between ES implementation and these IT infrastructure indicators (Spratt, 2000; Willcocks and Sykes, 2000). Empirical cases, such as Siemens Power, Quantum, and Cisco, also indicate that these factors are very likely to influence the reach and range of ES-enabled cross-functional communication and integration. Table 4.1 lists the measurement items for IT infrastructure.

Table 4.1: Measurement items and references for IT infrastructure

IT Infrastructure	Reference
1. The organization has a well-developed enterprise IT architecture that supports the deployment of an integrated, flexible, reliable, and secure business platform.	Bharadwaj (2000); Sambamurthy and Zmud (2000); Weill and Broadbent (2000); Allen and Boynton (1991)
2. The organization has a high quality physical IT infrastructure (hardware, software and communication networks) to connect users.	Broadbent, Weill, O'Brien, and Neo (1996); Weill and Broadbent (2000); Byrd and Turner (2001)
3. IT application covers a full range of corporate needs as they currently exist and as they are likely to arise in the near future.	Broadbent, Weill, O'Brien, and Neo, (1996); Ross, Beath, and Goodhue, (1996); Broadbent and Weill (1997); McAfee and Herman (2000); Pliskin and Zarotski (2000); Sumner (2000)
4. IT infrastructure investments decisions are based on industry best practice and technology standards.	McAfee and Herman (2000); Byrd and Turner (2001); Heijden (2001)
5. The organization's IT sourcing and vendor strategy has a long-term focus.	Feeny and Willcocks (1998); Willcocks and Sykes (2000); Heijden (2001)

Second, the increasing emphasis on the integration of business requirements and IT functions has upgraded the competence requirements of IT professionals. Based on the theoretical discussions of Byrd and Turner (2002), Bharadwaj (2000), and Ross, Beath, and Goodhue (1996), we measured IT human resources in terms of ES and business knowledge and skills as well as the practice of long-term skill development. These factors reflect the business and technological requirements of IT professionals that are fundamental in supporting organizations to facilitate a shared vision, to establish IT and business partnerships and mutual trust, to enhance cross-functional communication and collaboration, and to react quickly to changing technological challenges and opportunities. They play a

major part in determining the outcome of ES deployment and utilization because they affect the organizational skills and capability of effective ES management.

Based on the above view, we employed this variable to capture the IT human capital endowment of the organization. Supporting cases for these indicators include NIBCO (Brown and Vessey, 2001), Dow Corning (Ross, 1999), Metalica (Avital and Vandenbosch, 2000), etc. Table 4.2 lists measurement items and references for IT human resources.

Table 4.2: Measurement items and references for IT human resources

IT Human Resources	Reference
1. The organization has a significant number of business managers who possess high levels of ES management competence.	Parr and Shanks (2000);
2. The IT staff employed in the organization have well-developed business knowledge and skills.	Ross, Beath, and Goodhue (1996); Feeny and Willcocks (1998); Bharadwaj (2000); Byrd and Turner (2001)
3. The IT staff possesses high levels of competence with regards to ES-related software packages.	Ross, Beath, and Goodhue (1996); Sumner (2000); Byrd and Turner (2001); Krammergaard and Rose (2002)
4. The IT staff has strong interpersonal skills that help them in training and supporting ES users.	Ross, Beath, and Goodhue (1996); Parr and Shanks (2000); Sumner (2000); Byrd and Turner (2001)
5. The organization has programs for continuously investing in the development and training of its IT managers, technical staff and users.	Bharadwaj (2000); Sumner (2000); Lee and Lee (2000)

BPR capability

BPR capability is measured using 7 items based on concepts derived from prior research, for example Grover et al. (1995), Broadbent et al. (1999), and Stoddard

and Javenpaa (1995). The measurement items for BPR emphasize reengineering mechanisms such as shared business responsibility and risks, integration of ES and business process, and organizational incentive systems, that are recognized as major driving forces in the success of BPR. Such a measurement frame is designed to capture the social complexity of ES-enabled BPR. It covers the contextual factors that are likely to cause a deviation from the expected ES outcome.

Examining the case data, we found several cases – e.g., Tektronix (Westerman and Cotteleer, 1999), Digital China (McFarlan, Chen, and Peimers, 2002), Dead Sea Works (Pliskin and Zarotski, 2000), and Quantum (Radosevich, 1997) – that employed cross-functional teams, process ownership, articulated vision of business process, and renewed organizational incentive systems and job design to carry out the ES project and to smooth the process of ES deployment and process reengineering. As such, we believe that these measurement indices should capture the organizational practices and strategies that are causally associated with the success of ES deployment. Table 4.3 lists measurement items and references for business process reengineering.

Table 4.3: Measurement items and references for business process reengineering

Business Processes	Reference
1. The organization has assigned responsibilities to process owners for business processes.	Grover, Jeong, Kettinger, and Teng, (1995); McAfee and Herman (2000); Pliskin and Zarotski (2000); Heijden (2001)

Business Processes	Reference
2. The business processes reflect both business and IT strategies.	Venkatraman (1994); Grover, Jeong, Kettinger, and Teng (1995); Stoddard and Jarvenpaa (1995); Broadbent, Weill, and Clair (1999); Heijden (2001)
3. The executive team has identified and clearly articulated the scope of business process reengineering.	Grover, Jeong, Kettinger, and Teng (1995); Broadbent, Weill, and Clair (1999); Parr and Shanks (2000); Sumner (2000); Davenport (2000a); Heijden (2001)
4. The organization has established easy-to-apply evaluation criteria to measure the effectiveness of business processes.	Grover, Jeong, Kettinger, and Teng, (1995); Radosevich (1997)
5. The organization has redesigned jobs to reflect process-based vision and business model.	Davenport (1998); Lee and Lee (2000); Davenport (2000a); Brown and Vessey (2001); Hall (2002)
6. The organization has assembled a cross-functional team to support process integration.	Grover, Jeong, Kettinger, and Teng (1995); Radosevich (1997); Sieber, Siau, Nah, and Sieber (1999); Lee and Lee (2000); Davenport (2000a); Heijden (2001)
7. The organization has instituted incentive systems to encourage process thinking and process-driven decision making among employees.	Grover, Jeong, Kettinger, and Teng (1995); McFarlan, Chen, and Peimers, (2002)

Knowledge management capability

Following the suggestions of Grant (1996), Gold and Malhotra et al. (2002), and Davenport (2000a), we measured knowledge management capability with questions related to how the organizations manage information and knowledge.

Information and knowledge are measured by using 5 items emphasizing the management of the knowledge repository, accessibility of the knowledge repository, and the application of IT technology in knowledge retention and diffusion. In general, these practices underpin the organizational knowledge infrastructure. They are major mechanisms that facilitate ES knowledge

acquisition, retention, sharing, and diffusion. Because these practices influence the effectiveness of ES utilization, they are important to innovative ES deployment and thus to outstanding ES outcomes.

Empirical cases such as Dow Corning (Ross, 1999) and Metalica (Avital and Vandenbosch, 2000) reported the activity of document development and online learning systems to support ES training and system competence building. Cisco integrated ES with Internet and Intranet applications to facilitate electronic communication and learning (Nolan, 2001). All these reports provide empirical evidence of the relevance of the measurement items.

Table 4.4: Measurement items and references for knowledge management capability

Information and Knowledge	Reference
1. The organization has in place well structured and managed information and knowledge repositories for supporting overall business functioning.	Radosevich (1997); Avital and Vandenbosch (2000); Bhattacharjee (2000); Pliskin and Zarotski (2000)
2. The content of the information and knowledge repositories are relatively accurate, up-to-date, and relevant.	Sieber, Siau, Nah, and Sieber (1999); Avital and Vandenbosch (2000); Bhattacharjee (2000)
3. The organization has excellent access to ES information and knowledge held by partners, consultants, and research organizations.	Avital and Vandenbosch (2000); Bhattacharjee (2000); McAfee and Herman (2000); Davenport (2000a)
4. Organizational information can be easily accessed and shared across the enterprise by authorized employees.	Radosevich (1997); Avital and Vandenbosch (2000); Bhattacharjee (2000)
5. Diffusion of organizational information and knowledge is supported by robust and user-friendly knowledge management technologies.	Davenport (2000a)

IS management capability

We captured IS management capability by three variables: strategic alignment, organizational learning and ES competence building, and organizational transformation.

Strategic alignment. Strategic alignment has been identified as the management mechanism integrating both IT and business strategies. Following the research conducted by Henderson et al. (1996), Chan et al. (1997), Hirschheim and Sabherwal (2001), Feeny and Willcocks (1998), and Grant (2003), we measured strategic alignment in terms of ES strategy, IT organization, ES integration, and ES performance and risk management. Such measurement proxies focus on how ES deployment and exploitation is integrated with business vision and implemented in business processes.

ES strategy is reflected in organizational vision, development and articulation of strategy, the mechanism of execution of strategy, and the involvement of top managers. ES strategy moderates the impact of IT infrastructure, BPR, and knowledge management on ES outcomes through articulating the vision of ES adoption, defining the role of ES in the organization, aligning ES with business requirements, and regulating the process of ES implementation. It provides articulated plans and execution methods for enterprise-wide ES investment and utilization (Grant, 2003).

IT organization reflects the organizational approach to IT governance and IT resource deployment (Grant, 2003). Measurement indicators include the structure of IT organization, IT policy, IT sourcing strategy, and IT service delivery. With the focus on ES governance and IT structure, IT organization determines the organizational practice for carrying out the IT projects as well as the organizational capability to coordinate and integrate IT infrastructure and information services. Recognizing the tight link between IT organization and IT resource deployment, we suggest that the structure and governance of IT organization interact with ES deployment by influencing the IT infrastructure, ES-related BPR, and organizational knowledge management.

ES integration focuses on the alignment of ES implementation and business process redesign. Specific indicators include the fit between business process redesign and ES implementation, the reflection of business requirements in ES deployment and exploitation, and the relationship between IT and business units. According to Broadbent and Weill (1997), the congruence of IT and business strategies is strategically essential to maximize the IT investment. Following this view, we suggest that ES integration influences organizational flexibility in dealing with changing business opportunities and challenges.

ES performance and risk management is about the procedure of ES design, delivery, and use. Key indicators include ES project management, past IT

experience, ES project evaluation, and strategies of ES delivery. In general, ES performance and risk management represents the organizational experience and management practices employed to achieve the success of ES project management. Indeed, this issue covers the stages of project chartering and project configuration and rollout in the experience cycle of ES. As such, it is an important precedent and a necessary condition to capture the business value of ES.

In sum, the organization's ability to achieve a better alignment of ES and business requirements interacts with IT infrastructure, BPR and ES knowledge management. To the extent that these issues regulate the deployment of ES, the ES governance method, and the fit of ES and business requirements, they define the role of ES in business operation and thereby implicitly impact the ES outcome. As demonstrated by Grant (2003), these factors are strategically essential in deriving value from ES investment. Figure 4.5 summarizes the measurement indicators in terms of ES strategy, IT organization, ES integration, and ES performance and risk management. All the strategic issues and practices are confirmed via literature review and case references.

Table 4.5: Measurement items and references for strategic alignment

Enterprise Systems Strategy	Reference
1. There is a well-established vision for enterprise systems (ES) in the organization.	Markus and Tanis (2000); McAfee and Herman (2000); Parr and Shanks (2000); Pliskin and Zarotski (2000); Sumner (2000); Davenport (2000a)

2. The organization's ES strategy is fully integrated with the overall business strategy.	Broadbent and Weill (1997); McAfee and Herman (2000); Parr and Shanks (2000); Pliskin and Zarotski (2000); Davenport (2000a); Heijden (2001); Krammergaard and Rose (2002)
3. Key milestones for the ES program have been identified and articulated.	Markus, Axline, Petrie, and Tanis (2000); Markus and Tanis (2000); McAfee and Herman (2000); Parr and Shanks (2000); Pliskin and Zarotski (2000); Sumner (2000)
4. Executive management in the organization has been significantly involved in developing the ES strategy.	Grover, Jeong, Kettinger, and Teng (1995); Davenport (1998); McAfee and Herman (2000); Parr and Shanks (2000); Pliskin and Zarotski (2000); Sumner (2000); Davenport (2000a); Heijden (2001)
5. Senior information systems executives (CIO, VPIT, etc.) are directly involved in executing overall business strategy.	Pliskin and Zarotski (2000); Sumner (2000); Heijden (2001)
The IT organization	Reference
1. The structure of the IT organization reflects the both the IT strategy and overall business objectives.	Pliskin and Zarotski (2000); Heijden (2001)
2. The organization has well-functioning IT steering and project management entities.	McAfee and Herman (2000); Parr and Shanks (2000); Krammergaard and Rose (2002)
3. An effective ES team has been assembled to execute the ES strategy.	McAfee and Herman (2000); Parr and Shanks (2000); Sumner (2000); Krammergaard and Rose (2002)
4. ES outsourcing activities are supported by effective contract management structures and personnel.	Feeny and Willcocks (1998); Hirt and Swanson (1999); Hirt (2000); Pliskin and Zarotski (2000); Willcocks and Sykes (2000)
5. The strategic components of the ES delivery process are managed by the internal IT organization.	Parr and Shanks (2000); Heijden (2001); Krammergaard and Rose (2002)
Integrating ES into the business	Reference
1. Well-defined ES management processes are established and implemented in the organization.	Orlikowski and Hofman (1997); McAfee and Herman (2000); Parr and Shanks (2000); Pliskin and Zarotski (2000); Sumner (2000); Heijden (2001)
2. Business processes are redesigned to fit ES-embedded best practice.	McAfee and Herman (2000); Pliskin and Zarotski (2000); Sumner (2000)
3. Business process owners have overall responsibility for ES applications in their units.	Grover, Jeong, Kettinger, and Teng (1995); McAfee and Herman (2000); Pliskin and Zarotski (2000); Heijden (2001)

4. Business champions with sufficient authority and resources are associated with the ES project.	Orlikowski and Hofman (1997); McAfee and Herman (2000); Parr and Shanks (2000); Pliskin and Zarotski (2000); Sumner (2000)
5. Implementation of ES reflects business requirements.	Broadbent and Weill (1997); McAfee and Herman (2000); Parr and Shanks (2000); Pliskin and Zarotski (2000); Sumner (2000)
6. ES service and technology suppliers have substantial ES implementation competence.	McAfee and Herman (2000); Pliskin and Zarotski (2000); Sumner (2000); Krammergaard and Rose (2002)
7. ES project implementation teams comprise an appropriate mix of business, IT, and consulting personnel.	Hirt and Swanson (1999); McAfee and Herman (2000); Parr and Shanks (2000); Pliskin and Zarotski (2000); Sumner (2000); Krammergaard and Rose (2002)
8. The ES project team has a good track record of delivering projects that satisfy user, time, quality, and budget requirements.	Parr and Shanks (2000); Pliskin and Zarotski (2000); Sumner (2000); Krammergaard and Rose (2002)
ES Performance and Risk Management	Reference
1. The organization has explicit, well-articulated and established procedures for evaluating the performance of ES acquisition, delivery, and use.	Parr and Shanks (2000); Brown and Vessey (2001); Nolan (2001)
2. Performance in delivering ES to the business is benchmarked against best-in-class performers.	Radosevich (1997); McAfee and Herman (2000); Krammergaard and Rose (2002)
3. The organization has the capacity to finance the acquisition, deployment and long-term maintenance of ES.	McAfee and Herman (2000); Nolan (2001)
4. The benefits of the ES are clearly identified and communicated.	Radosevich (1997); Nolan (2001)
5. In deploying ES in the organization, IT managers focus on delivering intermediate ES products (early wins) to build commitment and involvement.	Avital and Vandenbosch (2000); Bhattacharjee (2000)
6. There are well established procedures for ES investment risk reduction and management.	Hirt and Swanson (1999); Hirt (2000); Nolan (2001)

Organizational learning and ES competence building. We measured the process of knowledge accumulation and diffusion by capturing ES-related

organizational learning and ES competence. These two issues are the building blocks of dynamic capabilities upon which firms can achieve resource integration, coordination, and reconfiguration (Zello and Winter, 2002).

The organizational learning process includes ES knowledge development, retention, diffusion, and method of knowledge institutionalization. In this research, we measured this capability in terms of formal programs and strategies for knowledge capturing and competence development. Such measurement focuses are especially relevant to ES research because they reflect the operational mechanisms that organizations applied to develop and diffuse ES knowledge across organizational entities. For example, Dow Corning established the PRIDE Academy for user training and support (Ross, 1999). As ES is often acquired from IS vendors, the effectiveness and efficiency of organizational learning shape the organizational competence of ES deployment and utilization, thereby influencing the ES outcome.

Organizational ES competence is measured by 4 items focusing on organizational capabilities, ES expertise, system integration, and proficiency in deploying ES in the business process. This capability is used to capture organizational proficiency in delivering ES projects and carrying out research. The items also reflect the organizational competences required for successful ES deployment. Spratt (2000), for example, suggests that the capability of system integration is essential to capturing the ES-enabled flexible IT infrastructure. According to him, in most

cases, the ES failure can be attributed to the lack of organizational competence in system integration. In addition, the case analysis points out that as ES is an emerging technology, most of the firms rely on consultants to supply the technical competence for ES implementation. As such, the capability of developing effective mechanisms to procure ES services becomes essential for long-term ES deployment and exploitation. Table 4.6 presents each of the measurement items and the associated supporting literature.

Table 4.6: Measurement items and references for organizational learning and knowledge accumulation

ES-related Organizational Learning	Reference
1. The organization has a structured program for researching, acquiring and diffusing information and knowledge about new technologies and processes regarding ES configuration, deployment and management.	Westerman and Cotteleer (1999); Sumner (2000); Nolan (2001)
2. ES related information is systematically shared through either newsletters, newsgroups, seminars, briefings, or other means.	Radosevich (1997); Ross (1999); Avital and Vandenbosch (2000); Nolan (2001)
3. The organization has put in place procedures to capture, codify, and disseminate ES knowledge held by individuals (such as technical specialists and consultants).	Westerman and Cotteleer (1999); Krammergaard and Rose (2002)
4. The organization has established effective partnerships with ES service and technology partners for knowledge transfer.	Ross (1999); Hirt (2000); Sumner (2000)
5. Effective links are maintained with external professional associations (such as research and development institutions) for user training and knowledge accumulation.	Ross (1999); Hirt (2000)
Organizational ES Competence	Reference
1. The organization has the expertise internally to develop its ES strategy.	Hirt (2000); Sumner (2000); Brown and Vessey (2001)

2. The organization has a well-developed competence in carrying out assessment and procurement of IT and IT services.	Radosevich (1997); Hirt (2000); Nolan (2001)
3. The organization has a well-developed competence in integrating and managing enterprise-wide technical and production environment of IT infrastructure.	Radosevich (1997); Nolan (2001); Sprott (2000)
4. A majority of users (business and IT) are proficient in the use of deployed ES.	McAfee and Herman (2000); Pliskin and Zarotski (2000); Sumner (2000)

Organizational transformation. We measured organizational transformation by two proxies: (1) ES-related change management, including change strategy, change program, human resource management, business process change, and reward and incentive change; and (2) organizational culture, including the process of rewarding high-level performance, job motivation, network management, incentives for continuous learning, and performance appraisal and reward systems to reflect business strategies.

The measurement of organizational change is designed to capture the process or managerial activities that facilitate the institutionalization of ES. Such practice does not directly impact the outcome of ES; it does, however, reflect the managerial commitment and organizational practice applied to escalating system buy-in. Consequently, it moderates the perceived business value of ES and the organizational capacity to capture the opportunities enabled by ES. As argued by Henderson and Venkatraman (1993), superior organizational transformation signifies the organization's ability to reap advantage from IT investment.

Organizations capable of developing and executing change programs are expected to minimize the hurdles encountered in ES deployment and utilization.

While change management emphasizes the processes and events leading to organizational change, organizational culture represents social systems and organizational institutions that moderate organizational behavior in terms of ES adoption, deployment, and utilization. It is one of the distinct IT resources affecting job content, working relationships and method of organizational learning and knowledge management. While recognizing the multi-faceted nature of organizational culture, we focus on the organizational human resources policies and incentive systems that tend to have a causal impact on the innovative utilization of ES. Table 4.7 summarizes the measurement items in both ES-enabled change and organizational culture.

Table 4.7: Measurement items and references for organizational transformation

Managing ES-enabled Change	Reference
1. Top management is highly supportive of and committed to ES-related change processes.	Grover, Jeong, Kettinger, and Teng (1995); McAfee and Herman (2000); Parr and Shanks (2000); Pliskin and Zarotski (2000); Sumner (2000)
2. The organization has implemented an explicit change management plan.	Grover, Jeong, Kettinger, and Teng (1995); McAfee and Herman (2000); Parr and Shanks (2000); Sumner (2000)
3. Efforts are made to involve affected organizational members in designing the ES-initiated change.	Parr and Shanks (2000); Sumner (2000); Heijden (2001)
4. The roles to be assumed by employees during and after the change are assigned.	Grover, Jeong, Kettinger, and Teng (1995)

5. Incentive plans are restructured to ensure commitment of organizational members to ES deployment and use.	Grover, Jeong, Kettinger, and Teng (1995); Ross (1999); Nolan (2001)
6. ES-enabled transformation processes are implemented in phases.	Ross (1999); Avital and Vandenbosch (2000)
Organizational Culture	Reference
1. The organization has implemented programs designed to nourish IT employees' intellectual, mental, social and physical well-being.	Orlikowski and Hofman (1997); Ross (1999)
2. The organization promotes individual and team creativity and innovation.	Orlikowski and Hofman (1997); Ross (1999); Brown and Vessey (2001)
3. Employees are encouraged to take personal responsibility for the accomplishment and quality of their jobs.	McAfee and Herman (2000); Brown and Vessey (2001)
4. Authority is delegated to all employees commensurate with their jobs and levels of responsibility.	Ross (1999); Hirt (2000); Brown and Vessey (2001)
5. Employees are comfortable with learning and adopting new technologies.	Orlikowski and Hofman (1997); Brown and Vessey (2001)
6. The organization has well-structured and accepted performance appraisal and reward systems to reflect the strategic priority of the business.	Grover, Jeong, Kettinger, and Teng (1995); Hirt (2000); Sumner (2000)
7. Employees tend to be highly satisfied with the jobs and have a low level of voluntary turnover.	Brown and Vessey (2001)
8. Mutually trusting working relationships exists between IT staff and business managers and users.	Sieber, Siau, Nah, and Sieber (1999); Sumner (2000); Brown and Vessey (2001)

ES outcome

ES outcome serves as a dependent variable in this research. Based on Shang and Seddon (2002), Venkatraman (1991), and Davenport (2000a), ES outcome is measured using ten items. These items capture both tangible and intangible values of ES in data transparency, information accessibility, knowledge sharing and

communication, operational efficiency, managerial decision support, process flexibility, inventory control, and customer support. In other words, we measure the ES outcome according to its strategic impact on IT infrastructure, learning and knowledge development mechanism, and business processes redesign covering a broad scope of operational and strategic issues. All these items are represented in the case report of Siemens Power (Hirt and Swanson, 1999; Hirt, 2000).

Table 4.8: Measurement items and reference for ES outcome

ES Outcomes	Reference
1. ES have significantly improved the quality and quantity of business information owned by or accessible to the organization.	McAfee and Herman (2000); Davenport (2000a); Davenport (2000c); Shang and Seddon (2002)
2. The use of the ES has enabled employee to develop process-oriented skills.	Bhattacharjee (2000); Lee and Lee (2000); Davenport (2000a)
3. ES have contributed to much better, higher levels, and quality of communication and information sharing within the organization.	Hirt (2000); Davenport (2000a); Davenport (2000c); McFarlan, Chen, and Peimers (2002)
4. ES have had a direct role in improving the financial performance of the organization.	Westerman and Cotteleur (1999); Brown and Vessey (2001); McFarlan, Chen, and Peimers (2002); Shang and Seddon (2002); Worthen (2002)
5. ES have allowed the organization to become more flexible and responsive in delivering products and services to its markets.	Radosevich (1997); McAfee and Herman (2000); McFarlan, Chen, and Peimers (2002)
6. ES have made significant contributions to increasing the efficiency and effectiveness of organizational processes and systems.	McAfee and Herman (2000); Davenport (2000a); Shang and Seddon (2002)
7. ES have provided effective tools to the organization for benchmarking its performance against major competitors.	Davenport (2000a)
8. ES has significantly contributed to the organization's financial performance either through cost reduction or revenue growth.	Davenport (2000a); Shang and Seddon (2002); Worthen (2002)

ES Outcomes	Reference
9. ES has improved the competitive position of the organization.	Davenport (2000a); Shang and Seddon (2002)
10. The standard technological platform enabled by ES provides a good basis for long-term strategic IT planning.	Duncan (1995); Buck-Emden (2000); Byrd and Turner (2001); Shang and Seddon (2002)

4.4. Data Analysis

Three data analysis techniques can be applied to this research: ordinary multiple regression (OLS), partial least square (PLS), and structural equation modeling (SEM). All three techniques are grounded in multiple regression; however, the latter two methods are particularly useful for explaining latent variables and structuring theoretical models. Yet, the applicability as well as the predictive power of each statistical method is subject to the data sample and research model. The required sample size and evaluation of each technique is summarized in Table 4.9.

Table 4.9: Multivariate data analytical methods (Jaccard and Wan, 1996; Stevens, 1996; Hair, Anderson, Tatham, and Black, 1998; Cohen, 2001)

Data Analysis Methods	Minimum Sample Size	Comments
Ordinary Multiple Regression	N > 30	<ul style="list-style-type: none"> When data assumptions (section 5.2) are satisfied, ORDINARY MULTIPLE REGRESSION is the best, unbiased measurement. A best choice when data sample is relatively small Easy to conduct with minimum learning curve
Partial Least Square (PLS)	N > 100	<ul style="list-style-type: none"> Capable of structuring theoretical models Capable of predicting theoretical variables A flexible multiple regression method that will allow researchers to conduct analysis when basic data assumptions are violated.

Structural Equation Modeling (SEM)	N > 400	<ul style="list-style-type: none"> • Powerful in constructing the model structure • Powerful in handling latent variables in statistical analysis • An excellent technique for controlling measurement errors when the sample size is large.
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Ordinary multiple regression is a well-known multivariate technique that is frequently applied in social science research when the research model involves multiple independent variables and a single parametric dependent variable (Hair, Anderson, Tatham, and Black, 1998). The fundamental concept of ordinary multiple regression is that the variance in a dependent variable can be explained by a set of linearly combined independent variables (Stevens 1996). According to Jaccard and Wan (1996), this measurement method provides an unbiased outcome when the sample data comply with basic statistical assumptions.

Partial least square (PLS) is a popular technique when the research model involves a latent construct and is subject to moderate sample size. PLS is based on various multivariate data analytical methods. As a result, this technique is capable of analyzing both metric and non-metric variables. PLS is flexible to the extent that it provides statistical analysis when the sample data seriously violate multicollinearity and normality (Chin, 2000). In addition, PLS applies the model structuring method to simulate the relationship between variables, which is especially useful when the research model involves a latent construct. However, the relaxed theoretical assumptions act as a two-edged sword. On the one hand, they increase the applicability of PLS to social science research. On the other

hand, it imposes theoretical concerns on PLS. While we observe an increasing application of PLS in IT research, the reliability of PLS is still under debate.

The other way to test the relationship between latent variables and dependent variables is structural equation modeling (SEM). SEM applies a modeling approach to structure the theoretical model and simulate the relationship path (Jaccard and Wan, 1996). This technique is favored over PLS because it complies with rigorous statistical assumptions to provide accurate predictions for large samples. Although SEM is well known for explaining the empirical data structure and better measurement error control (Jaccard and Wan, 1996), it requires a large sample size that is often difficult to achieve in social science research.

Based on the above discussion, it is apparent that both PLS and SEM provide relatively robust data analysis strategies. However, the sample size is a crucial factor determining the applicability of PLS and SEM (Stevens, 1996). Since both techniques require relatively large sample sizes, a small sample is very likely to cause a substantial shrinkage in predictive power and to result in a biased prediction. Accordingly, the low response rate and small data sample exclude the possibility of adopting advanced statistical techniques in this research. Therefore, ordinary multiple regression is the primary choice here. This technique is simple and widely supported by contemporary statistical packages. The following chapter discusses data measurement strategies and analytical outcome.

PART II. QUALITATIVE RESEARCH

4.5. Research Method

That the qualitative research method captures a rich source of information is widely recognized (Yin, 1994). In this research, the qualitative interview was employed to serve two purposes. On the one hand, the qualitative data provide a fertile ground of information for exploring an emerging theory (Eisenhardt, 1989). Such rich data has great potential for revealing the underlying, latent, and complex organizational practices of ES deployment and utilization. On the other hand, capturing qualitative information from top managers effectively reflects the strategic vision and managerial practice of the organization. Such information is useful for cross-validating the quantitative data gathered from the same source.

4.5.1. Process of Data Collection

In order to capture empirical information from different perspectives, we invited 10 CIOs and functional managers to participate in research interviews. The selection of the research companies was based on two major criteria. First, the companies were strong players in their industry sector and their operations depended greatly on information systems. Second, the companies had experience with ES implementation and deployment. Four of the eight companies we contacted agreed to participate in the interview. Seven IT and business managers from four organizations were interviewed to seek their perspective on the process of ES implementation and deployment.

A structured interview theme (Appendix 4) was developed and used to guide the interview process and to collect information about strategic aspects of ES deployment. The interview theme starts with contextual issues, including business context, the role of ES, and the status of ES deployment. This is followed with questions regarding IT infrastructure strategies, process transformation, user competence, and management process. In principle, these questions are designed to capture the processes and organizational events that lead to flexible IT infrastructure deployment, the enhanced functional fit of ES and business processes, organizational learning and competence building, and strategic ES deployment. To the extent of covering organizational routines and practices, we believe that the interview themes provide an adequate tool to capture information of organizational IS management capability.

Six organizational interviews with seven business and IT managers were scheduled in advance and then conducted in person by the researcher at the organization site. The interview process, which lasted between one and two hours, was documented by note taking and tape recording. Organizational documents describing the organization, the ES project, and project team management were collected and analyzed whenever they were available. In addition, the interview tapes were transcribed into a written format for data analysis. Because our goal is to understand the key processes of ES deployment, the interview themes were centered on organizational routines and practices. Such research supplements the quantitative research by providing vivid and reliable insights into the

contemporary practices of ES deployment. It should be noted that the data samples are based on Canadian firms and institutions only. However, the geographical issue here should not materially bias the research findings, because these firms are multinational players and the managers interviewed represent the top corporate level. It should also be mentioned that the ES projects studied here cover different software vendors and development methods.

The four organizations include a semi-conductor company (SCC), a health-life science company (HLC), an electronic manufacturing company (EMC), and an educational institution (EI). Table 4.10 provides background information about these organizations, their competitive environment, and their driving forces for ES adoption. It is notable that all the organizations addressed view the adoption of ES as a business solution, a means to leverage and consolidate information to achieve a common business process.

Table 4.10: Overview of the research organizations

Company Identifier	Informant	Company Description
SCC	CIO	<p>A multinational semi-conductor company with 1200 employees and annual revenue about 200 M per year.</p> <p>The company has three production foci: medical devices, network communication, and wireless communication</p> <p>In the past three years, the company has experienced economic down time, intensive price competition, shortened lead-time, and increasing industrial consolidation. The company developed ES to support business strategy and to provide the integrated information service.</p>

EMC	CIO ES Project Manager	<p>A multinational high-tech company focused on full range of electronic manufacturing services.</p> <p>The company has 800 employees worldwide with annual revenue about 200 M USD.</p> <p>In the past three years, the company has experienced cost competition and customer change. The ES investment is driven by the information needs for manufacturing forecast and integration of business flows.</p>
EI	CIO Executive Project Director	<p>A post-secondary educational institution with 2000 employees and 22000 students; annual revenue is close to 220 million per year.</p> <p>The educational sector has been relatively stable for the past few years. However, the university is focusing more intensely on marketing to attract students. The university moved to ES because the old systems were out of parts and lacked technical support.</p>
HLC	Global Manufacturing Head Financial Manager	<p>A global company with 12000 employees and annual revenue about 1.6 B in the field of health and life sciences.</p> <p>The company focuses on three businesses units: tele-therapy equipment, product sterilization, and nuclear medicine. The competing industry – the company is generally competing with government-funded, state-run enterprises – is highly regulated and relatively stable.</p> <p>In the past few years, the company has gone through four major acquisitions and business restructurings. The ES project is driven by information needs and business strategy to achieve a common business system with common processes.</p>

4.5.2. Data Analysis

We followed the procedures proposed by Miles and Huberman (1994), Yin (1994), and Larsson (1993) to conduct both within-case and cross-case analysis. Within-case analysis focuses on interview themes and supporting comments captured from transcripts. In particular, we looked for comments pertaining to the IT infrastructure strategies, process transformation, and organizational learning

and competence building that comprise the higher-order organizational practice and routines in ES deployment and utilization. For those companies where we had an opportunity to assess the same research questions from corporate and functional perspectives, we compared and contrasted both responses to capture consensus as well as conflicting opinions. Such analysis yields an empirical basis that supports, refutes, or extends the hypothesis regarding the significance of IS management capabilities in ES deployment and utilization.

In order to buttress and corroborate the research findings, we compared the findings across cases. In particular, we focused on comparing organizational practices in carrying out ES strategies. Chapter 6 shows how IS management capabilities interact with IT infrastructure capability, business processes, and knowledge management to enhance ES outcomes.

4.6 Summary

This chapter discusses the data sample, data collection strategies, survey instrument, and interview method in detail. In the phase of quantitative research, we designed the questionnaire to capture the dynamic capabilities at the organizational level. In order to reflect the business essence of ES implementation, this questionnaire covers the full scope of the organizational context and adequately reflects the critical issues and major practices identified in the ES literature review. In addition, major steps of theoretical and face validities are summarized in detail. While the content of the survey instrument is

comprehensive, the length of the questionnaire also reduces the probability of acquiring the reasonable response rate.

Although the technique of structure equation modeling is a preferred analytical method, this research adopts the ordinary multiple regression as the data analytical strategy because of small sample size. While multiple regression is not designed to test the effects of latent constructs, it provides a viable solution to explore the quantitative data when sample size is a concern.

Despite the development of operational constructs to capture the organizational processes and practices, this research further employs qualitative interviews as a supplementary method to buttress the research models and quantitative findings. The qualitative data provides rich information and diverse perspectives enabling the researchers to explore the best practice of effective ES deployment and utilization. Such rich information supplements the questionnaire survey to the extent that they depict the relatively comprehensive interaction of management practices and ES outcomes.

The following chapter describes the process and outcome of quantitative data analysis. Chapter 6 discusses the findings of the research interviews.

CHAPTER 5. QUANTITATIVE DATA ANALYSIS

Following the discussion of the research model and measurement construct, this chapter presents the statistical analysis of the data gathered from the questionnaire survey. The chapter begins with a descriptive analysis of the respondents who participated in this research. This is followed by exploratory factor analysis for construct validation and multiple regression analysis of the research data.

5.1. Descriptive Statistics

The purpose of descriptive analysis is to provide an overview of the respondent profile and to give a better understanding of the sampling frame. Descriptive analysis is an initial step in capturing the characteristics of the research data. This section starts with the analysis of the responding companies using frequency analysis. This is followed by bias analysis of respondents in terms of perspective, industry, and organizational characteristics and question responses. Finally, reliability and correlation analysis are performed to test the consistency and the level of interdependence of the measurement construct.

5.1.1 Profile of the Responding Companies

A total of 825 firms were contacted to seek their participation in this research. Among these, 403 were American-based firms and 422 were Canadian firms or Canadian subsidiaries. Ten of the survey kits were returned because of organizational relocation or other reasons, yielding an effective contact of 815.

Sixty-three of the 815 responded to our request, yielding a response rate of 7.73%. Among these, 36 of the respondents speak for the entire organization (57.14%) and 27 of the respondents speak for their group and division (42.86%).

There are several reasons for the relatively low response rate. First and most commonly, respondents do not see the business value of participating in research surveys. Many non-respondents that the researcher contacted indicated their corporate policy of not participating in research surveys. Although the underlying reasons are not clear, it is very likely that the downsized work force makes research participation a non-priority. As well, the strategic concern of disclosing corporate issues and information may also partially explain the unwillingness to participate. Secondly, some firms indicated that their IT department was fully outsourced or was not implementing ES. As such, these firms claimed that they did not have enough knowledge and information to answer the questions. Thirdly, personnel at the executive level often do not receive the questionnaire. This was especially true in this case: most of the executives that the researcher tried to contact were traveling for business reasons or located at other offices. Finally, some respondents expressed concern about the time required to answer the 10-page questionnaire. According to Dillman (2000) and Stevens (1996), there exists a casual relationship between the response rate and the length of the questionnaire. In this case, the length of the questionnaire may have reduced the probability of achieving a reasonable response rate (Stevens, 1996; Dillman, 2000).

This research follows the classification used by the *Financial Post* (Canada) to identify 24 business industries. Table 5.1 presents the industrial profile of the respondents. The responding firms, distributed across sixteen industries, manifest the widespread adoption of ES. Observed from the industrial profile of the respondents, the technology industry and “others” show a greater response rate than other business sectors. (This may have occurred because of the rapid growth of the technology industry in the past few years and research support from public agencies.) As well, a significant portion of the respondents represent consumer product firms.

Table 5.1: Industrial Profile of Respondents (N=63)

Industry Sector	Frequency	Percentage
Auto, Parts and Transportation Equipment	4	6.3
Biotechnology and Pharmaceuticals	2	3.2
Building Material	1	1.6
Communications & Media	1	1.6
Consumer Products	6	9.5
Fabricating & Engineering	3	4.8
Financial Management	1	1.6
Food & Beverage	1	1.6
Hospitality	2	3.2
Insurance	2	3.2
Metals & Minerals	2	3.2
Oil & Gas	2	3.2
Technology	15	23.8
Telephone & Utilities	2	3.2
Wholesale & Retail	4	6.3
Other	15	23.8

Table 5.2 summarizes the characteristics of the responding firms in terms of employee number, annual revenue, respondent positions, and separate IT department. Of the responding firms, 42.9 % have fewer than 1000 employees; 34.9% have more than 1000 but fewer than 10,000 employees; and 22.2% have over 10,000 employees.

The research also captures the size of the company via information about annual revenue. According to the definitions employed by Statistics Canada, medium-sized firms are firms with annual operating revenue over 5 million but less than 75 million; large-sized firms have annual operating revenue over 75 million. Accordingly, this research captures the general practice of both medium- and large-sized firms.

In terms of ranking the respondents, we classified them into four groups; namely, top managers, middle managers, line managers, and professionals. 'Top manager' refers to the executive level of the staff in charge of the strategic issues of the firm. Based on the respondent profiles, top managers include CEOs, CFOs, CIOs, CTOs, VPITs, and other VPs. 'Middle manager' refers to senior supervisory staff in charge of the running of the business and reporting to the top managers, such as IT directors, IT managers, and controllers. 'Line manager' refers to the staff responsible for the main activities of the firm, such as supervisors, team managers, and program managers. Finally, 'professional' refers to the respondent who engages in activities requiring special competences, such as accountant,

programmer, or engineer. According to the frequency analysis, this research captures diverse perspectives from all levels of the firm. In addition, almost all the responding firms have a separate IT function or department.

Table 5.2: Company characteristics of the Respondents (N=63)

Number of Employees	Frequency	Percentage
Less than 50	7	11.1
50-100	3	4.8
101-250	8	12.7
251-500	3	4.8
501-1000	6	9.5
1001-5000	14	22.2
5001-10000	8	12.7
10001-25000	7	11.1
More than 25000	7	11.1
Revenue		
Less than 50 million	13	21.6
50 – 100 million	7	11.1
100 – 250 million	5	7.9
250 – 500 million	2	3.2
500 – 1 billion	9	14.3
1 – 5 billion	15	23.8
5 – 10 billion	5	7.9
More than 10 billion	4	6.3
Other	3	4.8
Respondents		
Top managers (CEO, CFO, CIO, VPIT, other VP)	25	39.7
Middle managers (IT director, IT managers, service director, controller)	14	22.2
Line managers (commodity manager, project manager)	8	12.7
Professionals (developer, engineer, accountants, IT architect)	16	25.4
Separate IT department		
Yes	61	96.8
No	2	3.2

5.1.2. Statistical Analysis of Bias and Respondent Difference

Because of the very low response rate, it is necessary to examine the non-response bias to determine the generalizability of the research data. To test the existence of a non-response bias, we compared two groups of respondents, the companies returning the questionnaire early vs. the companies returning the questionnaire late (Armstrong and Overton, 1977). In this research, we categorized those firms that required more than two contacts to participate the survey as late response. A one-way analysis of variance (ANOVA) was performed to test the difference of means between the respondents and non-respondents based on two possible mediating demographic variables: number of employees and company revenue. The significance of F test is 0.5148 and 0.1667, respectively. Compared with the customarily applied 0.05 cutoff significant level, the outcome of F test supports the null hypothesis, ruling out the concern of a non-response bias. Such a statistical result confirms that the responding firms represent the research sample.

To examine the independence between the samples representing entire organizations vs. division and group, we performed chi-square test (χ^2) for both number of employees and company revenue. Chi-square (χ^2) is an analytical technique that is commonly used to test whether multiple groups of observed frequencies differ significantly. The p-value of 0.05 is applied to evaluate the acceptance of the research hypothesis. Tables 5.3 and 5.4 summarize the statistical analysis. The results from the statistical test indicate significance levels of 0.652 and 0.298, respectively. Both statistical outcomes suggest the acceptance

of null hypotheses. In other words, the perspective of respondents is independent of the number of employees and annual revenue of the firm.

Table 5.3: Statistical analysis of perspective of respondents vs. number of employees (N=63)

Perspective	Number of Employees									χ^2	Sign.
	Less than 50	50-100	101-250	251-500	501-1000	1001-5000	5001-10000	10001-25000	More than 25000		
Organization	2	2	4	1	4	8	5	6	4	5.95	0.652
Division	5	1	4	2	2	6	3	1	3		

Table 5.4: Statistical analysis of perspective of respondents vs. organizational size (N=63)

Perspective	Organization Size									χ^2	Sign.
	Less than 50 M	50-100 M	101-250 M	251-500 M	501-1B	1-5 B	5-10 B	More than 10 B	Others		
Organization	8	3	2	1	6	12	2	2	0	9.54	.298
Division	5	4	3	1	3	3	3	2	3		

M: million B: billion

To ascertain if respondent portfolios vary across the industry sector, we further conducted χ^2 tests for industry type against respondent perspective, number of employees, and revenue. Table 5.5 summarizes the outcome of the statistical analysis. All of the statistical analyses reject the tested hypotheses and confirm independence among industry sectors, perspective of respondents, number of employees, and organizational revenue.

Table 5.5: Statistical analysis of industry sector vs. perspective of respondents, number of employee, and revenue (N=63)

Statistical testing	χ^2	Significance
Industry sector vs. perspective of respondent	14.136	.515
Industry sector vs. number of employees	138.756	.116
Industry sector vs. revenue	117.319	.552

Table 5.6 presents the statistical test of position of respondents against response perspective, industry sector, number of employees, and revenue. The statistical results reveal a significant difference between the position of the respondent and response perspective. In other words, the statistical analysis suggests that the response perspective depends on the position of the respondent in the organizational hierarchy. As the data sample covers a wide spectrum of hierarchical levels, such a significant difference indicates that the data sample represents an overview of ES capabilities from both managerial and user perspectives. On the other hand, no significant difference is observed for the position of the respondent vs. industry sector, number of employees, and organizational revenue.

Table 5.6: Statistical analysis of position of respondents vs. responding perspective, industry sector, number of employee, and revenue (N=63)

Statistical Testing	χ^2	Significance
Respondent position vs. responding perspective	29.710	.000**
Respondent position vs. industry sector	51.269	.241
Respondent position vs. number of employees	29.968	.186
Respondent position vs. revenue	33.273	.098

** significant < 0.01

To investigate if the diverse perspective causes any difference in survey response, we further compared the means of 13 explanatory variables for response on behalf of the whole corporation and on behalf of the division. Table 5.7 summarizes the statistical analysis. No significant differences are found in the two response perspectives.

Table 5.7: Statistical analysis of perspective of respondents vs. measurement variables (N=63)

Statistical testing	χ^2	Significant
Responding perspective vs. ES strategy	14.429	.886
Responding perspective vs. IT organization	23.809	.473
Responding perspective vs. ES integration	23.168	.568
Responding perspective vs. ES performance and risk management	25.533	.323
Responding perspective vs. ES-enabled change	28.707	.276
Responding perspective vs. ES-related organizational learning	17.306	.835
Responding perspective vs. IT human resource	14.486	.912
Responding perspective vs. IT infrastructure	22.424	.264
Responding perspective vs. business processes	33.211	.190
Responding perspective vs. ES competence	16.118	.306
Responding perspective vs. information and knowledge	23.460	.376
Responding perspective vs. organizational culture	29.653	.330
Responding perspective vs. ES outcomes	27.789	.582

5.2. Model Testing

The purpose of model testing is to ensure the reliability and validity of the research model. This study employs both factor analysis and Cronbach's α to examine the research construct. By following the generally adopted procedure,

such model testing enables us to generate an interpretable and parsimonious measurement construct (Palvia, 1997; Gable, Sedera, and Chan, 2003).

5.2.1 Construct Validity and Measurement Reliability

The purpose of measurement validation is to determine the extent to which the research questions effectively reflect the research constructs and measure what they are intended to measure (Carmines and Zeller, 1979). Exploratory factor analysis (principle component analysis with varimax rotation) is a commonly accepted analytical technique that is often applied either to reduce a large number of variables or to verify that the factor loadings are statistically significant enough to represent their respective construct (Stevens, 1996). In this research, factor analysis is primarily used to test the proxy of research variables.

Three criteria are applied for factor evaluation: (1) only those components with an eigenvalue greater than 1 will be retained (Hair, Anderson, Tatham, and Black, 1998); (2) considering the small sample size, only items with a factor loading absolute value greater than 0.6 are considered representative (Stevens, 1996); (3) single-item factors are discarded (Jaccard and Wan, 1996).

It is important to note that we applied factor analysis to test whether the measurement indices factored into their respective constructs. Such measurement is fundamental because it verifies the representativeness of the measurement indices individually. It also provides a theoretical foundation upon which the

validity of higher-order research constructs can be measured. It should also be noted that subject to sample size, the criteria for accurately capturing the representative factors substantially accelerated from 0.4 to 0.6. Under such stringent criteria, too few factors for statistical analysis are likely to be accepted. As such, despite relying on the quantitative method for indicator verification, we also justify retaining indicators on theoretical grounds when the statistical outcome recommends too few variables. Construct validation is a repetitive process for evaluating the results of principal components analysis and involves face validation of the new factors, dropping items, and repeating factor analysis.

To further ensure the consistency of the measurement items, we also tested the reliability of the research construct. Reliability is a measure of the degree to which the respondent's answer is consistent across the measurement items. Because this research encompasses several constructs with multiple items measured on a 7-point Likert scale, the coefficient of Cronbach's alpha is applied to test the internal consistency of measurement scales. Cronbach's alpha is a common indicator measuring the proportion of variability shared among measuring items. A Cronbach's alpha of 0.7 or higher is commonly considered as a benchmark for reliability testing (Hair, Anderson, Tatham, and Black, 1998). The following sections describe the process of model testing.

5.2.1.1. Measuring Strategic Alignment

Strategic alignment was measured by four constructs, including ES strategy (5 items), IT organization (5 items), ES integration (8 items), and ES management (6 items). These constructs reflect the conceptual framework developed by Henderson et al. (1996) and Hirschheim et al. (2001), empirical research conducted by Grant (2003), and practical information captured from multiple case analyses.

“ES strategy” captures the information related to vision, plan, and process of developing and directing the implementation of ES (Henderson and Venkatraman, 1993; Henderson, Venkatraman, and Oldach, 1996). As noted by Hirschheim and Sabherwal (2001), managerial vision and decision-making are two of the major determinants of strategic IT alignment. IT organization captures information related to the structure of IT organization and ES governance. This measurement construct reflects contemporary IS management capabilities (Feeny and Willcocks, 1998; Willcocks and Sykes, 2000). “ES and business integration” captures the functional integration proposed by Henderson (1993). Finally, “ES performance and risk management” captures the processes of ES project management and performance control.

Exploratory factor analysis (principle component analysis with varimax rotation) was performed to test if items would factor into their respective constructs. In order to generate parsimonious yet predictable measurement constructs, we

carefully evaluated the emerging factors and their factored items in terms of factor scores, total variance explained, and α score. In addition, the measurement items were further examined for the possibility of compounding or overlapping with other measurement constructs. As a result, seven items were dropped because of single loading and overlapping with other measurement items. Table 5.9 summaries the outcome of factor analysis.

Table 5.9: Factor analysis (Strategic Alignment) N=63

Item	Loadings			
	ES Strategy	ES project management	ES integration	IT organization
ES Strategy 1	.720	.239	.153	.394
ES Strategy 2	.841	.116	.142	.347
ES Strategy 3	.793	.345	.326	.057
ES Strategy 4	.830	.384	.162	-.056
ES Strategy 5	.718	.292	.076	.077
IT organization 1	.220	.069	.275	.838
IT organization 2	.114	.369	.130	.768
IT organization 3	.711	.215	.402	.124
ES Integration 1	.353	.690	.304	.278
ES Integration 2	.034	.168	.849	.227
ES Integration 4	.226	.336	.752	.113
ES Integration 5	.120	.207	.814	.079
ES Integration 7	.231	-.045	.678	.088
ES Project Management 1	.189	.735	.004	.338
ES Project Management 2	.294	.664	.243	.001
ES Project Management 5	.391	.631	.064	-.029
ES Project Management 6	.189	.763	.215	.230
Eigenvalues	8.069	1.80	1.40	1.142
Variance explained	47.5%	10.6%	8.2%	6.7%
Cronbach's alpha	.9206*	.848**	.8184	.7186

*: reliability is measured based on five items of ES strategy and one item of IT organization

**: reliability is measured based on four items of ES project management and one item of ES integration

As shown in table 5.9, the construct testing emerged as a four-factor structure explaining 73% of the total variance. Several items did not load into their

respective construct. An IT organization item (an effective ES team has been assembled to execute the ES strategy) loaded on ES strategy rather than IT organization. An ES integration item (well-defined ES management processes are established and implemented in the organization) loaded on ES project management rather than ES integration. On the basis of face validity, we adopted the new categorization of these items for regression analysis.

Cronbach's α is computed based on the results obtained from factor analysis. The reliability of the four constructs, ES strategy, ES integration, ES project management, and ES governance, is greater than 0.7, suggesting measurement consistency (Stevens, 1996).

5.2.1.2. Measuring IT Infrastructure

Following the suggestion of Weill and Broadbent (2000) and Byrd and Turner (2001), we measured IT infrastructure capability by using two dimensions: IT human resources and IT infrastructure. Considering ES as part of the IT infrastructure, this research does not use the measurement items tested by other IT research. Instead, we measured IT infrastructure in terms of overall hardware and service qualities. As shown in table 5.10, the measurement items loaded cleanly into two factors, explaining 66.6% of total variance.

One item (the organization has a significant number of business managers who possess high levels of ES management competence), measuring the IT

competence of business managers, did not load on either one of the factors. According to the factor analysis rule adopted, this item was dropped. Two IT infrastructure items (the organization has a well-developed enterprise IT architecture that supports the deployment of an integrated, flexible, reliable, and secure business platform; the organization has a high quality physical IT infrastructure (hardware, software and communication networks) to connect users) loaded on IT human resource. Because both items measure the IT architecture and physical IT infrastructure, reflecting the key themes of IT infrastructure, we retained both items in IT infrastructure. As well, an IT human resource item (the organization has programs for continuously investing in the development and training of its IT managers, technical staff and users) has a lower factor loading score and loaded on IT infrastructure. We decided to retain this item in IT human resources for two reasons: first, it captures the substantial practice that enables the firm to develop internal competence to better utilize the involving IT; second, the user training and skill building is focused on the human issue rather than system deployment (Byrd and Turner, 2001). For both IT human resource and IT infrastructure, reliability was greater than 0.7.

Table 5.10: Factor Analysis (IT infrastructure) N=63

Item	Loadings	
	IT human resource	IT infrastructure
IT human resource 2	.850	.096
IT human resource 3	.860	-.068
IT human resource 4	.831	.053
IT human resource 5	.496	.582
IT infrastructure 1	.604	.481
IT infrastructure 2	.638	.535

IT infrastructure 3	.320	.701
IT infrastructure 4	-.087	.808
IT infrastructure 5	-.038	.830
Eigenvalues	4.142	1.85
Variance Explained	46%	20.5%
Cronbach's α	.8213*	.8049**

*: reliability is measured based on four items of IT human resources

**: reliability is computed based on five survey items of IT infrastructure loaded to IT infrastructure

5.2.1.3. Measuring Organizational Learning and Competence Building

According to the literature on knowledge management, organizational learning and competence building are two higher-order capabilities leading to effective knowledge creation, accumulation, integration, transformation, and transfer. Table 5.11 shows that the construct loaded into two factors, explaining 62.6% of the total variance. All but two factors (a majority of users are proficient in the use of deployed ES; effective links are maintained with external professional associations for user training and knowledge accumulation) did not load significantly on both factors. On the basis of the face validity and the importance of the information, we decided to retain both items for data analysis. Reliability for each construct was greater than 0.7, indicating the consistency of the measurement.

Table 5.11: Factor Analysis (Organizational learning and competence building)
N=63

Item	Loadings	
	Organizational learning	ES competence
Organizational learning 1	.847	.084

Organizational learning 2	.793	.094
Organizational learning 3	.815	.232
Organizational learning 4	.775	.159
Organizational learning 5	.571	-.079
ES competence 1	.057	.766
ES competence 2	.090	.852
ES competence 3	-.047	.904
ES competence 4	.345	.573
Eigenvalues	3.55	2.08
Variance Explained	39.4%	23.1%
Cronbach's α	.824*	.767*

*: computation of reliability includes the survey items with lower loading scores.

5.2.1.4. Measuring Organizational Transformation

Consistent with the perspective proposed by Orlikowski and Hofman (1997), we perceived the deployment and utilization of ES as an organizational transformation process. Two constructs, organizational change and organizational culture, are employed to capture the major processes of ES-enabled organizational transformation. While organizational change captures the change strategy and process of change, the organizational culture captures the information regarding reward systems and working environment that coordinate the organizational activities into a coherent whole.

One culture item (authority is delegated to all employees commensurate with their jobs and levels of responsibility) was dropped for two reasons. First, the factor score of this item was below the benchmark score of 0.6. Second, this item is duplicated in other culture measurements.

Three factors emerged from exploratory factor analysis. The survey items of organizational culture loaded cleanly into their respective constructs with eigenvalues of 7.099, explaining 54.6% of the total variance. However, the survey items of ES associated organizational change were factored into two constructs – “change process” and “change strategy”, explaining 9.9% and 8.4% of the total variance respectively. Compared with the culture issue, “change process” and “change strategy” account for a relatively small amount of variance in organizational transformation. A possible explanation is that organizational transformation is fundamentally a culture change rather than a change program or strategy. While the factor analysis suggests dropping components which account for a small amount of variance, Stevens (1996) suggested that this rule be adopted with caution. Considering the practical significance of change management in ES implementation (Roberts, Jarvenpaa, and Baxley, 2003), we decided to retain both “change process” and “change strategy” for further statistical analysis because they are the operational mechanisms by which organizations accomplish culture change. Reliability for each construct was greater than 0.7.

Table 5.12: Factor Analysis (Organizational transformation) N=63

Item	Loadings		
	Factor 1	Factor 2	Factor 3
Organizational culture 1	.664	.509	.039
Organizational culture 2	.798	.238	.333
Organizational culture 3	.786	.219	.323
Organizational culture 5	.772	.105	.152
Organizational culture 6	.614	.467	.080
Organizational culture 7	.696	.291	.244
Organizational culture 8	.659	.160	.494
Organizational Change 1	.438	.174	.759

Organizational Change 2	.303	.134	.739
Organizational Change 3	.035	.449	.782
Organizational Change 4	.239	.786	.417
Organizational Change 5	.327	.805	.122
Organizational Change 6	.199	.796	.278
Eigenvalues	7.099	1.29	1.09
Variance Explained	54.6%	9.9%	8.4%
Corresponding construct	Organizational culture	Change process	Change strategy
Cronbach's α	.902	.865	.827

5.2.1.5. Measuring BPR

ES-enabled business processes capability was measured using seven items derived from BPR literature and empirical ES cases. These items reflect empirical practice conducted by firms to achieve ES-enabled BPR.

Table 5.13 summarizes the analytical outcome of both construct validity and measurement reliability. All survey items factored into their respective construct cleanly with eigenvalues of 4.43813, explaining 63.4% of the total variance. Reliability of the survey items was .8961, confirming internal consistency of BPR measurement.

Table 5.13: Factor Analysis (Business process reengineering) N=63

Item	Business Processes Loadings
Business processes 1	.736
Business processes 2	.817
Business processes 3	.922
Business processes 4	.801
Business processes 5	.853
Business processes 6	.793
Business processes 7	.595

Eigenvalues	4.43813
Variance Explained	63.4%
Cronbach's α	.8961

5.2.1.6. Measuring Knowledge Management

Research on the perspective of knowledge management is still under development. In this research, knowledge management was measured using a single construct to assess the comprehensiveness as well as the accessibility of organizational knowledge and information.

In analyzing the responses, exploratory factor analysis revealed a unique factor explaining 72.4% of total variance. Cronbach's α was measured at .9013, confirming the response consistency of the survey items.

Table 5.14: Factor Analysis (Knowledge management) N = 63

Item	Knowledge Loadings
Knowledge and information 1	.870
Knowledge and information 2	.855
Knowledge and information 3	.838
Knowledge and information 4	.854
Knowledge and information 5	.837
Eigenvalues	3.6208
Variance Explained	72.4%
Cronbach's α	.9013

5.2.1.7. ES Outcomes

We measured ES outcomes by capturing the operational, strategic, and financial implications of ES from the aspects of IT infrastructure, tool of business process reengineering, and knowledge management. Such measurement complied with the suggestions of Shang and Seddon (2002) because they reflect the multidimensional implications of ES. As shown in table 5.15, the measurement items loaded cleanly to the respective construct with eigenvalues of 6.425, explaining 64.2% of the total variance. Reliability of the survey items was .9346, confirming the measurement consistency.

Table 5.15: Factor Analysis (ES outcomes) N = 63

Item	ES Outcomes Loadings
ES outcomes 1	.727
ES outcomes 2	.712
ES outcomes 3	.808
ES outcomes 4	.854
ES outcomes 5	.891
ES outcomes 6	.868
ES outcomes 7	.885
ES outcomes 8	.642
ES outcomes 9	.809
ES outcomes 10	.780
Eigenvalues	6.425
Variance Explained	64.2%
Cronbach's α	.9346

5.2.1.8. Summary

The processes of construct validity and reliability testing generate a measurement model with predictive powers. Table 5.16 summarizes the process of managing

measurement items in each research stage. The literature review stage focused on evaluating the adoptability of measurement items in ES research. Critical review of the measurement items and constructs occurred in the pre-testing stage when constructive suggestions were received from survey participants. Items determined to be either compounded with other items, overlapping, or redundant were dropped or collapsed into a single item with concise wording. Finally, the results of factor analysis identified the relative importance of each item in interpreting the research model. The outcome of factor analysis also resulted in further item reduction.

Based on the measurement construct emerging from factor analysis, we employed multiple regression to investigate the effect of IT infrastructure, BPR, and knowledge management to ES outcomes as well as the interaction effect of IS management capabilities with these independent variables.

Table 5.16: Summary of measures retained across research stages (Table adopted from Gable, Sedera, and Chan (2003))

Research Phase	Literature Review				Model Testing			
					Pre-testing		Factor Analysis	
Dimensions	Start	Add	Drop	Remain	Drop	Remain	Drop	Remain
ES Strategy	8		1	7	2	5		5
IT organization	9	4		13	8	5	2	3
Integrating ES into business	12			12	4	8	3	5
ES Performance and risk management	7	5		12	6	6	2	4
Managing ES-enabled change	10		1	9	3	6		6
ES-related organizational learning	6	3		9	4	5		5

IT human resources	8		2	6	1	5	1	4
IT infrastructure	8	1		9	4	5		5
Business processes	0	10		10	3	7		7
Organizational ES competence	7		1	6	2	4		4
Information and knowledge	7		1	6	1	5		5
Finance	6		6	0		0		0
Organizational culture	13	1		14	6	8	1	7
Partnership and link	5		5	0		0		0
ES outcomes	12	6		18	8	10		10
Total	118	30	17	131	52	79	9	70

5.3. Measurement Method

Although, for this research model, it would have been preferable to use advanced statistical methods such as structured equation modeling (SEM) and partial least square (PLS) to predict the strategic impact of organizational dynamic capabilities on ES deployment and utilization, this research adopted multiple regression as the analytical tool because of the small sample size. Rather than using covariance coefficients to test the latent constructs, we examined moderating effects by transforming the nominal scale into dummy variables. In other words, this research treated the moderating effects of higher-order IS management capabilities as “present” or “absent”.

We followed four major steps to analyze the survey data. First, we used the sample mean to create a single measure for the corresponding research construct. Second, the moderating variables were classified into two groups based on the

mean score of the responses across measurement items identified from exploratory factor analysis. Using a seven-point Likert scale where 1 denotes “strongly disagree,” 7 denotes “strongly agree,” and 4 denotes “neutral,” we classified the responses with mean score above 4 as “present” and mean score below 4 as “absent”. Third, the interaction effect is computed by multiplying moderating variables with independent variables. Finally, a series of regression models are tested. If the regression model with moderating effects is significant compared to the main effect model, then a moderating effect is present. In addition, a correlation matrix of all variables is summarized in Table 5.17. It is notable that the correlation between capability indicators and moderating capability indicators is positive and significant, implying that the presence of moderating IS capabilities can help IT infrastructure capability, BPR capability, and knowledge management capability. The following section summarizes the results of multiple regression analysis.

Table 5.17: Correlation Matrix (N=63)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. ES outcome	1.0													
2. Enterprise system strategy	.46***	1.0												
3. IT organization	.51***	.47***	1.0											
4. ES integration	.54***	.51***	.45***	1.0										
5. ES project management	.56***	.69***	.51***	.50***	1.0									
6.IT infrastructure	.60***	.51***	.70***	.54***	.52***	1.0								
7. IT human resource	.41***	.43***	.55***	.21*	.25**	.50***	1.0							
8. Organizational learning	.50***	.44***	.49***	.36***	.70***	.50***	.23*	1.0						
9. ES competence	.44***	.25**	.50***	.36***	.27**	.42***	.49***	.21*	1.0					
10.Organizational culture	.62***	.43***	.56***	.42***	.61***	.57***	.23*	.55***	.27**	1.0				
11. Change process	.60***	.41***	.43***	.47***	.53***	.58***	.45***	.55***	.26**	.60***	1.0			
12. Change strategy	.58***	.50***	.46***	.73***	.51***	.45***	.32***	.45***	.26**	.60***	1.0			
13. Business processes	.60***	.48***	.49***	.48***	.54***	.49***	.33***	.62***	.16	.63***	.57***	.56***	1.0	
14. Knowledge and information	.61***	.43***	.41***	.41***	.50***	.45***	.34***	.50***	.36***	.62***	.62***	.58***	.59***	1.0

*. p<0.1 **. p< 0.05 ***: p<0.01

5.4. Analysis and Result

As mentioned above, this research adopted multiple regression as an analytical method. According to the factor analysis, the IT infrastructure is a two-factor construct, the strategic alignment is a four-factor construct, the organizational learning and competence building is a two-factor construct, and the organizational transformation is a three-factor construct.

Based on the measurement construct suggested by factor analysis, a series of regression analyses was performed to test the relationship between dependent variables, independent variables, and moderating variable. The regression model derived from the research hypotheses is:

$$\begin{aligned} \text{ES outcomes} = & \alpha + \beta_1 * \text{IT infrastructure} + \beta_2 * \text{BPR} + \beta_3 * \text{Knowledge management} \\ & + \beta_4 * \text{IS management} * \text{IT infrastructure} + \beta_5 * \text{IS management} * \text{BPR} + \beta_6 * \text{IS management} * \text{Knowledge management} \end{aligned}$$

Where:

α : Constant

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$: parameter coefficient

We tested the research model by identifying the impact of the main effects and interaction effects. The first model that tested the relationship between dependent variables and independent variables was a benchmark against which to test the

moderating effects of IS management capability on ES outcomes. We then tested the moderating effects. Because of the small data sample and high correlation between moderating variable and independent variables, we added the moderating effects one by one.

5.4.1. Main Effects

Table 5.18 summaries the results of the multiple regression. Model 1 tests three hypotheses regarding the impact of independent variables on dependent variable. The main effects model yields an adjusted R^2 of 51.7% and a significant F-test of overall model fit.

Hypothesis 1 suggests that the level of IT infrastructure capability is positively associated with ES outcomes. Supporting the hypothesis, model 1 demonstrated a positive and statistically significant effect of IT infrastructure capability on ES outcomes. Hypothesis 2 predicted that the level of BPR capability is positively associated with ES outcomes. Supported by the regression model 1, BPR has a positive and statistical significant effect on ES outcomes. Hypothesis 3 predicts that the level of knowledge management capability is positively associated with ES outcomes. The positive and statistical significant effect of knowledge management on ES outcome supports this theoretical proposition.

Table 5.18: Results of Multivariate Regression

Dependent Variable: ES outcomes								
Variables	Model 1: Main Effect		Model 2: IS management moderate IT infrastructure		Model 3: IS management moderate BPR		Model 4: IS management moderates knowledge management	
	β	<i>t test</i>	β	<i>t test</i>	β	<i>t test</i>	β	<i>t test</i>
Intercept	1.25*** (0.561)	2.227	1.850*** (0.692)	2.673	1.660** (0.678)	2.447	1.840*** (0.680)	2.706
IT infrastructure	0.361*** (0.114)	3.154	0.190 (0.163)	1.161	0.319** (0.121)	2.639	0.298** (0.121)	2.464
BPR	0.208** (0.093)	2.222	0.174* (0.095)	1.825	0.073 (0.156)	0.47	0.186* (0.093)	1.985
Knowledge management	0.232** (0.088)	2.632	0.193** (0.091)	2.119	0.213** (0.090)	2.365	0.038 (0.156)	0.24
IS management * IT infrastructure			0.136 (0.094)	1.456				
IS management * BPR					0.124 (0.116)	1.073		
IS management * knowledge management							0.177 (0.117)	1.502
Adj. R ²	0.517		0.526		0.518		0.527	
F-test	22.033***		17.385***		16.858***		17.460***	
Incremental F-test			0.706		0.384		0.7522	

Note: parentheses indicates the standard error of the coefficient

*: $p < 0.1$ **: $p < 0.05$ *** $p < 0.01$

In sum, the results of the main effects model support the main hypothesis that IT infrastructure, business process reengineering, and knowledge management are positively associated with ES outcomes. As predicted, all three variables have a positive and statistically significant effect on ES outcome ($p < 0.05$). The main effects model suggests that the ES outcome can be better explained by taking into

account the practice of enhancing organizational IT infrastructure, BPR, and knowledge management capabilities.

5.4.2. Moderating Effect

Hypothesis 4 predicts that the association between ES capabilities (IT infrastructure capability, BPR capability, and knowledge management capability) and ES outcome will be greater with higher levels of IS management capabilities. We tested the moderating effect of IS management capability on IT infrastructure, BPR, and knowledge management separately. To capture the moderating effect of IS management capability, we applied an incremental F-test as documented at the bottom of table 5.18. None of the incremental F-test statistics is significant at the level of $p < 0.05$. In other words, there is no evidence from the quantitative data that the IS management capabilities has a moderating effect on ES capabilities. Also notable is that the main effect of IT infrastructure disappears when its interaction with IS management capability is included in model 2. Similarly, model 3 and model 4 indicated that the statistical significance of BPR and knowledge management disappear when the interaction effect is considered. There are two possible explanations for the vanishing of the main effects. First, the vanishing of the main effects could be explained by collinearity problems between ES capabilities and IS management capabilities. Second, it is very likely that there exists a compound effect between IS management capabilities and the three main effects.

5.5. Summary

The quantitative study investigates the effects of IT infrastructure, BPR, knowledge management, and IS management capability on ES outcome. Of these, the moderating variable – IS management capability – is treated as a dummy variable. Statistical regressions indicate the positive relationship between IT infrastructure, BPR, and knowledge management and ES outcome. Table 5.19 summarizes the statistical test of the four research hypotheses.

Table 5.19 Statistical outcome of four research hypotheses

Research Hypothesis	Outcome
H1: The level of IT infrastructure capability is positively associated with ES outcome.	Accept
H2: The level of BPR capabilities is positively associated with ES outcome.	Accept
H3: The level of knowledge management capability is positively associated with ES outcome.	Accept
H4: The association between ES capabilities and ES outcome, posited by hypotheses 1, 2, and 3, will be greater with higher levels of IS management capability.	Reject

Although the dynamic capabilities perspective suggests the moderating effect of higher-order IS management capabilities on competence coordination, integration, reconfiguration, and transformation, no moderating effect is detected from the available quantitative data. The failure to support the theoretical proposition could be explained in two ways. First, the correlation matrix presents positive and strong correlations among measurement constructs, suggesting the potential of collinearity problems in the measurement of the moderating effects. Second, the

sample size imposes methodological restrictions on the performance of advanced statistical analysis. In addition, the small sample size is often subject to the attenuation effect, causing difficulty in detecting statistical relationships (Stevens, 1996).

While the empirical research provides valuable insight into how and why firms achieve effective ES deployment and utilization, this study was subject to some methodological limitations. The deviation of quantitative research outcome and theoretical proposition also suggest a need to further investigate the role IS management played on ES deployment and utilization. Recognizing that IS management capability is embedded in organizational routines and strategic events, we conducted further research in the form of interviews to investigate the role of IS management.

CHAPTER 6. QUALITATIVE ANALYSIS

6.1. Introduction

In this study, we were motivated to conduct research interviews for two reasons. First, the small sample size and methodological limitation of the quantitative analysis raised concerns about the reliability and generalization of research outcomes, making supplemental interviews a necessary step to further investigate the research questions. Second, our quantitative research outcome does not support the hypothesis of the moderating effect of IS management capabilities on ES deployment and utilization. Such an empirical finding is inconsistent with other IT research suggesting the causal link between IT management, resource deployment and utilization, and outstanding IT outcome (Mata, Fuerst, and Barney, 1995; Ross, Beath, and Goodhue, 1996; Feeny and Willcocks, 1998; Bharadwaj, 2000). Inconsistent findings always invite different approaches to capturing alternative perspectives and exploring interesting issues (Layder, 1993). Considering qualitative research as an effective method to buttress quantitative data (Miles and Huberman, 1994), this study conducted seven interviews with representatives of four organizations to supplement and validate research outcomes.

This chapter discusses the impact of dynamic capabilities in ES deployment and utilization. The qualitative research findings support the presence of IS management capabilities and provides ample evidence of the moderating effects

of dynamic ES management capabilities on the integration and coordination of IT infrastructure, business processes, and knowledge management.

6.2. Research Findings

The qualitative data suggests that while the benefits of ES are rooted in the management of IT infrastructure, business processes, and organizational knowledge, the strategic implications of these ES capabilities is moderated by IS management capabilities. In most of the cases, the IS management capabilities and ES capabilities are two sides of one coin, to the extent that the IS management capabilities pave the evolutionary path of the ES capabilities. The following section provides an overview of the organizational environmental context. This is followed by a discussion of IS management capabilities in practice.

6.2.1. Environmental Context

In the past three years, unstable economic and political conditions have changed the business environment and competitive rules. Such an impact is especially obvious in the high-tech industry where the firms have experienced industrial consolidation and harsh competition during the economic downturn. In order to survive, the organization needs to be effective and efficient in cost control and product value-added. As the CIO of the electronic manufacturing company (EMC) and CIO of the semi-conductor company (SCC) commented, the

economic recession and decreased profit margins constantly challenge the firm's flexibility and capability to improve services around an information strategy.

In comparison with the high-tech industry, which has experienced a lot of turmoil and fear of consolidation in the past few years, the biotech industry is relatively stable. As a major player in the industry, the health-life science company (HLC) has steadily expanded by continuous acquisition and divestment. However, apart from the different competitive environment and industrial structure, the HLC also faces the challenge of information integration and communication across distributed, autonomous entities.

Compared with the business sectors, the educational institution competes in a unique environment. Public funding and enrollment rates are two big challenges determining the competitiveness of the institution. As such, the key IT challenge is to meet the computational requirements of the faculties, the information support needs of the administration system, and the technological expectation of the students. A stable and reliable IT infrastructure is essential to the provision of information services.

The shift in business and technological requirements has induced the adoption of the integrated ES for seamless information support. Yet, implementing ES often requires the renewal of IT infrastructure, business processes, and IT/business knowledge. In addition, successfully capturing the value of ES required

management capabilities to align ES deployment with business strategy, to transform organizational process, and to facilitate information sharing. These processes challenge the organizational capability in strategic planning, change management, and knowledge transfer.

6.2.2. Strategic Alignment

Strategic alignment is a multi-faceted issue involving the alignment of IT and business strategies and functional integration between IT and the organization (Henderson, Venkatraman, and Oldach, 1996). It is the heart of strategic ES deployment and utilization because it outlines a road map by which the ES/business relationship is identified and shared across the organization.

In his empirical research on global ES implementation, Grant (2003) addresses the difficulty of attaining strategic alignment. He suggests that the success of strategic alignment largely depends on organizational capability in effectively developing and aligning ES and business visions and strategies, structuring and governing IT organization, managing ES projects, and controlling ES risks. Indeed, these practices provide pivotal points in the development of the long-term integration and coordination of the IT infrastructure, business processes, and organizational knowledge repository. Strategic alignment thus is one of the major mechanisms and competitive necessities that determine the firm's ability to reap profit from ES investment.

In the context of our conceptual framework and literature review, we assess strategic alignment in terms of the strategic role of ES, ES and business integration, ES implementation strategy, and the role of the IT department.

6.2.2.1. Practice of Strategic Alignment

Strategic role of ES. In their effort to trace the processes of ES implementation and deployment, Markus and Tanis (2000) suggest that organizations often use ES to solve technological and business issues. Our qualitative data support their proposition. Among the four organizations that we interviewed, one was motivated by technological issues and the others by business requirements. The educational institution (EI), for example, highlighted the technological bottleneck caused by obsolete systems. “The mainframe-based administration system is about 30 years old,” the executive project director told us. “The old machine’s parts are not supplied at the current time. We are running the risk of hardware platform failure and this hardware problem is compounded with business needs.”

Yet, in spite of different driving forces for ES acquisition and adoption, all the firms address the importance of adopting an integrated information package and a central database to facilitate the information consolidation and integration, which supports information needs in a distributed business environment. For example, to meet the challenges of shortened lead-time and increasing industrial consolidation, the semi-conductor company (SCC) built a data warehouse to provide instant and up-to-date information to enhance organizational competitive

capability. Similarly, the executive project director of EI also described the role of ES as a utility for handling large volumes of information to meet real demands. The health-life science company (HLC), facing the onerous and complex task of integrating information and business processes across heterogeneous entities, chose ES implementation as a viable means to achieve a standardized business process. The global manufacturing manager of HLC described the strategic role of ES in this way:

In the past three years, the company has grown by acquisition and divesting areas of the business that were not expected to meet or did not appear to have a chance of meeting growth targets. . . . Now, we've got several different business units. In most areas, we've got completely different systems and completely different processes. So the consolidation exercise today is a tremendously manual effort. . . . One of the drivers behind the investment [in ES] is the move toward a common business system globally. Secondly, it is the move towards a single database. . . . With the ES solution in place, it will allow us to do enterprise services where we are bringing human resources, finance, and procurement under centralized policy and direction.

We classified two strategic roles of ES reflecting the diverse driving forces of ES adoption. One is the utility role where ES functions as a technological utility to develop a central information repository and handle a large volume of information services. The other is the enabling role where the deployment and utilization of ES inspires innovative IT and business strategies and enables new initiatives. As the CIO of EMC commented, "ES is the glue of our business processes. It is not perfect, but it is truly the inspiration for business. It is truly quite crucial for what we do".

The strategic intention to build integrated and seamless information services means a substantial renewal of IT architecture and infrastructure, business processes, and IS skills and knowledge. This reflects the strategic implications of IT infrastructure proposed by Broadbent, Weill, and St. Clair (1999).

ES and business integration. Several practices have commonly been used to achieve ES and business integration. They include forming ES teams with top executive managers, managing ES at the corporate level to coordinate and leverage the separate visions and supporting enterprise services, allocating sufficient resources to ES projects, involving business people in ES projects, identifying key business drivers and new business models, and changing the IT infrastructure to facilitate new business models. The CIO of EI describes their practice of integrating strategic objectives with operational objectives in this way:

Part of the system's integration is making sure the technology is in agreement well but the other part is making sure that the application integrates well with the functional users. In terms of managing the overall implementation in alignment with strategic objectives and operational objectives of the university, we do have a steering committee in place. In that steering committee we judge new initiatives. So people are asked to bring forth new initiatives either from my group, the IT group, but also from the functional groups. And I would say there's more almost from the functional groups. So they're driving the evolution of the business system but they're also being asked or being required to bring forth what we call a project charter which is really a business case to identify what is it that they are trying to do, what are the resource requirements and being able to justify how this now aligns with the overall direction of the university. . . . [ES strategy] is really an evolutionary policy driven largely by functional groups' requirements, the business requirements, and we're also trying to make sure that things are being driven by the business requirements, not people's individual agendas.

EI's practice vividly reflects the complexity of achieving a coherent view across the stakeholders. As emphasized by the executive project director, connecting project with strategy is important, yet difficult. It is a learning journey that requires lots of communication and feedback, top management support, process adjustment, and technological modification. In addition, our qualitative interview data suggest that the deployment and utilization of ES is not necessarily directed by business strategies. Some firms suggested that competence in ES deployment might also inspire innovative business strategies (p. 162). The approach to ES and business alignment determines the sets of critical ES functionalities, the ongoing evolution of ES, business processes, and method of cross-functional coordination and communication.

ES implementation strategy. The ES project is often managed by top-down approaches. Major practices of ES project management include ongoing system analysis, site visit and learning from other adopters, defining key milestones, and developing incentive programs. Apart from the general steps, ES implementation strategies differ from firm to firm. In SCC, for example, the IT department drives the ES project and the data warehouse was developed around the business processes to ensure the effectiveness of information services. HLC, in contrast, redesigned its business processes to fit the ES-imposed processes. "Basically, we're looking at the system as having best practices industry wide. Where possible, we will be changing our internal processes to best utilize the system the way it was designed", said the finance manager of HLC.

Still, the other firms simultaneously changed their business processes and customized ES to maximize the strategic fit. The CIO of EI describes their experience of implementing ES:

It's been an interesting journey in that the implementation is really a starting point and now it's really identifying and understanding all the applications that need to be customized, that need to be tailored, ... Again from a work flow standpoint, are we really optimizing the overall workflow?

The effort to optimize business flow and system customization raises the concern of organizational change and knowledge management. It also challenges the existing organizational culture and structure, a notion that was extensively discussed by Hall (2002).

Role of IT department. Depending on the method of developing and implementing ES, the role of the IT department varied. For example, SCC relied on the IT department to develop the integrated data warehouse. As such, the IT department is responsible for IT architecture design, system development, and system implementation. In contrast, other organizations relied on off-the-shelf software and service vendors to fulfill the technological and competence gaps, applying a hybrid IT governance model to manage technological and management issues separately. Such a practice tends to outsource the organizational hardware and software, taking advantage of an economy of scope while centrally controlling the IT investment decisions and strategic planning.

Different IT governance models also define the role of the CIO differently. In the centralized governance model, such as that adopted by SCC, the CIO is the chief architect who defines the scope and evolutionary path of the organizational IT infrastructure and information services. Yet, in the hybrid governance model, the role of the CIO is to leverage the functional IT investment and coordinate the diverse IT requirements and visions. The global manufacturing manager of HLC describes their evolutionary IT infrastructure and role of their CIO:

It's only within the last two years that we've had a chief technology officer or a chief information officer at the corporate level. Even within our own division, that's a relatively new position. ... That position was staffed at the corporate level to attempt to bring all of these separate visions together. And again, different divisions have been doing different things, so it was recognized that we required that centralizing influence at the top to try and bring some consistency and leverage everybody's investments.

6.2.2.2. Strategic Implication of Strategic Alignment

The strategic alignment of ES and business strategy is only a starting point in effective ES implementation, deployment, and utilization. It does not deliver ES benefits to the organization directly. However, the organization benefits from developing strategic visions and operational practices to effect IT infrastructure management, business processes design, and knowledge management.

IT Infrastructure

Our findings suggest that strategic alignment moderates the impact of IT infrastructure by paving the evolutionary path and creating business vision to

maximize the benefits of IT-enabled information resources (Grant, 2003; Ross 2003). By aligning ES and business strategy, organizations develop architecture competence aligning the evolutionary path of IT infrastructure with overall organizational direction. Such architecture competence influences the IT infrastructure capability because it defines the method of information service, IT sourcing strategies, and technical requirements for IT infrastructure (Ross, 2003). For example, in its evaluation of ES functionalities in organizational information services and processes improvement, SCC scratched off commercial ES applications and built the data warehouse on the basis of the operational processes and information needs. As the CIO commented, the integrated database design and application-based information service provides great flexibility in information services and long-term IT planning. The global manufacturing manager of HLC also commented that the decision to consolidate all the business processes and move to a single platform enabled the organization to centralize IT governance and thus achieve better leverage of the organizational resources.

Business Processes Reengineering

The impact of strategic alignment on business process reengineering is manifested in the effort to identify and to ensure that the key drivers differentiating the organization from its competitors are addressed and accommodated within the new process recommended by the software. An observed common practice of coordinating and managing process change is to adopt a top-down approach by which the executive level coordinates and controls the process change. In

addition, a cross-functional team composed of functional professionals is formed with the mandate to integrate the functionalities of ES with business needs. The CIO of EI describes the impact of the executive committee on business strategy in this way:

The steering committee really has broad representation within the university and we've just actually increased the representation to include all the four faculties. The major functional groups are represented on the steering committee, the executive are represented on the steering committee. I'm a member of the steering committee; I don't drive the steering committee. The project director does but generally the steering committee is when we try to set the direction in the evolution of the strategies of where we are going. So it's not a mandated policy but it's really an evolutionary policy driven largely by functional groups' requirements . . . and we're also trying to make sure that things are being driven by the business requirements, not people's individual agendas. And generally I would say it is working well.

Despite the efforts to ensure that the ES implementation addresses the business requirements, the executive project director emphasized that this process is never easy. The effectiveness of cross-functional interaction involves organizational culture and human issues that require substantial management efforts.

Knowledge Management

The interaction of strategic alignment and knowledge management occurs when ES implementation strategy and deployment involves the issues of benchmarking organizational process, defining business process, training users, and building competence. In other words, the ES strategy interacts with knowledge management throughout the journey of ES implementation, deployment, and renewal. The global manufacturing manager of HLC described the benchmarking

of HLC's operations against other global players, both in the same industry as well as other industries, as a learning journey enhancing the strategic deployment of ES. In addition, strategic ES management interacts with business processes by virtue of enabling the organization to critically examine its business processes and to identify the core business drivers (Lee and Lee, 2000). The practice of EMC effectively reflects the relationship between ES deployment, BPR, and knowledge development. According to the CIO of EMC,

We basically do it in parallel. ... Business people thought through the steps [they] should take to do the business. In parallel, my [IT] people were looking at the SAP functionality and set up the tool and implementing schedule. So the ERP, in conjunction with the thinking of the business process, enabled us to get to a better process. ... Basically, from our perspective, we need both. We also would look at the SAP and say, "Well here's a way to buy things, here's a way to do something". Basically, we use a two-way parallel.

The ES implementation strategy and deployment is also closely associated with the methods of organizational learning and knowledge transfer. Two of the interviewed firms implemented ES internally and the others paired organizational professionals with consultants to implement and deploy ES. The diverse strategies of ES implementation and methods of acquiring technical expertise raised different challenges for the firm ranging from building technological competence to knowledge transfer and acquisition. The CIO of EI analyzed the challenges raised by IT governance in this way:

In terms of insourcing, the biggest challenges here are trying to keep our technical skills fresh, our analysis skills fresh so that we are staying current. Not so much from a technology standpoint—

again technology should be led by the business requirements and just making sure we're evolving at a pace that makes sense for the university. Outsourcing provides some interesting challenges in that we haven't discovered a model that's actually economically beneficial to us yet. A number of vendors are approaching but it's hard to at the top level understand where the financial benefits actually are. There may be some strategic reasons for doing it, so in other words maybe we can't find the skills or we can't hire the skills at appropriate market rates, so there may be other drivers as we continue to evolve. So the benefits right now having the resources to manage this evolution is a good thing. I would say we are using insourcing for the most part. We do amplify our own internal resources by using consultants, but again the consultants work for us. We are not handing over big pieces of infrastructure to consultants who are now outsource at this point.

The notion of knowledge transfer and skill renewal appears to be an important issue in preparing users to move from an old system to a new IS. While strategically important, knowledge development and transfer should come with well-implemented ES systems and IT infrastructure. As argued by the executive project director of EI, the data quality and the understanding of the process of data conversion are more grounding issues than management issues in ES management.

Summary

In general, our research interviews revealed interaction effects among ES strategy and IT infrastructure and business process reengineering (Venkatraman, 1994). Such findings support the capability perspective that regards IS management as important in coordinating and integrating organizational processes. Extending the view of ES as a strategic enabler and process tool, the case studies reveal ES strategy as having a macro impact on the approach to organizational knowledge

management. Such findings position strategic ES management as a dynamic capability, instrumental for combining, coordinating, integrating, and transforming the ES capabilities to enable effective deployment and utilization of ES. Table 6.1 depicts the strategic aspects that emerged from the research interviews.

Although strategic alignment sketches the overall strategic considerations in IT deployment, process design, and knowledge accumulation, effective ES deployment and utilization is also largely determined by the capabilities in organizational transformation, learning and competences building (Lee and Lee, 2000; Robey, Ross, and Boudreau, 2002). The following section discusses evidence of organizational transformation and organizational learning and competence building in the organizations participating in the interviews.

Table 6.1: Major practice of ES deployment and utilization

Company	Strategic alignment
SCC	<ul style="list-style-type: none"> • ES design is based on information strategy. • The key functions of ES are integrated with strategic vision, business objectives, and organizational needs • The IT team drives system development and organizational change • The IT group thinks from a business and customer perspective rather than IT perspective. • The IT team constantly communicated with users to seek out information needs and functional requirements.
HLC	<ul style="list-style-type: none"> • ES implementation is driven by the need to leverage, consolidate, and integrate information • Moving from decentralized IT infrastructure to a centralized IT governance model. • Created a position of CIO at corporate level with responsibility for leveraging separate visions and centralizing IT investments. • ES is perceived as strategic enabler for strategy initiation • Benchmarks ES practice with the industrial best practice • ES implementation is driven at corporate level

	<ul style="list-style-type: none"> • A management team comprises top managers from different functional areas to ensure the fit of the system functionality and business needs. • Uses balance scorecard to identify the strategic drivers and the correct adjustments and measurements.
EMC	<ul style="list-style-type: none"> • ES project is driven by the needs for customer information, forecast, financial flow, and supply chain management • ES project is led by top executive level • ES project is owned by business owners to ensure the fit of business needs and technological solutions • ES remains top priority
EI	<ul style="list-style-type: none"> • Implementation of ES is driven by the technological need to replace the outdated mainframe systems. However, IT is perceived as a strategic asset to standardize applications and technologies. • A steering committee with broad representation from the university manages all the initiatives and ensures the application integrates well with the functional users. • ES implementation is led jointly by IT group and business functional groups. • Implementing a new governance model to ensure that the IT decisions have a strong alignment with the strategies, the operation, and the business of the university.

6.2.3 Organizational Transformation

The key aspect of organizational transformation is centered on organizational culture and change management. These are complex issues involving changes in operational process, business rules, and job content. Although organizations do not necessarily rely on IT for organizational transformation, ES has been consistently perceived as a tool for business process change (Davenport, 1998). Indeed, ES-induced process change and organizational transformation is often valued as one of the important benefits of ES (Shang and Seddon, 2002). The global manufacturing manager of HLC describes the relationship of ES and organizational transformation in this way:

[ES] is a tool. The success or failure [of ES] is really determined by the people that are using the tool. It's an opportunity for us. We've chosen in this project to specifically avoid what we're calling big air reengineering. We're using leading practices, we're using the standard products being brought to the table by Oracle

and IBM and their role as implementation consultants. We're using their industry leading practices as a model and making sure that we identify what our key business drivers are and modifying that model to best suit our business roles. Now we're not attempting to go in and upset the apple cart and start over. So we're not doing extensive modeling of the "as is" activities we're talking about the "to be" activities as defined by Oracle and IBM who are particular businesses and then making sure that we're not missing any of our key business drivers. So the challenge from our perspective is to identify and ensure that those key business drivers, the things that differentiate us from our competitors that they are addressed and accommodated with whatever the new process design will be.

Our findings suggest that organizations often adopt a top-down approach to manage organizational change. Yet, the practice of organizational change is idiosyncratic from firm to firm. Major practices suggested by respondents include building ES applications around business change, forming cross-functional teams to foster functional buy-in, enhancing communications to champion changes in business processes and job content, and formulating an incentive program to motivate the organizational change. The following section discusses the practice of organizational transformation in terms of organizational culture and organizational change management.

6.2.3.1. Practice of Organizational Transformation

Organizational Culture. Organizational culture refers to the common norms and behavior of an organization. Organizational culture is usually reflected in the organizational structure and organizational governance model. It is one of the critical factors determining the fit of ES functionalities and business requirements (Soh, Kien, and Tay-Yap, 2000). As well, organizational culture is a key driver

determining the method of organizational change management. As argued by Danvenport (1998), the fit of organizational culture and the ES-imposed governance model is one of the determinants of the success of ES.

The qualitative research data reveal different levels of culture impact. Some firms are relatively insensitive to culture change, while others have perceived the organizational culture as a major issue in the success of the ES project. For example, the high-tech companies compete in a rapidly changing environment where firms are constantly challenged to demonstrate flexibility and agility in dealing with short product life cycles and changing customer requirements. In such a business environment, culture change becomes the norm. The CIO of EMC had this to say about their practice and perception of culture change:

We're not so good at that [culture change]. ... Here, it's a privately owned company. The level of maturity of people here is pretty high. A lot of the time when we have an issue, we work through the options, we decide on a course of action. We prepare ourselves to take that course of action and then we tell the people, "This is what we are going to do." We don't spend a lot of time talking about [whether] it is going to have any negative effects, or how we are going to affect people's jobs or behavior. Basically, we just do it and we deal with things as issues come up. From the cultural side, we're relatively insensitive, to be honest. But it's also the nature of life in manufacturing. In high-tech manufacturing, you have to be quite flexible and quite fluid. You have to be willing to change on a more constant basis.

While the CIO of EMC did not consider culture change as an important issue in ES management, HLC personnel had quite a different perspective on the impact of culture on ES deployment and utilization. In HLC, building consensus for

organizational decisions is the norm. As discussed by the global manufacturing manager, such an organizational culture imposed risks in the ES project:

It's [culture change] a risk that has been identified. The traditional culture at HLC has been one of decision by consensus. Let's get everybody together and talk about it and we'll talk about until everybody feels comfortable. Moving to this model—that's not something in today's business world that is really applicable so it's expected there will be some culture change from that perspective. Also from the individual business unit level there's tended in the past to be a lot of autonomy and do what's best for your business without necessarily considering the overall corporate requirements and stuff like that, so it's expected there will be some changes culturally as we drive towards a more centralized plan, centralized approach.

From the perspective of culture, the ES-imposed best practice challenges the existing organizational architecture and governance model. Such a challenge is especially substantial when the existing culture contradicts the centralized governance model. Relatively autonomous organizations need to take the culture issue seriously to overcome implementation hurdles caused by user resistance. A strategic concern such as this brings change management into the realm of strategic ES deployment and utilization.

Change management. Change management refers to management practices or formal programs that endeavor to alter the existing organizational culture and operational practice to achieve satisfactory business results through IT implementation (Gibson, 2003). It is a transition mechanism by which organizations control and manage the IT risks presented by the opposition between the existing organizational culture and the new working environment. As

addressed by the executive project manager of EI, change management is about the practice of preparing workers to overcome the culture shock caused by new IS and working processes. Such practice involves changes in business rules, work content, and working relationships.

We observed a common recognition of the importance of change management across the interviewed firms. Our qualitative data indicated that change management is a multi-dimensional issue that involves changing culture, building new skills, and modifying incentive policies. The CIO of EMC gave a step-by-step description of their change management procedures:

First and foremost – once we've designed the process, we spend time with the users to meet their needs, to train them, to explain to them what we're trying to achieve here. So there's the first level of awareness training. And then generally we try to get them involved in the testing and then the new process. Again, right away, you try and get them to understand what some of the issues can be in a new process. We then do some level of training with them, depending on the level of complexity of what's being changed. We tend to try to run this like an apprenticeship program. So we tend to have people who very quickly understand changes and solutions, while some others are a bit slower. So we try to pair people who quite quickly assimilate change to the ones who are a bit slower. ... [Also], there are bonus programs, like stock bonus programs with the executives and with the employees. There's regular performance appraisals and with due process. [There are] a lot of professional plans. We review those at six months and at a year and try and guide people and promote those people who demonstrate superior performance. And we try and counsel those who are a lot further behind

The effort to smooth the ES implementation, deployment, and utilization process involves the managerial leadership setting the course and scope of change management, as well as the organizational practice of championing and

institutionalizing the new working practice—an observation that reflects the notion proposed by Gibson (2003).

6.2.3.2. Strategic Implication of Organizational Transformation

IT Infrastructure

The capability of organizational transformation emerges when the organization uses ES to modify the business model and operational processes to achieve effective resource deployment and exploitation. The capability of organizational transformation moderates the strategic role of IT infrastructure to the extent that it integrates the ES application into the business infrastructure. This integration is essential in order to maximize the value of ES in process support. It also redefines the organizational information service model. The CIO of the Semi-Conductor Company provides a vivid description of how ES application integrates with the business process and organizational culture:

I think part of what we do transforms the way business works and the way people think because information is presented. The ability to understand what's happening in a project because the information is readily available really changes the corporate culture. . . . In our singular R&D environment, [the ES-enabled information services] really transformed the way people think because all the documents and work-in-progress documents are available to every employee. So in dealing in an R & D environment, we always knew that people were looking at exactly the same process. We also use a set of collaboration tools to ensure that every employee has an opportunity to edit the changes. . . . it really simplifies the process.

Business Processes Engineering

The organizational transformation capability also fosters the creative utilization of ES to enable business initiatives and innovative process design. Research interviews suggest that organizations use ES as a tool to integrate business process, improve functional communication, foster cross-functional collaboration, and facilitate a centralized enterprise service model. While the ES-enabled process redesign provides an opportunity for the organization to totally rethink and reform the business model, such a fundamental culture change is rather complicated and requires careful change management. In fact, because the process-based application interacts widely with operational processes, the success or failure of the ES-enabled process redesign greatly depends on the organizational practice of ensuring organizational buy-in and smoothing the transformation process. The global manufacturing manager of the health-life science company offers a detailed description of their change management:

As far as facilitating the change, what we're looking to do is really reinforcing in our communication out to the populace at large, and we've got an extended team of part-time sources beyond the full time people. We've got an extended team of what we're calling subject matter experts whose job is not to design the new system or the new flows but to serve as validation points for the proposed new flows. We really spend a lot of time communicating with those people and saying we're not looking at replicating what we're doing today and your job is to identify what the key business drivers are and then assist us whenever we go back out to the user community and demonstrate the business flow through the conference room pilot workshops. . . . So there is going to be a communication and feedback loop. Again, as we complete each one of these stages, we're expected to get formal signoff from the functional managers in each of these areas that, yes, we have demonstrated that we have met all of the key business drivers. . . . We spent a lot of time getting people like myself visible and familiar across other sectors so that people do have a comfort level.

. . . We are really trying to listen to people but at the same point trying to emphasize that it is not going to be the same old, that there will be a change, and get ready for the change.

Knowledge Management

The interaction of organizational transformation and knowledge management occurs when process change becomes a learning journey through which organizations accumulate process and technological knowledge and transform operational competence to competitive advantage. The organizational transformation, with contextual modification of organizational culture and business practice, is important to organizational knowledge management to the extent that the process design facilitates the understanding of the entire business flow and key business drivers. Such understanding underpins the creation of objective knowledge and information bases. The knowledge base, then, forms a common ground for cross-functional communication and facilitates organizational learning behavior. The global manufacturing manager of HLC illustrates the interaction between process design and knowledge management:

As we're defining the process, we are actually generating end user training and standard operating procedures through the software tools that they're bringing to the table. So again, as far as training the end users in subject matter . . . a lot of that will be done as part of the design process and we will drill down in a document what the new design will be, right down to the level of actual keystrokes and tutor-based documents, which will be online training tools that will be available after the rollout of the project. It'll be available for use for online training for the end user as well as reference and help information after the go-live date

In sum, the capability of organizational transformation may be expected to coordinate, integrate, and innovate the utilization of IT infrastructure, business

processes, and organizational knowledge and information. Through culture change and effective change management, the transformation may alter the thinking of company personnel as well as the method of using information. Consequently, it will contribute to the relatively tight integration between ES and the business process. Table 6.2 summarizes the practice of organizational transformation.

Table 6.2: Major practice of organizational transformation

Company	Organizational transformation
SCC	<ul style="list-style-type: none"> • ES application was built around business change. • The current and open information services have streamlined the workflow and changed the work content. • By changing the information services, ES has transformed the company's decision-making processes. • The new IT system has imposed uncertainty on user groups. As such, managing the user community is a must. • Transforming the way people think. • Using documents to keep the business process simple
HLC	<ul style="list-style-type: none"> • Ensure the key business drivers are addressed and accommodated with the new process design • Create a team to serve as validation points for the proposed new flows and business models. • The ES team comprises people from five business functional areas, HR, Finance, procurement, manufacturing, and sales order management. • Communicate with people about the new process and job change • Continuous communication and feedback to get formal signoff from the functional managers. • Prepare people to anticipate the coming change. • Paired ES consultants with corporate leaders for developing and delivering consistent messages for process change.
EMC	<ul style="list-style-type: none"> • Multi-functional group meets several times a week • Change is constant and users are well informed about the change • Incentive program is in place to motivate the organizational change
EI	<ul style="list-style-type: none"> • The university has done the analysis to ensure the choice of the best options. • A lot of change is taking place to ensure a smooth adoption of the new technology. • The implementation of the new system is perceived as a chance to reengineer the business processes. However, re-engineering the business process to optimize the use of IT

	<p>resources and make the university more effective and efficient remains a key challenge.</p> <ul style="list-style-type: none"> • Functional groups focus on making sure the functional areas are set up for the change.
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6.2.4. Organizational Learning and Competence Building

Organizational learning and competence building is an important issue determining the effectiveness of ES deployment and utilization. Organizational learning and competence building involve continuous learning and feedback to build up a knowledge base for strategic support. These are underlying forces driving the evolution of ES implementation and deployment. Through learning and feedback, the organization accumulates experience and builds up an objective knowledge base for system implementation, user training, and competence renewal. Through competence building and renewal, the organization paves the way to creative ES utilization. Although the issues of organizational learning and competence building may not attract the same level of attention as strategic alignment and processes transformation in current ES research, they are nonetheless crucial to the success of ES deployment and exploitation. According to Zello and Winter (2002), organizational learning is the major driving force propelling the evolution of dynamic capabilities.

While change programs outline the methods of modifying organizational culture and working environments, organizational learning and competence building are at the heart of organizational transformation (Roberts, Jarvenpaa and Baxley, 2003). These are the operational mechanisms by which organizations modify and

renew their knowledge infrastructure. Our qualitative data underscore user training and knowledge sharing as two major mechanisms. The global manufacturing manager of HLC provides a vivid description of their practice to modify the knowledge infrastructure and renew the IT skills:

It has been a two-year project where the initial pilot project here at HLC will be led by the IBM team but the intent is to have the knowledge transferred so that effectively the IBM component of our roll out team will diminish by a factor of about 6. ... At the project level we've assigned a person full time with responsibility for development of the training and education program. Again, starting from the top down we've almost completed this full-time project team. We're now getting it to identify the training requirements of the next level down, which is the part-time resources and then going from there down into the actual end user training documentation, and then the actual delivery of the training.

The knowledge transfer effort pinpoints the important role of user training and competence building in the process of ES deployment and utilization. Such practice influences organizational capability to strategically deploy and utilize ES, a notion discussed by Lee and Lee (2000). While organizational learning and ES competence do not directly contribute to ES outcome, they are nevertheless important issues influencing organizational capability to capture ES benefits.

6.2.4.1. Strategic Implication of Organizational Learning and Competence Building

IT Infrastructure

IT is viewed as a strategic tool that supports organizational knowledge management. ES, with the extensive involvement of business process and integrated information services, interacts with the organizational learning process in two major ways. From the process point of view, ES provides a new opportunity to transform implicit process knowledge into a codified and sharable knowledge infrastructure, providing a knowledge base for information sharing and cross-functional communication (Lee and Lee 2000). From the information point of view, the integration of information increases the transparency and consistency of organizational information and supports strategic decision-making.

In assessing the driving force of ES adoption, all the organizations commented on the importance of information integration in centralizing resource control and deployment. In addition, all the firms perceived ES implementation and deployment as a process of continuously learning to amplify the internal knowledge base and to create new competences in an on-going base. In essence, the importance of organizational learning and competence building is reflected in the ES competence of IT teams and their technological support to other functional areas. The CIO of EI comments on the implications of IT competence for ES deployment and utilization:

Knowledge accumulation, again I think the functional project teams were a good focal point for accumulating knowledge,

knowledge of the new system, building a bridge between the knowledge of the new system and the business processes that it had to support within the university and I think it was a good start in organizational learning. The project teams were comprised of people that knew how to run the Registrar's Office, for example. So they knew how all these things were and so they were able to actually accumulate knowledge for how to implement the system and how the system would actually work.

The interaction of organizational learning and competence building with IT infrastructure is important because it determines the extent to which organizations can utilize ES innovatively and effectively. It also affects the organizational capability to capture benefits from involving ES functionalities. As the finance manager of HLC commented, the technological competence of the core team is essential in providing a high level of support for users to effectively utilize ES.

Business Processes Reengineering

Organizational learning and competence building interact with the business process design to provide an objective knowledge base and information source that enables effective process evaluation and design. Such interaction creates a two-way loop linking learning and change management in the achievement of satisfactory ES deployment and process support. The CIO of the semi-conductor company attributes the success of data warehousing in strategic support to its tight integration of business applications, business rules, and standard information format. In the same vein, the CIO of the Educational Institution points out the challenges of knowledge accumulation and change management. He comments:

We tend to focus on the negative, but again because a large part of the change was driven from the functional side and the functional

side was a very key stakeholder in the whole process. Information sharing I think was done quite well; knowledge dissemination I think happened reasonably well. Because the functional groups knew how the system was going to be used, they were able to spot where the deficiencies were. In some cases I think the requirements were clear; in other cases I think the requirements may have evolved a little too haphazardly, but generally I think it was a good team effort in terms of understanding the application, understanding how the application would be implemented.

Knowledge Management

In the context of ES implementation and deployment, the organization often applies two learning strategies to manage organizational knowledge and information: knowledge transfer from consultants and user training to institutionalize the new process and information platform. The CIO of the Educational Institution describes the role of the consultant in ES implementation as a knowledge source who brings in unique ES skills or augments the existing skills of the university staff. The global manager of the Health-Life Science Company depicts their approach to training practice as a top-down approach. According to him, the company developed extensive training programs to enhance the competence level of project teams and user groups. In addition, the training documents and education programs further facilitated the internal knowledge management and competence building. “There is likely a real benefit to doing some baseline training to bring everybody up to a common level of understanding as far as what they should be expecting the system to do for them”, said the global manufacturing manager, HLC. Table 6.3 presents the evidence of organizational learning and competence building.

Table 6.3: Practice of organizational learning and competence building

Company	Organizational learning and competence building
SCC	<ul style="list-style-type: none"> • The company focuses on personal and professional development, including one to two weeks of annual training • Uses e-mail and documents to keep users informed • The company developed the system in house to maintain the high level of technological and business competences
HLC	<ul style="list-style-type: none"> • Extensive training program to help users understand the new systems and functionalities • Hire consultants for knowledge transfer • Extensive training program for full-time implementation teams, part-time human resources, and users. • Assign a person full time at the project level with responsibility for development of training and education program. • Create tutor-based documents for online training
EMC	<ul style="list-style-type: none"> • Intensive training program • The organization built up solid knowledge about the system
EI	<ul style="list-style-type: none"> • Project team accumulates solid system knowledge and competences, building a bridge between the knowledge of the new system and the business processes that it had to support within the university • Extensive training for knowledge transfer • Consultants provide expertise and training to fill skills and competencies gaps but do not involve the management issue. • Provides numerous training workshops and seminars

6.3. Summary

The qualitative interview provides multi-faceted data to identify and assess the strategic implications of strategic alignment, organizational transformation, and organizational learning and competence building. From the perspective of dynamic capabilities, these capabilities are strategically important towards capturing the value of ES. They constitute the operational platform and managerial practice which accelerate the congruence of ES deployment and business requirements. They also enable the organization to explore the benefits of ES and to creatively use ES to compete in a volatile business environment.

Although the dynamic capabilities were separated into three categories for examination, it is important to note that these capabilities are complex processes and often intertwined with one another. The development of these capabilities requires continuous learning and refinement (Zello and Winter, 2002). In addition, the strategic implications of these capabilities tend to be compounded and their outcomes manifest through strategic integration, coordination, and transformation of IT infrastructure, business process reengineering, and knowledge management to become core competences of ES. This compounded effect provides a partial explanation of the difficulty of identifying dynamic capabilities in a survey approach.

Through the personal interviews, we also found similarities in IS management across the interviewed firms. These observations indicate that dynamic capabilities are idiosyncratic in detail yet common in key features, a notion highlighted by Eisenhardt and Martin (2000). We also found that while all the firms adopted similar practices and strategies to deploy and utilize ES, each of them considered relatively different implications of ES.

In summary, the qualitative research provides an opportunity to explore the implicit organizational practices and processes. Through in-depth research interviews, we are able to identify critical issues, major practices, and core

benefits and challenges associated with flexibility in ES deployment and exploitation.

CHAPTER 7. DISCUSSION

The resource-based paradigm is a dominant theoretical perspective in the study of organizational resources and their consequential impact on sustained competitive advantage. In recent years, however, the dynamic capability perspective has become a turning point that extends the theoretical ground of the RBV paradigm from static resource analysis to dynamic integration, coordination, and transformation (Teece, Pisano, and Shuen, 1997). Applying this stream of thought to ES research, we investigated the organizational capabilities underlying effective and efficient ES deployment and utilization. Our research context is organizational practice. This approach is consistent with the view of the value-creating process of IT in which effective system deployment and utilization are necessary predecessors (Soh and Markus 1995; Tippins and Sohi, 2003). The following sections discuss the theoretical and empirical implications of this research.

7.1. Theoretical Implications

This research positions organizational processes and practices strategically in the ES implementation journey. Fundamentally, the implementation of ES is multifaceted. In this research, we conceptually discern three dimensions of ES capabilities - IT infrastructure, BPR, and knowledge management (Lee and Lee 2000; Weill and Broadbent 2000; Davenport 2000a; Tippins and Sohi 2003) - that underpin the success of ES deployment and utilization.

IT infrastructure. Both qualitative and quantitative data suggest that the IT infrastructure constitutes the essential technological backbone supporting the ES-enabled information services and integrated business model as well as facilitating on-going functionality expansion and enhancement. Without the telecommunication and physical IT support, the firm cannot benefit from the integrated business model and centralized information services (Broadbent, Weill, O'Brien, and Neo, 1996; Weill and Broadbent, 2000). Our quantitative data supports the research hypothesis that there is a positive relationship between IT infrastructure and ES outcome. Moreover, in interviews with senior IT/business managers, we found the strategic intent of implementing ES to be correlated strongly to the development of information and communication infrastructure in a distributed environment. Such a finding is consistent with the view of Weill and Broadbent (2000) that the ES project is part of the IT infrastructure. It also suggests that the many lessons learned from developing IT infrastructure are applicable to ES deployment and utilization.

In addition to the physical IT infrastructure, IT human resources are also found to be essential to ES deployment. While the technological competences are important for user support and training, our research suggests that IT human resources should also develop business knowledge and interpersonal skills to better support the process-based ES (Ross, Beath, and Goodhue, 1996; Byrd and Turner 2001). In all but one case, the firms developed partnership with an ES service provider to supplement the technological competences. In addition, a

cross-functional team was established to achieve better alignment of ES and business needs. Examining both IT infrastructure and IT human resources, we found that most of the ES adopting firms treated their ES project as a business project. In such a practice, typically, ES is not totally abandoned to the IT department. Instead, functional buy-in is viewed as one of the essential determinants for maximizing the benefits of a seamless integration of ES capabilities and business processes.

Business process reengineering. Business process reengineering was found to be critical for embedding the new processes into common routines. Our quantitative analysis supports the research hypothesis that the capability of business process reengineering contributes to a higher level of ES outcomes. Such an empirical outcome supports the view that ES is a business project rather than an IT project (Davenport, 1998; Davenport, 2000a). It also implies that accumulated BPR knowledge and experience is applicable to ES implementation and deployment.

The qualitative data further revealed that BPR is a continuous process across the life cycle of ES implementation. It is not just a unique event occurring in the early stage of system planning and implementation but a continuous process that maximizes the strategic utilization of ES (Davenport, 1998). Firms expecting to capture the benefits of ES should examine their business processes constantly to align them with the changing business environment. The CIO and ES project manager of Electronic Manufacturing Company commented that their ES project

as a continuously improving process. “The ES project will never be complete. We always look for a better way to use ES.” This typical example shows that the refinement of business processes should constantly keep up with the evolutionary pace of ES and the changing environment if firms expect to capture the value enabled by ES. It also suggests that organizations can constantly capture the benefits of ES by creatively utilizing ES to redesign business processes (Shang and Seddon, 2002).

Knowledge management. Knowledge management is identified as an essential mechanism to build up knowledge infrastructure to capture and retain internal and external knowledge. In most of the cases, organizations developed knowledge partnerships with the service providers and system vendors to bridge the competence gaps and to facilitate knowledge transfer. In addition, knowledge diffusion was often delivered by extensive user training and document sharing (Lee and Lee, 2000). Our research data support the positive impact of knowledge management on ES outcome quantitatively and qualitatively. Such findings reflect the strategic importance of knowledge management in ES deployment and utilization, a notion proposed by Lee and Lee (2000). Organizations that are capable of building and utilizing an ES knowledge repository are expected to better capture the benefits of ES.

Indeed, such empirical findings support our research proposition and theoretical assertion that firms cannot capture the benefits of ES without developing the

capabilities of IT infrastructure, BPR, and knowledge management. This finding contributes to an understanding of the fundamental driving forces of effective and efficient ES deployment and utilization.

IS management. In addition to the identification of the causal link between these ES capabilities and ES outcome, IT researchers have frequently highlighted the importance of IS management in bridging IT competences and IT outcomes (Mata, Fuerst, and Barney, 1995; Feeny and Willcocks, 1998; Willcocks and Sykes, 2000; Tippins and Sohi, 2003). The quantitative data did not support the presumption of a moderating effect of IS management capabilities on three dimensions of ES capabilities either because of the compounded effect or effects of collinearity between IS management capabilities and the ES capabilities. However, the qualitative data highlights the moderating effects of IS management capabilities on the integration and coordination of ES capabilities. Our qualitative data indicates that strategic alignment interacts with the ES capabilities by setting up an operational strategy to carry out ES implementation effectively. It also ensures a strategic fit between ES deployment and business needs. Through strategic planning, organizations also define the scope as well as the methods in business processes design and knowledge management. All of the firms that we interviewed have adopted a top-down approach to ensure strategic alignment. In some cases, the IT governance model was changed to carry out the ES strategies. Such findings confirm that strategic alignment is typically important in the

deployment of IT infrastructure and the design of business processes (Grant, 2003).

The capability of organizational transformation highlights the importance of organizational flexibility and innovativeness in process and culture change to capture the ES-enabled business benefits. All the firms have developed change plans to increase system buy-in. In our qualitative research, we observed both radical and evolutionary change processes. Some firms progressively release signals of organizational and job change, while others force the user to buy-in. The empirical data suggest that the progressive approach fosters a smoother organizational transformation. Besides the change plan, we also observed the impact of organizational culture on ES deployment and utilization. Firms that delegate authority and responsibilities to ES teams seem to have better control of the organizational change. Furthermore, incentive systems and evaluation mechanisms have also been demonstrated to be effective tools to motivate effective organizational transformation. This evidence suggests that organizational transformation is a socially complex issue that demands extensive management attention, reflecting the concept of dynamic capability suggested by Teece, Pisano, and Shuen (1997).

Ultimately, organizational learning and competence building is revealed in two ways: knowledge acquisition and knowledge transfer. Information sharing, cross-functional communication, and user training are common practices of

organizational learning. Indeed, IS management capabilities are operational mechanisms associated with ES buy-in and its creative usage. According to the CIOs and project managers, the level of ES competence determines users' appreciation of the functionalities provided by ES. It also affects competence in identifying functionality gaps and the requirements of operational processes. Such capabilities are idiosyncratic and closely intertwined with the organizational practice of change management.

Based on the evidence of the moderating effect in our qualitative data, we conclude that IS management capabilities are necessities for achieving effective ES outcomes. Such findings support the assertion that dynamic capabilities are competitive necessities only. IS management capabilities affect the outcome of ES by influencing the level of IT infrastructure, BPR, and knowledge management. As such, firms that possess outstanding IS management capabilities are expected to outperform those that do not.

ES and Competitive Advantage. Our empirical data support the research hypothesis that implementing ES is not sufficient to deliver business value. Rather, ES outcome depends on IT infrastructure, BPR, knowledge management, and IS management capabilities. Based on this view, the standard ES applications provide business opportunities only. Our findings suggest that capturing ES-enabled value-adding opportunities is a socially complex issue that often requires fundamental changes in organizational and IT infrastructure, operational

processes, and the knowledge repository. Stated differently, the process of capturing ES-enabled business value involves developing robust IT infrastructure, redesign of business processes, and development of ES knowledge infrastructure (Davenport, 2000a). In addition to these fundamental issues, firms should also develop IS management capabilities to coordinate, reconfigure, and integrate these capabilities. Our quantitative data also reveal that the IS management capability is common in key features but its details are strongly correlated with the organization's evolutionary path and managerial decision-making. Our findings expose the myth that ES can provide competitive advantage directly by supplying the missing pieces of how firms achieve effective ES deployment and utilization.

7.2. Practical Implications

This research sought to uncover the sets of organizational routines that carry out the mandate of ES deployment and utilization and to identify how the coordination and integration of these routines drive business value creation as a result of ES deployment. Based on the theoretical premises, the organizational routines are dynamic capabilities that can serve as both strategic drivers for and constraints on ES deployment. Organizations that expect to benefit from ES investment should develop effective ES capabilities to integrate ES with strategic needs. Our findings suggest that robust IT infrastructure, processes design, knowledge management, and flexible IS management are essential to effective and efficient ES deployment and utilization. These capabilities represent the

substance of the organizational business and IT strategies. Organizations that have clear ES visions are capable of designing business processes to capture the benefits of ES, and are effective in accumulating ES knowledge and competence from internal and external sources and from the ES implementation process itself, are expected to be more successful in deploying ES strategically. Furthermore, organizations that are capable of integrating ES deployment around business change demonstrate operational efficiency and flexibility in information resource utilization and sharing. Thus, ES capabilities are a competitive necessity for effective ES deployment. They may also represent stumbling blocks in ES deployment, however, if firms fail to develop them effectively and use them efficiently.

CHAPTER 8. CONCLUSION AND FUTURE RESEARCH

The strategic implication of IT has been a major concern to both researchers and practitioners as organizations constantly invest great portions of their revenue for information technologies. The transition to ES magnifies this issue to the extent that the success or failure of system implementation causes direct impact to organizational survival and methods of business operation. However, despite the struggle to navigate the swamp of ES implementation, a clear understanding of the business practices involved in achieving outstanding ES deployment and utilization and the strategic implication of adopting an application package has remained elusive.

This research utilized the concept of dynamic capability to explore the process issue of ES deployment and use. This research illustrated that organizations cannot benefit from ES by simply owning the system. Rather, the benefit of ES derived from how the IT infrastructure, organizational processes, and knowledge repository are configured and applied to execute business strategies. We further identified the dimensions of IS management capabilities that may either enhance or impede the process of ES benefit generation and accumulation. Research findings indicated that these ES capabilities are essential to create valuable ES outcomes. The following sections discuss the contributions and limitations of this research. This is followed with the conclusion and directions for future research.

8.1. Contribution

This research makes three major contributions. First, by applying the concept of dynamic capabilities, this research provides a theoretical explanation of the process of ES value creation. It also establishes the theoretical ground to address the question raised by Weill and Broadbent (2000) about common IT infrastructure. By exploring the impact of organizational context and management practice, this research positions the organizational practice in ES deployment and utilization as a unique and imperative aspect of value creation. Such an approach offers a new avenue for strategic IT research.

Second, this research contributes to both ES and RBV research to the extent that we provide a substantial indicator for capability measurement. The development of the RBV paradigm has been asymmetrically focused on qualitative research. However, by interpreting business routines as organizational capabilities, quantitative measurement becomes feasible.

Third, this research demonstrates the methodological benefits of combining both qualitative and quantitative research methods in research design. This combination effectively reduces the vagueness of research theory and enhances the reliability of research outcomes. It is especially beneficial when the research theory is in the emerging stage and empirical quantitative references are scarce.

Without combining both methods, we cannot elicit the important yet implicit impacts of IS management capabilities on ES deployment and utilization.

8.2.Limitations

This research is one of the first attempts to understand the practice of ES deployment and utilization and to capture and measure the relationship between organizational practice and ES outcome. While this study employed a combination of quantitative and qualitative research methods to cross-check the research results, a methodological concern was identified in the process of quantitative data analysis. With restricted sample size, the analytical processes are subject to the problem of low power, yielding a relatively conservative prediction. Indeed, the small data sample tends to attenuate and bias the data analysis, suggesting the need for caution in the interpretation of statistical outcomes. Such sample and methodological limitations suggest the need for future research to explore the moderating effects of management capabilities on ES outcomes by using advanced statistical techniques such as structural equation modeling or partial least square techniques.

In addition to the methodological concerns, this research is also subject to data gathering concerns. First, the research informants are limited to North America only. Such a confined data source may weaken the generalizability of the research findings in different geographical settings. Second, the qualitative data is centered on the research themes only. While such a research focus enhances the

effectiveness of data collection, it may also miss some important issues that are not captured from the outset. Indeed, the process-oriented questions have limited our ability to capture the problems that may rise either from different strategic implications of ES in organizations or from insufficient management capabilities. Furthermore, our qualitative data also subject to top managers' perspective only. It did not capture the users' perspective in ES deployment and utilization. As such, we have limited ability to assess the gap between ideal outcome and reality. Thirdly, the current study captures snapshot information only, and thus is limited in its ability to compare the impact of ES capabilities across the journey of ES implementation. Fourthly, this research is focused on ES management rather than the generic IT management. As such, any general application of findings to IT management should be undertaken with caution. Finally, the outcome of qualitative research is subject to the researcher's experience and skills in capturing the information from interview data. We found significant information overlap in some research questions. This created challenges in categorizing the qualitative data appropriately.

8.3. Future Research

In sum, the theoretical framework and measurement instruments ground the logical link between the RBV paradigm and ES implementation. In particular, this study provides a theoretical foundation for the major processes leading to effective ES outcomes. Using the perspective of dynamic capabilities, we unfolded the managerial issues and practices in the journey of ES acquisition,

deployment, and utilization. Indeed, the theoretical implications suggest that ES adopters will benefit from ES-enabled strategic flexibility and agility by effectively managing ES-associated IT infrastructure, BPR, and knowledge management.

Despite the theoretical contribution and research findings, future research is needed to verify the measurement construct and research model by using different analytical strategies. Current research positions organizational routines within the context of strategic IT management. From the information technology point of view, this research answers the question of how organizational routines such as organizational strategy, processes, and learning, influence the outcome of IT deployment. However, what is not clear is the interaction effects of the independent variables and the three dimensions of moderating variables and their consequential implications for ES outcomes. A large data sample analyzed by the special techniques of latent construct, such as partial least square and structural equation modeling, is needed to further explore the interaction effects among independent variables as well as the interactions among the three dimensions of IS management capabilities.

Examining the qualitative research method, we note two issues that require further investigation. First, our research approaches the dynamic capabilities by capturing the practices that are necessary for effective ES deployment and utilization. Such an approach, however, cannot identify the associated problems that may occur in

the journey of ES implementation. Further investigation is needed to investigate the implications of dynamic capabilities from strategic, business, and operational aspects. Second, this research provides a snapshot of ES capabilities only. Future research may apply the longitudinal research design to capture the evolution of dynamic capabilities and their consequent impacts.

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Appendix 1. Process and Outcomes described in Each Secondary Data

Data source	Chartering	ES Project rollout and system shakedown	Onward and upward
Quantum's Leap (Radosevich 1997)	<ul style="list-style-type: none"> • ES is perceived as the solution for service differentiation • Big-bang approach • Select ES from Oracle and bring in consultants from Price Waterhouse and HP 	<ul style="list-style-type: none"> • Project team involved top managers, business managers, and key employees from each business units. • Extensive testing and training to promote user buy-in. • Renew IT infrastructure • Assign process owner • Design change procedures • Strong project leadership • Success system implementation after extensive effort and preparation. 	<ul style="list-style-type: none"> • Enhanced business capabilities.
Digital China Holdings Limited (McFarlan, Chen, and Peimers, 2002)	<ul style="list-style-type: none"> • Adopted SAP R/3 to enhance information visibility and integrity of management systems • ES implementation is perceived as management system reform 	<ul style="list-style-type: none"> • Experience stagnation in the early stage of system implementation when managers perceived ES as a tool only. • Organizational restructure during the ES implementation • Restructure the project team • Strong management involvement to ensure the success of the project. • Ongoing user training and corresponding appraisal system. • System rollout successfully. 	<ul style="list-style-type: none"> • Benefits from improved inventory control and production flexibility • Use ES as platform for B2B and supply chain management • Use ES as platform to support organizational transformation

Nestle (Worthen, 2002)	<ul style="list-style-type: none"> • SAP was adopted to transform the separated autonomous structure into a highly integrated company 	<ul style="list-style-type: none"> • Project team is constituted by senior managers and IT professionals • Communication is a issue at the early stage of ES implementation • Poor user training and knowledge accumulation • The rollout had collapsed into chaos. • User presents the knowledge gap to the new business process. • The project started all over again with strategy of slow and steady wins. 	<ul style="list-style-type: none"> • Achieved significant savings on ROI. • A trustworthy demand forecasts
Siemens Power Corporation (Hirt and Swanson, 1999)(Hirt 2000)	<ul style="list-style-type: none"> • The adoption of SAP is driven by technological reason. • Project budget is approximately \$5 million and 220 users were scheduled to work on the system by 1997 • Phases approach • A careful assessment in terms of fit and system features • Negotiate a tough consulting contract to ensure budget control and knowledge transfer 	<ul style="list-style-type: none"> • Provide narrative descriptions to supplement insufficient user training • Strong management support • Change management • Process redesign • User involvement • Strong project leadership • First set of modules goes live on time and below budget but experience user resistance. • Significant knowledge accumulation and user skill enhancement in the second phase of ES implementation 	<ul style="list-style-type: none"> • Experience operational efficiency and enhanced cross-functional collaboration through integrated database. • Applied the processes and system knowledge for innovative ES utilization and functionalities improvement

International Multifood (Price and DeSanctis, 1999)	<ul style="list-style-type: none"> • ES project is initiated with the purpose of reengineering of business processes • ES is developed in-house 	<ul style="list-style-type: none"> • No international multifood managers were on the project team. • Project performance management and risk control is always an issue. • Pilot causes disastrous outcome – long wait time, order-taking errors, stock-outs, pricing errors, and service unreliability. • Mounting human resource problems. 	<ul style="list-style-type: none"> • Continuing loss of customers
Moore Medical Corporation (Mcafee, 2001)	<ul style="list-style-type: none"> • The ES project is assisted by Arthur Andersen Consulting 	<ul style="list-style-type: none"> • The project costs nearly \$7 million and experiences significant cost overrun • Moore satisfied of the system capability but felt that the information retained are not fully utilized. 	<ul style="list-style-type: none"> • The system proved to be passive and reactive to demand. • Moore is facing the decision of investing in the CRM system.
Metalica (Avital and Vandenbosch, 2000)	<ul style="list-style-type: none"> • ES is motivated by BPR • A clear vision of system impact and benefits 	<ul style="list-style-type: none"> • Adopts phases approach to accumulate experience • Reform project partner and team leader when needed • Expanded the core team with skilled and experienced personnel • SAP was not thoroughly tested before go live. • Pilot implementation is a disaster and the pilot site experienced turmoil effects and losing customers. • Change the training approach from job-orientation to process-orientation to provide logical rationale of the new business process. 	<ul style="list-style-type: none"> • Experienced the integrated business process and operational efficiency. • Metalica reported significant sales growth in 1998 compared with 1997.

Cisco Systems, Inc. (Cotteleer, Austin, and Nolan, 1999; Noland, 2001)	<ul style="list-style-type: none"> • ES project is initiated to support the long-term organizational growth • Big-bang approach • Contracting KPMG for consulting services 	<ul style="list-style-type: none"> • Strong managerial support • Strong project team • Effective training and knowledge accumulation • Strong vendor commitment from Oracle, the hardware vendor, and KPMG • ES was completed successfully and on time. • Using the “conference room pilots” (CRP) approach to develop a deeper understanding of the software and its process impacts. 	<ul style="list-style-type: none"> • Standard and flexible IT platform architecture • Web-enabled processes – create end-to-end capability; e-platform, and supply chain management
Tektronix, Inc. (Westerman and Cotteleer, 1999)	<ul style="list-style-type: none"> • ES project is launch to support information needs of rapid growth business. • Clear project vision 	<ul style="list-style-type: none"> • Management support • Develop a global business model • Develop a set of “business practice change guideline” • Strong business and IT leadership. • Paired consultants with Tektronix employees for system implementation • System rollout is success. • Tektronix learns and accumulates knowledge from each stage of ES implementation 	<ul style="list-style-type: none"> • Information visibility, enhanced inventory control and better business decision- making. • Tektronix benefits from increased efficiency and standardization.

IBM Technology Group (McAfee and Herman, 2000)	<ul style="list-style-type: none"> • Adopted SAP R/3 for global integration 	<ul style="list-style-type: none"> • Start global SAP R/3 rollout in 1994. • Experiencing difficulties in early implementation because of lack of familiarity with R/3 system. • Establishing set of standards for SAP implementation across functional areas. • Accumulate SAP knowledge for global implementation • Significant resistance from users about the standard imposed by SAP. • Top management support for new technology and processes • The deployment of IT infrastructure is internally focused and not integrated with external business partners. 	<ul style="list-style-type: none"> • IBM realizing SAP benefits in terms of worldwide common processes, business flexibility, customer responsiveness, warranty tracking, worldwide inventory management, business control, and decreased IT budgets. • Considering expanding ES functions with B2B integration
FoxMeyer Drug Corporation (Scott and Vessey, 2000)	<ul style="list-style-type: none"> • Clear business vision and strategy for the ES adoption • Big-bang approach • Restructure organization prior to ES initiation. • FoxMeyer was uncertain if ES can process large volume of transaction 	<ul style="list-style-type: none"> • Inadequate training and system knowledge • Inadequate change management • The system interface problem with new customer resulted in millions of dollars in inventory loss • Damaged inventory and losses from duplicate shipments cost \$15.5 million 	<ul style="list-style-type: none"> • Bankrupt after the project failure.

<p>Geneva Pharmaceuticals (Bhattacharjee, 2000)</p>	<ul style="list-style-type: none"> • ES project is driven by BPR • Adopted SAP R/3 for generic sector. However, each generic subsidiary proceeded with its own independent R/3 implementation that limited data sharing across subsidiaries. • Adopting phases approach 	<ul style="list-style-type: none"> • Change leadership when project showed signals of out of control. • Several R/3 basis personnel and Oracle database administrators were hired on full-time basis. • Thorough pilot testing • Phase I was not done in the most effective way and very success. • Replace the consulting firm from technical-orientation to operational process-orientation for phases II and III implementation. • Process model redesign. • Training was job-oriented rather than on how to use the system. • Assign change agents. 	<ul style="list-style-type: none"> • Improved decision-making processes. • Job roles were streamlined, standardized, and consolidated. • Capable to leverage with future technology improvements and process innovations.
<p>NIBCO (Brown and Vessey, 2001)</p>	<ul style="list-style-type: none"> • ES project is initiated based on long-term growth 	<ul style="list-style-type: none"> • Clear project time frame, scope, and budget • Form a triad leadership team. • Hire IBM to be an implementation partner • Allocate full time based human resources • Initiate weekly newsletter. • Allocate bonus incentive • Extensive user training • Expect short-term operational turmoil but confident of long-term ES benefits in terms of operational improvement, inventory cost reduction, and increase of return of investment. 	<ul style="list-style-type: none"> • N/A

University of Nebraska (Sieber, Siau, Nah, and Sieber, 1999; Lee and Lee, 2000)	<ul style="list-style-type: none"> • ES project is initiated base on the understanding of both business and technological needs. • Partner with IBM 	<ul style="list-style-type: none"> • Strong management support • Form a powerful team • Fit-gap analysis • The university is restricted for system customization because of the legal agreement with SAP. • Articulated business process and rules. • ES project was completed on time. • Campus transition teams were formed to serve as change facilitators and agents. • Experienced effective functional communication and knowledge transfer. 	<ul style="list-style-type: none"> • The university experiences enhanced operational efficiency.
Dow Corning Corporation (Ross, 1999; Scott et al. 2000)	<ul style="list-style-type: none"> • ES project is motivated by the need for global supply chain • ES project did not use implementation partner. • Adopt full range of ES modules with limited modification. 	<ul style="list-style-type: none"> • Established a committee consists of senior level officers and combined IT function with business process. • Identify key processes needed for integration • Good organizational culture • Pilot testing showed problems of user training and change management • Implementation teams experiences the limited understanding of local practice. • Valuable experiences are learned from the pilot implementation • The company provided extended training for area team members. 	<ul style="list-style-type: none"> • Expected integrated business processes and better information control.

<p>Owen's Corning (Brown, 1998)</p>	<ul style="list-style-type: none"> • Adopted "good enough" process reengineering 	<ul style="list-style-type: none"> • A consultant team was engaged to work with reengineering team • Devote full IT resources to ES project • A top-down leadership support • Aggressive project schedule • Full time consultant to serve for system integration and project management • Renew reward system • Set up a superstructure for coordinating contacts across the IS consultants. • In the early phase of system implementation, Owen's Corning claimed the system benefits regarding cost reduction, increased productivity, and process-oriented structure • Take organizational learning from earlier releases • Develop new capabilities through knowledge transfer • Global rollout was conducted in 70% certification level. 	<ul style="list-style-type: none"> • The big-bang rollout causes turmoil effect in business operation.
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Omega (Krammergaard and Rose, 2002)	<ul style="list-style-type: none"> • A perceived need for better communication and data integration • Choose SAP R/3 after the evaluation of several ES systems • Choose big-bang approach. • Decide to build-up internal ES experience with the help of external consultants. 	<ul style="list-style-type: none"> • ES project is conducted by steering committee, project group, super users, and internal consultants • Fit-gap analysis • Regular project meeting • Super-user and regular user training • First three months after system went live were characterized as chaotic – large backlog of production and late delivery. • Deliberate problem solving, system tuning, and user training. However, the company experienced deficit in the fiscal year. 	<ul style="list-style-type: none"> • User skill building • Aligning ES with business needs • ES focus is turning to configure the system when necessary and take in new functionality and modules to improve business performance and upgrading the system.
Provincial Power Corporation (Minsky and Newson, 2000)	<ul style="list-style-type: none"> • Adopts beta version of SAP IS-U/CCS • Hire Price Waterhouse to assist the implementation of ES. 	<ul style="list-style-type: none"> • PPC managers shadow PwC consultants to learn important project management and technological skills. • Strong management support • Project performance and risk control • Fit-gap analysis • The pace of system development was slow down at SAP and caused project control issues such as time pressure, budget constraints and technical problems. • Because of time constraints, training and user preparation was cut short. 	<ul style="list-style-type: none"> • N/A

<p>Dead Sea Works (Pliskin and Zarotksi, 2000)</p>	<ul style="list-style-type: none"> • IS change was initiated due to technological and organizational reasons. • Choose the R/3 ERP, the Oracle DBMS, and the HP server hardware. • Big-bang system transition; avoid system customization 	<ul style="list-style-type: none"> • Risk management through carefully controlling project size, technology, and structure. • Understanding business process • Strong top-management support. • Hire special trainers. • Establishing a flexible and responsive computerized help-desk with trained individuals. • By January 1, 1999, all the planned modules are working. • No resistance was observed. 	<ul style="list-style-type: none"> • Improved business results, technology replacement, and reduction in the total cost of technology ownership. • Create a platform for future process reengineering and integration.
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Appendix 2 Cover Letter

< date >

Dear <Individual Name>

We, researchers at the Eric Sprott School of Business of Carleton University, are examining the nature and impact of enterprise systems (ERP, CRM, etc.) deployment and use on firm performance.

The move to enterprise systems has become a popular practice. Reports in the business press and academic journals indicate that enterprise systems offer significant benefits in terms of operational efficiency and effectiveness. However, the adoption of enterprise systems raises the following strategic questions: a) In what ways do enterprise systems capabilities contribute to distinct organizational outcomes? b) How does organizational process influence enterprise systems deployment and use? We seek answers to these questions from organizations with experience in deploying and using enterprise systems.

Your organization has been selected to participate in this study. We are requesting that you complete the enclosed questionnaire and return it in the stamped, self-addressed envelope provided. We anticipate that the findings of this research will be extremely valuable to both practice and research. Consequently, we ask that you provide us with your perspective and knowledge of your company's practice in deploying and using enterprise systems. Completing this survey should take about 30 minutes. Please answer all the questions. We understand that your time is very valuable and greatly appreciate your effort in helping us with this research.

We seek responses from multiple perspectives, both business and IT. However, if you are not involved with the enterprise systems project, we ask that you pass this questionnaire to a manager or professional who is involved. You may request a copy of the research results by completing the enclosed research request form.

Individual questionnaires are confidential and will not be disclosed by the researchers under any circumstances. Anonymity will be ensured when reporting the research findings based on this questionnaire. Should you require any additional information, please do not hesitate to contact Y.H. Chen (613-520-2600 Ext. 7490; yhchen@sprott.carleton.ca) or Dr. Gerald Grant (613-520-2600 Ext. 8006; Gerald_grant@carleton.ca). Thank you for your time and help in completing this questionnaire. Your input is highly appreciated.

Best regards,

Gerald Grant
Assistant Professor, Eric Sprott School of Business
Carleton University

Appendix 3. Questionnaire

ENTERPRISE SYSTEMS CAPABILITY ASSESSMENT QUESTIONNAIRE

SECTION A: THE GENERAL BACKGROUND

Please enter the sector number to the blank.

A1. I am responding to these survey questions with the following perspective. Enter one only (_____).

1. My
whole
corporation | 2. My
division/group | 3. Public Sector
Department | 4. Public
Sector
Division |
|-------------------------------|-------------------------|--------------------------------|---------------------------------|

A2. Please specify the industry sector to which your organization belongs. Enter one only (_____).

1. Auto, Parts and
Transportation
Equipment	8. Fabricating &
Engineering	17. Pipelines
2. Banks & Trusts	9. Financial Management	18. Real Estate
3. Biotechnology and
Pharmaceuticals	10. Food & Beverage	19. Steel
4. Building Materials	11. Gold & Precious
Minerals	20. Technology
5. Chemicals and
Fertilizers	12. Hospitality	21. Telephone &
Utilities
6. Communications &
Media	13. Insurance	22. Transportation &
Environmental
Services
7. Consumer Products	14. Metals & Minerals	23. Wholesale & Retail
	15. Oil & Gas	24. Other
	16. Paper & Forest Products	

A3. Please specify the approximate number of employees in your organization. Enter one only (_____).

1. Less than 50	4. 251 - 500	7. 5000 - 10000
2. 50 - 100	5. 500 - 1000	8. 10000 - 25000
3. 100 - 250	6. 1001 - 5000	9. More than 25000

A4. What is the total revenue of your organization? Enter one only (_____).

1. Less than 50 million	5. 500 - 1 billion
2. 50 - 100 million	6. 1 - 5 billion
3. 100 - 250 million	7. 5 - 10 billion
4. 250 - 500 million	8. More than 10 billion
	9. Other

A5. Please specify what your current position is within the company.

A6. Does your organization have a separate IT function or Department? (_____)

1. Yes 2. No

A7. If it does, what is the title of the highest ranking person responsible the IT function or department

A8. For two recent (within 5 years) enterprise systems projects undertaken in your organization, indicate the following

				Project was/is being delivered		Project meets the proposed objectives
Project Description	'Go live' date	Cost	Software Supplier	On Time	Within Budget	
				() 1 Yes 2 No	() 1 Yes 2 No	() 1 Yes 2 No
				() 1 Yes 2 No	() 1 Yes 2 No	() 1 Yes 2 No

SECTION B: ENTERPRISE SYSTEMS (ES) CAPABILITY ASSESSMENT

Please consider the following issues in which your organization operates. Using the 7-point scale below, indicate to what extent you agree with the following statements:

1 – strongly disagree 2 – disagree 3 - disagree slightly 4 – neutral 5 - agree slightly 6 – agree 7 - strongly agree 0 – not applicable Please enter your answer in front of each issue.

THE GENERAL BUSINESS ENVIRONMENTAL CONTEXT

General and Business Environmental Context							
1. strongly disagree	2. disagree	3. disagree slightly	4. neutral	5. agree slightly	6. agree	7. strongly agree	0. not applicable
B1. () The organization has, in the past 12 months, undergone a major rethinking of its strategic priorities to respond to developments in the general business environment.							
B2. () The industry to which the organization belongs has been transformed significantly in response to regulatory changes.							
B3. () The industry to which the organization belongs has undergone intensive restructuring activities in the last two years.							
B4. () The organization has, in the past 12 months, experienced significant shifts in demand for its products or services.							
B5. () The organization faces increasing pressure from stakeholders, financial markets, or government to improve performance and profitability.							
B6. () The organization's profitability has been sharply affected by current economic trends (growth or recession).							
B7. () The organization has been forced to deploy new enterprise information systems for business survival and growth.							

ES Outcomes							
1. strongly disagree	2. disagree	3. disagree slightly	4. neutral	5. agree slightly	6. agree	7. strongly agree	8. not applicable
O9. () ES has improved the competitive position of the organization.							
O10. () The standard technological platform enabled by ES provides a good basis for long-term strategic IT planning.							

Please specify any other related issues that are in your opinion important for development of organizational ES capability:

Research Request Form

If you would like to receive the results of this study, please provide contact information requested below. This information will be kept separate and not related to the information provided.

Name:

Address:

Email:

Telephone:

THANK YOU for taking the time to complete this questionnaire. Please return it by *September 15, 2003* to yhchen@sprott.carleton.ca or gerald_grant@carleton.ca.

Appendix 4. Interview Themes

Enterprise Systems Capability Survey

Interview themes

Discussion Issues	
1.	Organization Background: Could you please briefly introduce your company in terms of industrial sector, business activities, number of employees, revenue, etc.?
2.	Interviewee position and perspective: What is your current job title and to whom do you report? From what perspective will you be speaking during this interview? For example, are you speaking for your organization as a whole, for your division, your business unit, or department?
3.	Business context and drivers: How has your organization's business environment changed in past three years in terms of: market (competitors, etc.), regulation (deregulation), customer preference and demand, industry structure (restructuring), etc. What would you consider to be some of the key drivers of information technology investments in your company at this time?
4.	Role of enterprise systems (ES): How would you describe the role of enterprise systems (ES) in your organization? Is it strategic, simply a utility, or somewhere in between? How is ES investment integrated into the strategic vision and business objectives of your organization?
5.	Status of ES deployment: At what stage of ES deployment is your organization (assessment, implementation, fully deployed, upgrade and renewal) Can you tell me who is leading the ES implementation effort and what is the involvement of executive managers, the role of the IT group/department, etc.?
6.	IT infrastructure and service delivery model: Could you tell me about your corporation's IT infrastructure strategy. What IT service and technology delivery model (in-sourcing, outsourcing, role of consultants etc.) are you following? What are the associated benefits and challenges?
7.	ES enabled process transformation: ES have been perceived as a major tool for business processes reengineering. What is your perspective on this? In general, did your organization change business processes to suit the ES enabled processes? If so, what strategies did your company follow to facilitate and enable the change?
8.	User competence: What is your organization's practice in building user competence (training, knowledge development, etc.). How effective are users at information sharing, knowledge dissemination, and decision making within the ES context?
9.	Management Processes: To understand more about your organizational processes for implementing and utilizing ES, what management processes does your organization apply to support and foster <ol style="list-style-type: none"> a. Strategic IS/IT alignment b. ES-enabled organizational transformation (process change, culture change, etc.) c. Knowledge accumulation and organizational learning
10.	Business value outcomes: Finally, how do you evaluate the contribution of ES to overall business value in terms of <ol style="list-style-type: none"> a. Information availability and quality b. Cost rationalization (reduction, reallocation, etc.) c. Cross-functional communication and coordination d. Infrastructure quality and agility e. Overall financial performance f. Business flexibility
11.	Future of ES: What role will ES play in your organization's future? What opportunities and challenges do you anticipate in deploying ES?

Appendix 5. A Follow Up Letter

<date>

Dear <individual name>,

Two weeks ago we mailed you a questionnaire seeking input about your organization's experience with enterprise systems deployment and use. We believe your organization is recognized as one of the key players with regards to the current practice of enterprise systems deployment and usage.

Enterprise systems adoption has become common practice across industry sectors. However, deriving value from these substantial investments have been more problematic. Best practice firms tend to have developed advanced capability to orchestrate the whole process of systems choice, implementation and use. To advance our understanding of how firms develop enterprise systems capability we seek the comments of the top executives, who, we feel, can provide valuable insight regarding the strategic implications of such a significant business undertaking. We believe that the results will shape thinking in both research and practice and will contribute to a better understanding of the major factors influencing effective enterprise system deployment and exploitation.

If you have completed and returned the questionnaire to us, please accept our sincere thanks. If you did not receive the questionnaire, or if it was misplaced, please e-mail us at _____ and we will mail you a new questionnaire kit today. Alternatively, an electronic copy of the questionnaire is available at | _____ The username is *respondent* and the password is *Carleton2003*. Please fill out the form and return it to us by e-mail

We are very grateful for your help and look forward to receiving your comments.

Sincerely,

Dr. Gerald Grant & Ying-Hueih Chen